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Effects of Token Economy on Mathematics Achievement of Children with Attention Deficit Hyperactivity Disorder (ADHD) in Government Practising Schools in Buea, Cameroon

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Abstract: *While previous studies have examined the relationship between the symptoms of ADHD and academic achievement, fewer studies have examined the relative contribution of behavioural therapies such as Token Economy to enhance academic achievement in children with ADHD. The current study examined the effect of Token Economy on the academic achievement of primary three school children with Attention Deficit Hyperactivity Disorders in Government Primary schools in Buea, Cameroon. This study employed a quasi-experiment, pre-test post-test control group design. The main objective was to find out whether token economy could be effective in enhancing academic achievement among primary three school pupils with ADHD in Buea- Cameroon. The population comprised of all children with ADHD in government primary schools in Buea. The sample was 20 (11 males and 09 females) drawn from one government primary school in Buea (Government Practicing School Muea, Group 1. Three instruments were used for the study; a) An interview guide for teachers to ascertain their knowledge of the disability before diagnosis of the children; b) ADHD Behaviour Checklist which was in line with the Diagnostic and Statistical Manual for Mental Disorder adapted and used for the study and c) Teacher made tests in mathematics, reading and spelling. The teacher made tests were administered as a pre-test to establish achievement level of sampled children. The tests were re-administered as a post-test to assess potential changes in pupils' achievement level. The study lasted 8 weeks. 10 children in the experimental group received tokens on a continuous reinforcement schedule for successfully completing academic tasks in mathematics, reading and spelling. The tokens were cumulated weekly and exchanged for backup reinforcers. The other 10 pupils who constituted the control group did not receive tokens. Data was collected and analysed using mean scores for the research questions. The findings indicated that token economy significantly enhanced academic achievement in mathematics for primary three school pupils with ADHD.*

Keywords: *Token Economy, Academic Achievement, Attention Deficit Hyperactivity Disorder (ADHD).*

1. INTRODUCTION

This article presents a recent and inclusive perspective of the use of token economies in primary schools. The search terms included: token economy, token systems, token reinforcement, behavior modification, classroom management, operant conditioning, animal behavior, token literature reviews, and token economy concerns. When children generally leave their protective family circles to go to a regular school, they embrace a new life full of excitement and great ambition. In school, these children are evaluated irrespective of their abilities or disabilities in terms of their proficiency at abstract tasks such as mathematical calculations, reading and issues of general knowledge. Mathematics, reading and general knowledge constitute the subject matter on which children in Cameroon are tested at the end of their primary school end of course examination. What these children acquire about themselves as academic achievers and the subject matter they learn are two very important notions in the lives of school children. It has been observed that lots of children are not learning because they have special needs which are not attended to in the regular classrooms (Bailey, 2014). One of such groups of children is those with Attention Deficit Hyperactivity Disorder (ADHD). ADHD is a widespread behavioural disorder, usually diagnosed in school-age children, marked by persistent inattention, hyperactivity and impulsivity (Bhandari, 2015). Children with

ADHD act without thinking and have trouble focusing. They may understand what's expected of them but have trouble following through because they can't sit still, pay attention or focus on details.All children act this way often when they are anxious or excited. The difference with those with ADHD is that symptoms are present over longer periods and happen in different settings (home, school). These symptoms hurt a child's ability to function socially and academically. Academically, ADHD has an impact on the children and they are at risk for low grades, class repetition, dropping out of post primary institutions, placement in special education (McAuley, 2009). Many factors come into play when we examine the academic achievement of children with ADHD. Some are, age of the children, nature of the lessons, type of instructional resources, behavioural strategies used and teacher attitudes. ADHD being a behavioural disorder, the focus in this study is on using Token Economy (TE), a behavior modification program to enhance their academic achievement in mathematics, reading and spelling. TE is preferred because it is known to target specific academic behaviours, using positive reinforcement to increase wanted and appropriate academic behaviours. TE permits a child to earn a token immediately following the display of positive behaviour and then trading that token later for some kind of reward. Because these children can experience persistent symptoms and functional and academic impairment into adulthood, there is urgent need to address these issues early while the children are in primary school so as to put them on the same pedestal to compete with children without ADHD in different academic disciplines. The purpose of this study therefore is to investigate the effect of Token Economy on academic achievement of primary three school children with ADHD in Buea, Cameroon in the area of mathematics.

2. BACKGROUND TO THE STUDY

ADHD is a behavioural condition defined by the presence of severe and pervasive symptoms of inattention, hyperactivity and impulsivity [American Psychiatric Association (APA) 1994]. The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria (APA 1994) state that "the child with ADHD must exhibit a number of inattentive, impulsive and hyperactive behaviours over a period of 6 months, before the age of 7, which should be present in school and at home, and which significantly impair daily functioning". ADHD is one of those disabilities found in some children in regular education classrooms in Cameroon.

Children with attention problems have difficulties with one or all parts of the attention process. Some children may have difficulty concentrating on tasks (particularly on tasks that are routine or boring). Others may have trouble knowing where to start a task. Still others may get lost in the directions along the way. A careful observer can watch and see where the attention process breaks down for a particular child (American Psychiatric Association, 1994). Those with hyperactivity always appear as restless, fidgety, and always on the "go" or "motor driven"(American Psychiatric Association, 1994). Their impulsivity leads them to speak out of turn, interrupt others, and engage in what looks like risk-taking behaviour.

Not only are these symptoms all multidimensional constructs, they also overlap and interact with each other. For example, a short attention span can lead a child to move around excessively, and therefore can contribute to hyperactivity. Poorly sustained attention on difficult or unrewarding tasks can be attributed to an inability to inhibit impulses to quit the dull task and find a new, more rewarding pursuit. Thus it is difficult to separate the elements of ADHD. These differences in attention, hyperactivity/impulsivity can also be observed in young children who rapidly shift from one activity to another when playing or in older children who show little persistence of effort in tasks that lack intrinsic appeal or immediate rewards. Such tendencies naturally contribute to the academic difficulties of many children with ADHD. Rates of on-task behaviour are particularly low when passive classroom activities (e.g., listening to teacher instruction, solving problems in mathematics, reading silently) are required (Vile, DuPaul, Jitendra, 2006).

Based on their inattentive, hyperactive and impulsive characteristics, children with ADHD have difficulties passing classes due to their forgetfulness, disorganization or careless mistakes in answering questions, keeping track of all the important information needed to manage their studies (Bailey, 2014). This leads to low achievement of children with ADHD. Children with ADHD experience academic hardship which includes slow, weaker reading comprehension and poor spelling fluency (Ghelani, Sidhu, Jain and Tannock, 2004). Their ability to do mathematics is affected by the difficulty with sequencing, attention, memory, recall or organization. They struggle with memorization and organization of numbers, operation signs, and number facts.

Children with ADHD often have difficulties in spelling. This is manifested by their inability to spell single or double syllable words correctly, listen to sounds and spell words, complete words with given sounds or letters, spell words presented in a picture, or spell words read in a passage. They make many spelling errors that reflect poor understanding of word structure, even when they can read. Proper spelling of words helps lay the basic foundation that every child will need throughout his/her education and life. These symptoms cause significant impairment in academic functioning. Their failure to achieve causes them to often receive constant criticisms and correction from teachers and parents, who believe the behaviour, is intentional. The combination of negative feedback, poor academic achievement, and social problems may contribute to low self-esteem and other emotional problems. Barkley (1998) classified the symptoms of ADHD often found in children as follows:

a) Academically: They tend to be underachievers for intelligence and show some specific learning disabilities.

b) Behaviourally: They have short attention span, easily distracted, restlessness, poor impulsive control and destructiveness.

c) Socially: They have poor peer relations, noncompliance to command, very aggressive, belligerent and disrespectful to language, poor self-control/high risk taking, poor social problem solving skills and immature self-speech.

d) Cognitively: They manifest high levels of inattention, poor retention and are distractible.

e) Emotionally: ADHD child show depression, excitability, immature emotional control and excessive frustration.

Barkley (1998) says teachers and parents frequently report that children with ADHD underachieve academically compared to their classmates. These reports have been confirmed in studies demonstrating that children with ADHD typically obtain significantly lower standardized achievement test scores than do comparable groups of typical children (e.g. Barkley, DuPaul, & McMurray, 1990).Many clinicians reason that with a reduction of core symptoms, the academic performance of children with ADHD may improve over an extended time period as the child is more available for learning academic skills. Analysis of the regulations permitting the integration of all children into regular schools indicates the provision of equal opportunities for all persons with disabilities (PWD), as a priority for the government of Cameroon. With the enactment of the first law; law No. 83/13 of July, 1983 and Decree No. 90/1516 of 26 November 1990 relating to the protection and wellbeing of persons with disabilities (PWD) in Cameroon, the government is encouraging the education of pupils and students with disabilities in regular schools. Chapter IV, section 28 of the new law on disability in Cameroon; Law No. 2010/002 of 13 April 2010 still relating to the protection and welfare of PWD in Cameroon further stipulates that the state shall take specific measures to guarantee PWDs access to education and vocational training. More importantly, in line with the conclusion of the World Conference on EFA held in Jomtien, Thailand in 1990, the government adopted the Sector Plan for Primary Education, included in Cameroon's 1998 Education Framework. This Plan was strengthened by the 2000 Dakar Framework for Action promoting EFA, aiming to ensure the availability of free primary education for all. It could therefore be argued that the Cameroonian Constitution and the National Sector Plan for primary education are non-discriminatory and consequently ensure the inclusion of CWDs in primary schools. Thus, everyone, boys and girls, ADHD, non-ADHD have equal access to education and should not be discriminated against on any ground including disability.All these laws are aimed at meeting the international demands set by the Universal Declaration of Human Rights, Article 26 of 1948 which state that everyone has the right to education and the elementary education is compulsory. Having these children with diverse learning disabilities in the regular school system in Cameroon is one thing and enabling them achieve their academic goals is however another thing.

With the above provisions, teachers need to have accurate knowledge with which they can effectively participate in the process of the assessment and treatment for children with ADHD. Unfortunately, few studies that have attempted to assess teachers' knowledge of ADHD suggest that teachers often lack knowledge of ADHD and they tend to have substantial misperceptions about the nature, course, causes and outcomes of ADHD (Barbaresi & Olsen, 1998; Jerome, Gordon, & Hustler, 1998; Sciutto, Terjesen, & Bender, 2000; Snider, Busch, & Arrowood, 2003; Vereb & DiPerna, 2004;

Weyandt, Fulton, Schepman, Verdi, & Wilson, 2009). These misperceptions cause the children to be labelled as lazy, dull, disobedient, stubborn and unwilling to work.

Again, although in service training are organised to equip primary school teachers with competences on handling children with special needs in regular schools, these seminars are few and as such teachers lack the basic competences to handle such children. The lack of resources is also a problem. Teachers need to have adequate resources and materials developed specifically to bridge the gap between the understanding of ADHD and classroom practice. The impact of ADHD on functioning has considerable effects on a child's performance at school and such children with ADHD often struggle to concentrate or do well in their studies. This is can be seen in their poor performances, high repetition rate, high dropout rate, low achievement of literacy and numerical skills (McAuley, 2009); low rates of school graduation, poor reading and mathematics standardized scores, increased rates of school expulsion (Loe & Feldman, 2007). If not properly handled, these children can suffer severe behavioural, social and academic difficulties which will adversely affect their development as individuals as well as the development of the nation, Cameroon. They therefore need to be taught using appropriate intervention techniques or therapies to permit them excel as their non-ADHD peers. Given that academic underachievement has been associated to poor job-related and purposeful outcomes later in life, identifying the predictors of academic achievement in children with ADHD holds important real-life implications.

Token economy (TE) is a behaviour modification strategy that involves the delivery of a conditioned reinforcer (e.g., a poker chip, sticker, point, or other stimulus) that can later be exchanged for another reinforcer, called a reward. According to Cooper, Heron and Heward (2007), TEs consist of three components including a list of target behaviours or responses, tokens or points that will be earned for exhibiting the target response(s), and a menu of items or activities or privileges for which the points or tokens can be exchanged. Initially, these tokens have no value until they are paired with teacher praise and used to purchase back up items contingent upon specified desirable behaviours (Kazdin, 1977; McLaughlin & Williams, 1988; Pfiffner, & O'Leary, 1993; Pfiffner, Rosen, & O'Leary, 1985). At designated periods (i.e., daily, weekly, etc.) those accumulated tokens are exchanged for rewards with previously ascribed values. These rewards may consist of tangible objects (candies, biscuits, and toys), activities or privileges (Abramowitz, & O'Leary, 1991; Barkley, 1998; Carbone, 2001; Grandy & McLaughlin, 1999; McLaughlin & Williams, 1988).

Token economy is an intensive, in-class positive reinforcement program for building up and maintaining appropriate classroom performance and behaviour. TE may be needed when other positive reinforcement programs, such as selective use of teacher attention or a home- based reinforcement program, are insufficient to motivate the child with ADHD to behave and perform appropriately.According to Fiksdal (2014), TEs have a long history of changing behaviours among humans. Lancaster started the trend with the use of tickets within large classrooms in the early 1800's followed by the use of cherries and cakes in the early 1950's to teach Latin and Greek to children (Lancaster, 1805; Skinner, 1966). One of the first therapeutic applications of a token economy was delivered by Avendano Carderera in 1959 who gave a ticket to children for good behaviour (Rodriguez, Montesinos, & Preciado, 2005). Staats and colleagues applied a token economy system to a student with reading problems in the late 1950's. These studies indicate that token economies have been used for quite some time to modify behaviour. Although individuals with ADHD can be very successful in life, without identification and proper treatment, ADHD may have serious consequences, including academic underachievement and school failure, problems in social relations, risk for antisocial behaviour patterns (Barkley, 2006).

Several studies have been carried out in many countries, especially with the modification of problem behaviour (Rabiner, 2006; Barkley, 1990; DuPaul & Stoner, 1994; Goldstein, 1995; and Walker & Walker, 1991). Adibsereshki, Abkenar, Ashoori, Mirzamani (2014), investigated the effectiveness of using tangible and social reinforcements in the classroom on the academic achievement of students with intellectual disabilities in Iran. The results revealed that there was a significant difference in the academic achievement scores of the groups after applying the intervention and the mean difference in achievement scores for the tangible reinforcement group was significantly higher than that of the social reinforcement group.Ashouri, Mirzamani, Jalil-Abkenar, and Adib-Sereshki (2007) investigated the effectiveness of Token economy reinforcer on the academic achievement of 9th grade boy students with intellectual disability in science class in Tehran Province. The results of this study

showed that there was a significant increase in academic achievement of students with intellectual disabilities in the experimental group (used token economy) compared with the control group. Ihiegbulum, Ihiegbulem & Igwebuike (2011) investigated the effect of TE on academic achievement of secondary school students in Rivers State Nigeria. The results revealed that the experimental groups put up higher academic achievement than the control groups. It was also found out that TE had significant effect on academic achievement of the experimental groups.

However, not many studies relating to the effect of token economy on academic achievement has been carried out in Cameroon. Buriya (2013) carried out a related study in Cameroon in which she investigated the effect of energizers on attention sustenance among children with hyperkinetic behaviour in primary schools in Mezam Division. The findings revealed that energizers had a significant effect on attention sustenance of children with inattention, hyperactivity, and impulsivity. It was therefore concluded that, energizers have a great role to play in the attention sustenance of learners with hyperkinetic behaviour. If the inattention problem of children with hyperkinetic behaviour can be reduced using energizers, is it possible that, with the use of TE, children with ADHD can also achieve academically like their other peers in reading, spelling fluently, and solving mathematical problems accurately? It is therefore against this background that this study was designed to investigate the effect of token economy in enhancing academic achievement (in reading, spelling and mathematics) of primary three school children with attention deficit hyperactivity disorder.

3. STATEMENT OF THE PROBLEM

A successful later education depends on a proper laid down foundation received at the primary school level. Children with ADHD symptoms find it difficult to concentrate in class and thus often face difficulties in achieving academically. Their characteristic inattention, hyperactivity/impulsivity causes them to perform poorly in mathematics, reading and spelling. This poor academic achievement can be observed in the low achievement of literacy and numerical skills as seen in low test scores in reading, spelling and mathematics which subsequently can lead to high repetition and dropout rates. Many reasons could account for this low achievement rates for children with ADHD. Many teachers in regular schools hold misconceptions for children who fail to meet academic expectations. Such children, including those with ADHD, are labelled as dull, lazy, stubborn, disobedient, delinquent and sometimes laughed at by their peers. This poor teacher and pupil attitude towards children with ADHD, compromises their chances of success. Chances of success of children with ADHD are further compromised by the fact that teachers make use of inappropriate teaching strategies, lack of appropriate instructional materials, overcrowded classrooms and poor understanding of the disorder. All these minimize the chances of these children to compete side by side their non-ADHD peers.

Research has it that ADHD shows up in early childhood and continues to a troubling degree throughout childhood and adolescence into adulthood. Given the high prevalence of ADHD, its chronicity, its long-term repercussions e.g. cause alterations in school and family functioning and in relationships with classmates; the search for effective treatments to manage it has been a constant concern for the last few decades. While many interventions, such as the use of stimulant medication and multimodal treatments (combination of two or more behavioural treatments) have been used widely to target and reduce disruptive behaviour, very few have targeted academic achievement. Using a single behavioural intervention strategy such as token economy has been proven to be effective in other countries. Token economy has a long history of changing behaviours, decreasing disruptive behaviours within the class, increasing academic behaviours such as increasing test performance, increasing academic engaged time and academic performance, and increasing academic accuracy. This study was therefore designed to find out the effect of token economy on the academic achievement of primary three pupils with ADHD in Buea, Cameroon.

4. OBJECTIVES OF THE STUDY

The study was designed to achieve the below objective:

- To determine the effect of Token Economy on mathematics achievement of children with ADHD.

Specific Research Questions

- What effect does token economy have on the academic achievement of children with ADHD in mathematics?

Research Hypotheses

H_{O1} Token economy has no significant effect on the academic achievement of children with ADHD in mathematics.

Ha_1 Token economy has a significant effect on the academic achievement of children with ADHD in mathematics.

5. REVIEW OF RELATED LITERATURE

Studies on the use of behavioural therapies such as TE to modify the academic achievement of children with ADHD have been conducted in different contexts. This section of the article articulates on the theoretical, conceptual and empirical perspectives for the study.

6. THEORETICAL REVIEW

6.1. Skinner's Operant Conditioning Theory

Operant conditioning is an extensively recognized approach to learning developed largely by B. F. Skinner (1974). This familiar approach to learning was established from the pre-existent theory "Law of Effect" formulated by Edward Thorndike (1942). Operant Conditioning deals with operants - intentional actions that have an effect on the surrounding environment (McLeod, 2007). Operant conditioning is defined as the use of consequences to modify the occurrence and form of behaviour. "To put it very simply, behaviour that is followed by pleasant consequences tends to be repeated and learned. Behaviour that is followed by unpleasant consequences tends not to be repeated and not learned" (Alberto & Troutman, 2006). Operant conditioning thus focuses on using either reinforcement or punishment to increase or decrease behaviour. Through this process, an association is formed between the behaviour and the consequences for that behaviour.

Operant conditioning model has a number of principles some of which have substantial bearing to this study. These include positive reinforcement, negative reinforcement, punishment, shaping, extinction, generalization and modelling. In positive reinforcement, Skinner (1974) believes that giving positive reinforcement greatly increases the likelihood that a response will be repeated in similar circumstances. For example, if a child receives a sticker or chip each time he/she completes the homework (i.e. a reward) he/she will more likely repeat this behaviour in the future, thus strengthening the behaviour of completing their homework. Another way to increase behaviour is by applying negative reinforcement. This form of reinforcement involves the removal of a certain stimulus (usually an aversive stimulus) after a particular behaviour is exhibited. The likelihood of the particular behaviour occurring again in the future is increased because of removing/avoiding the negative consequence. For example, when an ADHD child is constantly being reminded by the mother to do his homework, when he starts his homework, his mom's constant and annoying reminders will cease.

Punishment is the act or process of imposing and/or applying a sanction for an undesired behaviour when conditioning toward a desired behaviour (Boundless, 2016).For example a child is asked to kneel in front of the class for failing to write worded numbers in figures. Iheanacho, (1992) defines punishment as the presentation of an unpleasant or aversive stimulus to decrease an undesired behaviour. The use of punishment has several negative side effects including inducing fear or hostility and the failure to learn the correct response in the particular situation (Carlson & Buskist, 1997). Extinction occurs when behaviour is weakened as a result of not experiencing an expected positive condition or a negative condition is stopped (Changing Minds, 2016). That is, support for the behaviour is taken away and the behaviour drops. Cherry, (2016) says extinction can also occur if the trained behaviour is no longer reinforced or if the type of reinforcement used is no longer rewarding. For example a child who receives candies for reading fluently, stops being reinforced in other attempts, will gradually decrease the reading accuracy.

Shaping is a form of operant conditioning which involves the reinforcement of successive approximations of the target behaviour (Boundless, 2016). Behavioural approximations are behaviours that, over time, grow increasingly closer to the actual desired response. That is behaviours are broken down into tasks and learners learn the tasks step by step beginning from the simplest to the most difficult task. For example, an ADHD child who tantrums every time she is asked to write her spelling words, shaping could be used to increase this academic behaviour by; making her write her

name at the top of her spelling worksheet. Next she should be made to write one spelling word of her choice; then three spelling words of her choice; then all odd numbered words or all even numbered words; then all spelling words except one, and lastly, all spelling words, with each step clearly and consistently reinforced by the teacher.

Generalization is the repetition of experiences acquired in one learning situation to other situations (Iheanacho, 1992). For example, teach a child to add "s" on to the end of the words "tree," "car," and "dog," when referring to more than one, and then he/she does so with other nouns, without having to be taught each noun individually. In modelling a learner observes the behaviour of a model and consequently imitates the behaviour because of positive consequences obtained by model from the behaviour. By using these principles effectively, behavioural psychologists such as Skinner argued that you can encourage and teach almost any behaviour to anyone (Lee, 2015). However, the fundamental thing is to observe the individual's responses to specific stimuli and then decipher the type of reinforcement procedure to use to change behaviour. Unlike classical conditioning, a form of learning that binds external stimuli to reflexive, involuntary responses; operant conditioning involves voluntary behaviours, and is maintained over time by the consequences that follow those behaviours. Gredler (2005) advances the following assumptions as the foundation of operant conditioning:

- Learning seen by observers as change in behaviour, is related to changes in environmental events (these events being antecedents of and consequences of an action).
- One can determine relationships between behaviour and the environment only if the characteristics of the behaviour and the experimental conditions under which it occurs are defined in physically observable terms and observed under controlled conditions.
- The only acceptable sources of information about the causes of specific behaviours are data from the experimental study of behaviour (people must observe both the behaviour and its causes).
- The appropriate data source is the behaviour of the individual.
- Of prime importance in the operant conditioning model is the focus on relationships between environmental events and behaviour defined in physical observable terms.

According to Skinner, conditioning is actually accomplished most successfully when done on a specific schedule. Skinner thus developed the concept of the "reinforcement schedule". A reinforcement schedule is a tool in operant conditioning that allows the trainer to control the timing and frequency of reinforcement in order to elicit a target behaviour (Boundless, 2016).Reinforcement schedules therefore determine how and when behaviour will be followed by a reinforcer. Reinforcement schedules are divided into two categories, continuous and partial reinforcement schedules: a) in continuous reinforcement schedules (CRS), every desired behaviour is reinforced every time it occurs. This schedule is best used during the initial stages of learning in order to create a strong association between the behaviour and the response. b) In Partial reinforcement schedules, behaviours are reinforced based on ratios (reinforced after so many occurrences) or intervals (reinforced after a certain time interval). There are four schedules of partial reinforcement:

1. **Fixed-ratio schedules** are those where a response is reinforced only after a specified number of responses. This schedule produces a high, steady rate of responding with only a brief pause after the delivery of the reinforcer. An example of a fixed-ratio schedule would require that a child provides correct responses to a fixed number of questions say three or four, before obtaining the reinforcer. The fundamental idea here is to pursue the right amount of work, given the reward schedule.
2. **Variable-ratio schedules** occur when a response is reinforced after an unpredictable number of responses. This schedule creates a high steady rate of responding. Gambling and lottery games are good examples of a reward based on a variable ratio schedule. A variable ratio on average reinforces say every third response (for example one response would produce reinforcement, sometimes four responses, sometimes two etc.). It is done in such a manner so that the child maintains or even increases his/her output.
3. **Fixed-interval schedules** are those where the first response is rewarded only after a specified amount of time has elapsed. This schedule causes high amounts of responding near the end of the interval, but much slower responding immediately after the delivery of the reinforcer. For example, a pupil is rewarded at the end of a mathematics class for good performance recorded.

4. **Variable-interval schedules** occur when a response is rewarded at various time intervals randomly. The pupil's behavioural performance is higher and steadier because he/she cannot determine the next time that the next reinforcement will be made. Consequently, the child remains motivated throughout the learning process in the hope of being reinforced. For example a pupil is rewarded at different times of the day for demonstrating good behaviours.

Through the process of consequence manipulation, behaviours can systematically be altered (Skinner, 1968); problem behaviours can be decreased while desirable behaviours can be increased. These basic principles have been applied in a wide variety of settings for the purposes of systematic and practical behaviour change. The focus on external stimuli as the controlling agents for behaviour has allowed practitioners across a variety of disciplines to systematically manipulate environmental stimuli, resulting in corresponding behaviour changes. Behaviourist theory such as that proposed by Skinner has influenced the teaching practice of educators for many years and behaviour management strategies which produce positive behaviour change have been developed and used in classrooms of all types (Zirpoli & Melloy, 1997). These strategies emphasize overt behaviours and the environmental factors that are related to those behaviours. The following suppositions underlie the philosophical foundations of behaviour theory and practice: Firstly most behaviours are learned, secondly most behaviours are stimulus-specific, thirdly most behaviours can be taught, changed or modified and fourthly, behaviour change goals should be specific and clearly defined, (Zirpoli & Melloy, 1997, p.5).

Operant conditioning is a vehicle for teachers to achieve behaviour modification in order to improve classroom management and facilitate learning (Tuckman, 2009). Operant conditioning explains a wide range of phenomena, such as learning language and phobias (McLeod, 2007). According to the Skinner approach (n.d.), operant conditioning has practical advantages, specifically in the area of education: 1) when a person is rewarded for a behaviour, it is more likely for it to occur again; 2) people are more aware of how to control behaviour which has become very important in parenting techniques; 3) this theory is very helpful when raising children, and when teaching them; 4) a child that has been punished after acting in a certain way will less be likely to model that behaviour again; 5) it is a very helpful way to control students behaviour; 6) It outlines the environmental determinants of behaviour. Using Token economy can help modify a child's behaviour. A token program is one of the most powerful behavioural interventions improving school behaviour (McLaughlin &Williams, 1988). In children with attention deficit disorder (ADD), the changes due to token economy can be comparable to those obtained by stimulant medication (O'Leary and O'Leary, 1976). Token programs allow for the use of more powerful incentives than are typically available in classrooms. In addition token programs have the advantage of providing more immediate rewards than home-based programs (O'Leary & O'Leary, 1976)

6.2. The Relationship of the Theory to the Study

The relevance of the operant conditioning theory to this study is that, learning is dependent on its consequences; this means behaviours which are reinforced are likely to be repeated and those which are not reinforced are unlikely to be repeated. In other words, the operant conditioning theory features that reinforcing and punishing consequences have effect on behaviour change. Like Flora (2004) the most valid approaches for children with ADHD learning is to conduct an analysis of the individual's behaviour and environmental interactions and to implement an intervention based on that analysis and the systematic application of behaviour including reinforcement of appropriate operant responses.

Overall, Skinners' operant conditioning has great relevance in today's society as it seen as the form of behaviour control operating in schools all across the world in the 21st century. It is also a key process to note in the development of children because it can have great impact on the influence of a child's morals. Through positive/negative reinforcers a child can learn to mimic behaviours that are considered "right " by the majority of society and begin a process of weeding out the undesirable behaviour. This gives a child a great starting foundation of what they consider to be "norms", allowing them to mature into successful and responsible individuals. The basis of token economy system has its roots in the Behaviourist Model, which has to be implemented in specific and appropriate ways to achieve a desirable outcome, which in this case is the desired behaviour. In this light the author believes that Token economy as an operant conditioning technique can be effective in bringing about an improvement in academic achievement for children with ADHD in mathematics, reading, as well as spelling.

7. CONCEPTUAL REVIEW

In this section, various concepts regarding the phenomenon under study have been reviewed.

8. TOKEN ECONOMY (TE)

Within an educational setting, a TE is a system for providing positive reinforcement to a child or children by giving them tokens for completing tasks or behaving in desired ways. They are often used as a method of strengthening behaviour, or increasing its frequency, because the tokens are a way of "paying" children for completing tasks and the children can then use these tokens to buy desired activities or items (Miltenberger, 2008). TE work by specifying the behaviours to be performed, as well as the consequences for performing them (Hernandez & Reitman, 2015). Performance of the behaviours described in token programs usually dictates the delivery of immediate consequences (i.e., the token) and facilitate progress toward long-term goals. When employed in the classroom, token systems are used to motivate children and adolescents to increase some behaviours and reduce the frequency of others.

As with many behaviour management techniques, if applied correctly and consistently in a systematic fashion over an extended period of time, TE can be a highly effective method for changing or controlling student behaviour (Mathur, 1996). Some reasons why TE are considered effective include: (1) tokens can be easily dispensed without disrupting the teaching/learning process; (2) tokens can be exchanged for a variety of individualized backup reinforcers and, (3) token economies can be used to help the student acquire skills that will eventually lead to other more natural reinforcers such as good grades (Mathur, 1996). TE works because the tokens become paired with the earning of the back-up reinforcers and the child only gets tokens for engaging in desired behaviours (Miltenberger, 2008). A backup reinforcer is an activity, item or privilege that the child likes and enjoys. Therefore the target behaviours (should) be made to occur more often. Tokens can take the form of poker chips, happy faces, points recorded on a card or chalkboard, marbles in a jar, or stickers. In everyday life, money serves as a very powerful "token" that can be exchanged for a virtually limitless number of reinforcers. TEs are typically used in classroom settings with children who are exhibiting difficulty completing academic tasks or are having problems. One example of a TE system in a special needs classroom is where the children receive stamps to put in a payment book. The children receive a stamp each day that they meet or exceed their goals or desired behaviours. When they receive a specific number of stamps, they cash in their payment books for a reward (Turnbull, Turnbull, Shank, & Leal, 1999). Zecker (2005) believes that special needs children (for example: those with ADHD) require a token economy system that is more powerful, more frequent, and more linked in time to the desired behaviour than do their non-ADHD peers.

Thomson (2006) as well as the TE forum (n.d.) presents below, the elements necessary in every TE:

- **Tokens:** Anything that is visible and countable can be used as a token. Tokens should preferably be attractive, easy to carry and dispense, and difficult to counterfeit. Commonly used items include poker chips, stickers, point tallies, or play money. When an individual displays desirable behaviour, he or she is immediately given a designated number of tokens. Tokens have no value of their own. They are collected and later exchanged for meaningful objects, privileges or activities. Individuals can also lose tokens (response cost) for displaying undesirable behaviour.
- **Clearly Defined Target Behaviour:** Individuals participating in a token economy need to know exactly what they must do in order to receive tokens. Desirable and undesirable behaviour is explained ahead of time in simple, specific terms. The number of tokens awarded or lost for a particular behaviour is also specified. Targeted behaviour could be school/academic related or conduct related.
- **Back-Up Reinforcers:** Back-up reinforcers are the meaningful objects, privileges, or activities that individuals receive in exchange for their tokens. Examples include food items, books, pen/pencils, candies, toys, extra free time, or outings. The success of a token economy depends on the appeal of the back-up reinforcers. Individuals will only be motivated to earn tokens if they anticipate the future reward represented by the tokens. A well-designed token economy will use back-up reinforcers chosen by individuals in treatment rather than by teacher.

- **A System for Exchanging Tokens:** A time and place for purchasing back-up reinforcers is necessary. The token value of each back-up reinforcer is pre-determined based on monetary value, demand, or therapeutic value. For example, if the reinforcer is expensive or highly attractive, the token value should be higher. If possession of or participation in the reinforcer would aid in the individual's acquisition of skills, the token value should be lower. If the token value is set too low, individuals will be less motivated to earn tokens. Conversely, if the value is set too high, individuals may become easily discouraged. It is important that each individual can earn at least some tokens.
- **A System for Recording Data:** Before treatment begins, information (baseline data) is gathered about each individual's current behaviour. Changes in behaviour are then recorded on daily data sheets. This information is used to measure individual progress, as well as the effectiveness of the token economy. Information regarding the exchange of tokens also needs to be recorded.
- **Consistent Implementation of the TE by the Teacher:** In order for a TE to succeed, all involved staff members must reward the same behaviours, use the appropriate amount of tokens, avoid dispensing back-up reinforcers for free, and prevent tokens from being counterfeited, stolen, or otherwise unjustly obtained. Staff members should also be evaluated periodically and given the opportunity to raise questions or concerns.

8.1. Advantages for Using Token Economy

According to Kazdin and Bootzin (1972, p. 343) the use of tokens as a method of delivering reinforcement through the child exchanging them for back-up reinforcers has a number of advantages. For example, they:

- bridge the delay between the target response and back-up reinforcement
- permit the reinforcement of a response at any time
- may be used to maintain performance over extended periods of time when the back-up reinforcer cannot be parcelled out
- allow sequences of responses to be reinforced without interruption
- maintain their reinforcing properties because of their relative independence of deprivation states
- are less subject to satiation effects
- provide the same reinforcement for individuals who have different preferences in back-up reinforcers
- may take on greater incentive value than a single primary reinforcer'

Additionally, Miltenberger (2008) highlights how:

- Positive reinforcement, via the use of tokens, can be provided immediately after the target behaviour occurs.
- A token economy is structured; therefore there will be consistency with how positive reinforcement is delivered for target behaviours.
- A child's future planning skills can be developed because different amounts of tokens need to be earned for different types of backup reinforcers and the tokens must be kept until enough has been earned.

TE is a form of reinforcement, thus it is imperative to examine the concept of reinforcement in greater detail.

8.2. Attention Deficit Hyperactivity Disorder (Adhd)

Health experts say that Attention Deficit Hyperactivity Disorder (ADHD) is the most common behavioural disorder that starts during childhood (Medical News Today, 2015). It is the most recent term given by psychiatrists to a childhood disorder that has had a variety of names in the past (Weender, 2001), ranging from idiocy, imbecility and encephalitis Lethargica (Rafalovich, 2004). George Frederic still in 1902, made clinical distinctions between the first two nineteenth century medical terms, Idiocy and Imbecility. Still described Idiocy as a mental deficiency or extreme stupidity caused by malnutrition or disease of the nervous centres, occurring before birth or before the

development of mental faculties in children (Rafalovich, 2004). To him, Imbecility was a medical diagnosis that included persons who could not function within conventional structures and engaged in behaviours that are socially inappropriate (Rafalovich, 2004). Twenty years later, an American physician Dr Bradley, observed that children treated with stimulant medication showed fewer signs of impulsive and hyperactive behaviour. He believed alongside the professional community and theorized that hyperactive children were brain damaged (Austin, Reiss, Burgdorf, 2007). The concept of hyperactivity as a disorder caused by something other than brain damage was again reintroduced by Stella Chess in 1960, who described the "Hyperactive Child Syndrome" as an environmentally- based problem caused by faulty parenting. As a result of her work, the official medical name was changed to Minimal Brain Dysfunction (MBD). Also in 1965, the American Psychiatrist association (APA) changed the name to "Hyperkinetic Reaction of Childhood" supporting the theory that hyperactivity was not a biological disorder but an environmental problem.

In 1980, the term "Attention Deficit Disorder (ADD)" with or without hyperactivity was included in the Diagnostic and Statistical Manual of Mental Disorders, Third Edition (DSM-III; the official manual that provides descriptions and definitions of currently accepted psychiatric diagnoses). When the concept of ADD was formulated, little or no empirical research on this issue existed (Barkley, 2006). At that time, it was not evident if the attention deficit of the subtype of ADD without hyperactivity was qualitatively similar to that of the subtype with hyperactivity, or if the two types had to be considered as two separate psychiatric disorders (Barkley, 2006). In order to further improve the criteria, in particular with respect to empirical validation, the revision of the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III-R) in 1987 removed the concept of two subtypes and renamed the disorder "Attention deficit-Hyperactivity Disorder (ADHD)"with symptoms of inattention; impulsivity and hyperactivity combined into a single list. Before the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders Text Revision (DSM-IV-TR) was outlined in 1994, another large field trial was conducted (Lahey, Applegate, McBurnett, et al, 1994).

8.3. Subtypes of ADHD

Three subtypes of ADHD were identified on the basis of structured diagnostic interviews of multiple informants and of validation diagnoses. The previously heterogeneous category of ADHD according to DSM-III-R was consequently subdivided into three subtypes (Lahey et al.1994), i.e. a predominantly inattentive type, a predominantly hyperactive-impulsive type, and a combined type with symptoms of both dimensions (American Psychiatric Association, 1994). Today, DSM-IV-TR has adopted almost identical criteria for the identification of inattentive, hyperactive, and impulsive symptoms for ADHD.

8.4. Characteristics of Children with ADHD

The three primary characteristics of ADHD that are observed in children with the disorder are inattention, hyperactivity, and impulsivity (American Psychiatric Association, 1994; DSM-IV-TR, 2000). The signs and symptoms a child with attention deficit disorder has depends on which characteristics predominate.

Attention requires that the individual has the ability to watch, notice someone with keen interest that can be sustained over a period of time. Hyperactivity on the other hand is not just a high level of activity, but disorganized and purposeless activity. It refers to a range of undue body movements, ranging from restlessness, persistent fidgeting while seated to frantic running around the room for no clear reason. Impulsivity is the tendency for an individual to do things suddenly without careful thought. These characteristics affect not only the academic lives of children with ADHD; they may affect their social lives as well. Lougy, DeRivo & Rosenthel (2007) outlines the behaviours of children with ADHD in the three different categories listed above.

8.5. Inattentive Behaviours of Children with ADHD in the Classroom

- They frequently daydream and like to play alone.
- They often have difficulties sustaining attention in tasks and classroom discussions and needs constant reminders to join the group.

- They are often forgetful and fail to remember daily rules or activities.
- They often do not complete school tasks or chores and have difficulties following through in the classroom.
- They often have difficulties organizing tasks and activities.
- They often avoid, dislike, or are reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework).
- They often lose things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools).
- They have difficulties paying attention when given directions by the teacher and are often easily distracted by extraneous stimuli.
- They have difficulties staying focused on a school task or play activity for an extended period of time compared with other children in the classroom.

8.6. Hyperactive Behaviours of Children with ADHD in the Classroom

- They often fidget with hands or feet or squirm in seat or fall out of seat.
- They often leave their seats in the classroom during lesson when remaining seated is expected.
- They often run about or climb excessively in situations in which it is inpriate.
- They often have difficulties playing or engaging in leisure activities quietly
- They are often "on the go" or often act as if "driven by a motor".
- They often talk excessively or make noises.
- They often blurt out answers before questions have been completed.
- They often toss toys or other objects.
- They often interrupt or intrude on others (e.g., butts into conversations or games).

8.7. Impulsive Behaviours of Children with ADHD in the Classroom

- They act without thinking, e.g., they will begin assignments without waiting for directions from the teacher
- They blurt out answers in class before questions are completed.
- They have difficulties waiting for their turn in line or in games
- They will make many errors on an assignment in an effort to finish quickly.
- They need constant reinforcement and have difficulties with delayed gratification.
- They often intrude on other people's conversations or games and violate space boundaries.
- They lack the ability to keep powerful emotions in check, resulting in angry outbursts or temper tantrums
- They often guess, rather than taking time to solve a problem.

These characteristics often make children with ADHD have severe problems in paying attention, following instructions, and completing tasks. In addition, their disruptive, demanding behaviour makes them unpopular with peers. Children with these characteristics often receive constant criticisms and correction from teachers and parents, who believe the behaviour, is intentional. The combination of negative feedback, poor academic achievement, and social problems may contribute to low self-esteem and other emotional problems.

9. POSSIBLE CAUSES OF ADHD

Apparently, there is no single "cause" of ADHD; Rather, ADHD symptomatology may result from a variety of causal mechanisms (Barkley, 2006; Nigg, 2005). Within-child variables, such as neurobiological factors and hereditary influences have received the greatest attention in literature (Barkley, 2006; Nigg, 2005). Environmental influences (for example family stress, poor parental disciplinary practices) appear to modulate the severity of the disorder, but do not play as large a causal role as neurobiological variables (Barkley, 2006; Nigg, 2005).

9.1. Neurobiological Causes

Earliest hypotheses suggested that children with ADHD had structural brain damage that contributed to attention and behaviour control difficulties (Barkley, 2006). There appear to be minor structural differences between the brains of individuals with ADHD and those of normal controls. Specifically, studies using both structural (e.g., magnetic resonance imaging [MRI]) and functional (e.g., positron emission topography [PET]) imaging techniques have indicated important differences and possible abnormalities in the fronto-straited networks of the brain (Nigg, 2006), as well as cerebellar regions, splenium of the Corpus Collosum and right Caudate (Valera, Faraone, Murray, & Seidman, 2007). Interestingly, one of the sections of the brain that has been studied in this regard is the prefrontal cortex, which purportedly is involved in the inhibition of behaviour and mediating responses to environmental stimuli. In addition, the neurotransmitters, dopamine and norepinephrine, are presumed to be "less available" in certain regions of the brain (the frontal cortex), thus contributing to ADHD symptomatology. This hypothesis has been based in part, on the action of stimulant medication (for example, Ritalin) in the brain where in the availability of dopamine and no repinephrine is increased. Based on available evidence, it is presumed that these neurobiological differences are due to abnormalities in normal brain development resulting from genetic, hormonal and/or environmental factors (Nigg, 2006).

9.2. Hereditary Influences

There is consistent evidence that ADHD is a highly heritable disorder that runs in families (Waldman & Gizer, 2006). Evidence supporting primary role of genetic factors has been obtained in a number of ways. First, there is a higher rate of concurrent and past ADHD symptoms in immediate family members of children with ADHD relative to their non-ADHD counterparts (Faraone et al., 1993). Furthermore, there is a higher incidence of ADHD among first-degree biological relatives, relative to adoptive parents and siblings for children with ADHD who were adopted at an early age (Vander Oord, Boomsa, & Verhulst, 1994). A second research strategy to investigate the heritability of ADHD symptoms has been to investigate symptom patterns in monozygotic (MZ) and dizygotic (DZ) twins. Specifically, the probability of one twin having ADHD given that the other twin has the disorder is significantly among MZ twin pairs than DZ twin pairs (Levy, Hay, McStephen, Wood, & Waldman, 1997). Because MZ twins share only 50% of their genes, it is presumed that higher concordance rates among Mz twins support a substantial role for hereditary (rather than environmental) factors in the expression of ADHD symptoms.

9.3. Environmental Toxins

Over the years, a variety of environmental toxins have been hypothesized to account for ADHD symptoms. Some of the more popular theories have implicated nutritional factors, lead poisoning, and prenatal exposure to drugs or alcohol (Barkley, 2006). Feingold (1975) for example, argued that certain food additives (artificial food colorings, salicycates, and sugar) led to childhood hyperactivity. Well controlled studies that have explained this hypothesis, as well as similar assumptions about sugar indicate that dietary factors play a minimal role in the genesis of ADHD (Barkley, 2006). More recently, investigators have found a significant relationship between maternal smoking (Milberger, Beiderman, Faraone, Chen, & Jones, 1996) or cigarette smoking (Mick, Beiderman, Prince, Fischer, and Faraone, 2002), and ADHD. Presumably, these environmental toxins and related factors may compromise brain development that then increase the risk for ADHD. Nigg (2006) in a comprehensive review of etiological factors related to ADHD estimated that prenatal exposure to alcohol and nicotine along with early childhood exposure to lead accounts for approximately 11% of the variance in later ADHD symptoms.

9.4. Prevalence of ADHD

The prevalence of ADHD among school children according to studies conducted in Africa ranges between 5.4% and 8.7% (Bello, 2014). The studies coming from South Africa documented a prevalence of about five percent, which concurred with the finding of a prevalence of about five percent in the meta-analysis study of world- wide prevalence of ADHD. The only epidemiological study among school children coming from the Democratic Republic of Congo documented a prevalence of 6.0%, while the only epidemiological study coming from Nigeria among school children revealed a prevalence of 8.7 % (Bello, 2014). Supposedly, prevalence rates in Cameroon could fall within the African ranges of 5.4% and 8.7%. Boys with this disorder outnumber girls in

both clinic-referred (approximately a 6:1 ratio) and community based (approximately a 3:1 ratio) samples (Centre for Disease Control and Prevention, 2010, 2013; Froehlich et al., 2007). More than 50% of children diagnosed with ADHD receive medication for this condition, while 12% and 34% receive special education and mental health services, respectively (Pastor & Reuben, 2002). Lower rates of diagnosis and treatment exist among African American children probably due to differences in parent beliefs about ADHD, greater exposure to socio-environmental risk factors, and lack of access to treatment services (Miller, Nigg, & Miller, 2009). Practitioners must therefore be aware that social and cultural factors account in part for the prevalence, diagnosis and treatment patterns. Behavioural therapy, which uses positive consequences to increase the likelihood of achieving certain behaviours, is among the leading psychosocial interventions for children with an ADHD diagnosis (University at Buffalo, 2015). Given the high prevalence of ADHD, its long-term repercussions, and its chronicity, the search for effective treatments to manage it has been a constant concern for the last few decades.

9.5. Mathematics/ Arithmetic Disability

Dyscalculia is a term that has been used frequently when talking about a mathematic disability. The unexpected learning problem that usually arises after a classroom teacher or a trained professional has provided appropriate learning experiences to a child over a considerable period of time is typical of a learning disability in mathematics. These children often have difficulties making progress in mathematics when compared to children of their peer and age group (Bryant, n.d.). Mathematics disability refers to problems with the language component of mathematics: understanding concepts, decoding written problems into mathematical symbols, and following a sequence of steps (Wawryk-Epp, Harrison & Prentice, 2004). Children diagnosed with a disability in mathematics may have a difficult time recalling and understanding basic facts and often cannot remember the multiplication tables despite spending hours trying to memorize them. Reading mathematical signs and copying numbers or figures correctly may be difficult for these children. They may also have difficulties with direction and orientation (American Psychiatric Association, DSM-IV-TR, 2000).

Every individual in today's society need mathematical skills for daily functioning. Unfortunately, development of these skills is not easy for all children and more specifically for those with ADHD who are slow in mastering the basic addition, subtraction, multiplication and division facts when compared with their normally developing peers (Swanson and Beebe-Frankenberger, 2004). Generally, 4% -7% of school aged children experience some kind of mathematics disability (Fuchs & Campton, 2005). According to Geary, Hoard, Byrd-Craven and DeSoto (2004), children with ADHD have difficulties carrying out mathematical calculations because they cannot easily use or retrieve essential mathematics facts. Mathematics facts include subtraction, addition, division, multiplication (ChrisDendy, 2011). One study found that, by age eleven, 80 percent of children with ADHD will be at least two years behind in reading, writing, spelling, and mathematics (Appalachia Educational Laboratory), thus the need for an appropriate intervention plan.

Research carried out by Mayes & Calhoun (2006) reveals that 26% of children with ADHD have a specific mathematic disability. The relationship between ADHD and mathematics disability can be examined from two perspectives: Firstly, the behavioural implication that ADHD has on classroom learning; somehow, children with ADHD, because of their inattentive, impulsive/hyperactive behaviours, fail to process the instructional language thus falling behind in mathematics. Secondly, the interplay of cognitive factors i.e. working memory, executive function and inattention. Working memory is an executive function which means that it is used to help make momentary decisions as well as long-term plans (Platt, n.d.). It is the area in which phonological or visual information is temporarily stored for the purpose of processing and manipulating the information (Swanson & Beebe –Frankenberger, 2004; Martinussen, Tannock & Chaban, 2006). Weaknesses in working memory contribute to difficulties in mathematics problem solving for children with ADHD (Swanson & Beebe –Frankenberger, 2004).

GreatSchools Staff (2016) postulates that difficulties of a child with a mathematics disability could stem from problems in one of the following areas:

a) Memory

Memory problems may affect a child's performance in the following ways: 1) Difficulty remembering how to solve a problem that was taught earlier in school; 2) problems with their ability to remember

basic mathematics facts; 3) Difficulty remembering specific signs and symbols as well as recalling steps in solving mathematics problems.

b) Cognitive Development

Due to delays in cognitive development, children with mathematics disability have trouble which hinders learning and the processing of information. This might lead to problems with: understanding number systems, understanding relationships between numbers, e.g. fractions and decimals, addition and subtraction, multiplication and division; using effective counting strategies.

c) Visual- Spatial

Problems in his area interfere with the child's ability to perform mathematics problems correctly as experienced in; misaligning numerals in column for calculation, solving multi-digit calculations that require "burrowing" (subtraction) and "carrying" (addition).

d) Poor Mastery of Mathematics Rules and Procedures

Children with mathematics disability often demonstrate developmental delay in learning the rules and procedures for solving calculations and word problems. An example of a rule is, any number multiplied by zero equals zero. A procedure includes steps for solving arithmetic problems such as addition, subtraction, multiplication and division.

e) Lack of Understanding of Mathematical Language

Mathematic language such as greater than, less than, equal to, is sometimes very difficult to be understood by children with ADHD. Unfortunately, a child has to know what each word or symbol means in order to understand a mathematic problem as meaning cannot be inferred from the context.

10. EMPIRICAL REVIEW

Educators have identified challenging behaviours and academic difficulties as a major concern and many teachers report feeling ill-equipped to assist children who exhibit challenging behaviours. By not addressing challenging behaviours and academic deficits during primary school, young people could face a number of adverse outcomes during adulthood. Despite the fact that scholarly literature is abounding with suggestions about dealing with academic difficulties that are most often associated to the academic deficits of children with attention deficit hyperactivity disorders, practitioners have and are still putting in much effort to come up with the best interventions for improving these conditions. Children with academic and behavioural problems do not react to contingencies in the same way as their peers that do not deal with these issues (Oosterlaan & Sergeant, 2005). They benefit instead from rewards and consequences that are given immediately and regularly (Kaiser & Pfiffner, 2010). That is why this study seeks to examine the effect of token economy on the academic achievement of children with ADHD.

Behaviour modification techniques have been successfully implemented in the classroom setting for children with ADHD symptoms and has produced marked reductions in off task and disruptive behaviour as well as marked improvements in academic productivity (DuPaul & Eckert,1997; Pelham, Schnedler, Bologna, & Contreras, 1980). In fact, Pelham and colleagues (1998) identified at least 23 studies supporting the efficacy of behavioural interventions in the classroom setting and consider behavioural interventions in this setting to meet criteria for well-established treatment.

Several behavioural treatment techniques have been found successful in school settings such as daily report cards, token economy programs, response-cost procedures, and positive-reinforcement (DuPaul, 2003). Many researchers have found that token economies increase desirable behaviour, as well as improve academic performance, in children with ADHD by reducing activity level and increasing time on task (Pfiffner & O'Leary, 1987; Pfiffner, Rosen, & O'Leary, 1985.

Pfiffner & O'Leary, (1987) investigated the effect of token economy on reading. They found that third graders with ADHD completed more daily teacher-made vocabulary assignments and passed more standardized weekly reading tests when a token economy system was in place. Pfiffner et al. (1985) also found that second and third graders with behaviour problems increased their academic productivity and on-task behaviour when a token economy program was implemented.

Rosenbaum, O'Leary, and Jacob (1975) investigated the effects of group reward and individual reward for 10 male hyperactive elementary school students. The participants were divided into two groups (individual reward program and group reward program) to allow maximum balancing with regard to age, grade in school, and score on the Conner's abbreviated scale. The student's teacher rated the participant four times daily on individually determined target behaviours. At the end of the day, the student could exchange his tokens (in this experiment cards were used) for candy, either for himself (individual reward) or for himself and the entire class (group reward). Teachers completed the Conner's Teacher Rating Scale four times during the course of the study, and they completed the Problem Behaviour Report at the end of each week. Results indicated a significant treatment effect, but no difference was found between groups. Maintenance effects continued four weeks post intervention. Teachers also completed a questionnaire to assess teacher satisfaction with the interventions. Results suggested that the teachers preferred the group intervention procedure.

Bettinger (2008) analyzed a randomized experiment in Coshocton Ohio in which students were given cash rewards if they performed well on state achievement tests; he found a small significant increase in Mathematics performance but not in reading. The evidence is modestly positive and contradicts the opposing view that rewards impair the intrinsic motivation of students (Corpus, Lepper, & Iyengar, 2005).

McGinnis, Friman, and Carlyon (1999) examined the effect of token rewards on "intrinsic" motivation for doing mathematics. This study used a multi-element baseline design to analyse the effects of token rewards delivered contingent upon completion of mathematics problems by two middle-school boys. Time spent on mathematics task and number of work pages completed increased (with high accuracy) during reward conditions and were maintained during fading and withdrawal. At follow-up, time spent and work pages completed remained well above baseline for 1 boy and fell below for the other, while accuracy remained high and ratings of liking mathematics were the highest possible for both boys. Overall, the results are inconsistent with warnings about use of token rewards to motivate children.

11. RESEARCH METHODOLOGY

Research Design

The research design adopted for this study was the quasi-experimental pre-test- post-test design with Non- Randomized Experimental and Control groups. This design is widely used in behavioural research primarily for the purpose of comparing groups and/or measuring change resulting from experimental treatments (Gay, 2009). The design was modelled according to Fraenkel & Wallen (2000) and Borg & Gall (1993) thus: $\frac{0 \text{ x } 0}{0 \; 0}$

Where: 0 represents pre-test and post-test given to both experimental and control groups;

x- represents the treatment.

The straight line shows that the groups were intact.

x – Represents the treatment (independent variable) while academic achievement as measured by test scores in mathematics, reading and spelling for ADHD children in primary 3 was the dependent variable. Since quasi-experiments are natural experiments, findings in one may be applied to other subjects and settings, allowing for some generalizations to be made about the population.

12. AREA OF STUDY

This study was carried out in Muea, Buea in the South West region of Cameroon. The South West region, one of the English speaking regions with its capital in Buea has a population of 1, 520,868 inhabitants (National institute of statistics, 2009). This region is divided into six administrative divisions, namely: Fako, Kupe Manenguba, Lebialem, Manyu, Meme, and Ndian. These divisions are further divided into sub divisions. This study was carried out in one government primary school in Buea Sub Division of Fako Division in the south-west Region of Cameroon. Fako Division is divided into four sub-divisions, namely Buea, Idenau, Tiko and Muyuka. Fako Division has a total of one hundred and thirty five (135) primary schools comprising 57 Government, 49 Confessional and 29 Lay Private schools (Regional Pedagogic Inspector for School Map & Co curricular activities, Regional Delegation for Basic Education- Buea, 2015). For proximity and proper monitoring, Buea

sub-division was selected as study area by the researcher. In Buea sub division; there are 26 Government, 11 Confessional and 19 Lay Private schools, making a total of 56 schools. For purposes of this study 1 of the 26 government schools (Appendix J) in Buea sub division was selected that is, Government Primary School (GPS), Muea-Group one. GPS, Muea-Group one is located at the south Eastern slope of Mount Cameroon bordered by Lysoka to the East, Liongo to the South and Molyko to the North. The school was established in 1984. The total enrolment for the 2015/2016 academic year stood at 537pupils with class three having 74 pupils (GPS Muea Group One School Records). The school has sixteen teachers and one head teacher.

12.1. Population of the Study

The population for this study was made up of all primary 3 school children studying in government primary schools in Buea - Cameroon, for the 2015/2016 academic year. According to the school population report obtainable from each of the schools visited, there were a total of 4,483 pupils in government primary schools in Buea. 661 out of them were pupils of primary 3.

12.2. Target Population

The target population for this study was made up of all children with ADHD in primary three in all government primary schools in Buea- Cameroon, for the 2015/2016 academic year. No detailed statistics as per the number of ADHD children present in primary three of all government primary schools could be obtained from the human resource department of the Delegation of Social Affairs, Buea.

12.3. Sample

The sample of this study was made up of 20 pupils with ADHD (8-10 years in class 3) and their teachers selected from one primary school Government Practicing School Muea. Eleven were boys and 9 were girls. This class (3) chosen for the study, had two streams 3A and 3B. Class 3A was assigned to the experimental group and 3B to the control group. Each group had 10 ADHD pupils. The sample of 20 ADHD pupils for this study was considered suitable using the quasi-experimental pre-test/post-test control group design. According to Alao (1982) remedial intervention is highly successful with smaller groups. Kolo (1992) is also of the opinion that the numbers may vary from 3 to 12 persons. See table below:

Table1.1. *Sample*

Region	**School**	**Class**	**No of participants(Pupils) by Gender**		**Total**	**No of Participants (Teachers)**
			Males	**Females**		
South West Region	GPS Muea Group 1	3A(Experimental group)	6	4	10	1
		3B (Control group)	5	5	10	1
		Total	11	9	20	02

Table 1.1 above indicates that participants for the study were drawn from one school in the South West Region of Cameroon. The next section deals with sampling and sampling technique.

12.4. Sampling Technique

The purposive sampling technique was used to select participants. The rational for using the purposive sampling technique was that only children with ADHD (8-10years) who met the eligibility criteria based on a behaviour rating scale designed by DSM-IV-TR, 2000 and who had difficulties in reading, spelling and solving mathematical problems, as responded by the teachers, qualified for participation. As such, data was collected from 20 children with ADHD within the age bracket of 8-10 having difficulties in reading, spelling and solving mathematics problems were successfully selected to participate in this study. Also the2 teachers of primary 3 (regular teachers of these classes) from the GPS Group 1, Muea in the South West region were purposively selected to participate in the study.

The reasons for selecting this class of pupils were; Firstly, ADHD symptoms are highly manifested among children within this age bracket as revealed by literature. Secondly, this is the intermediate class of the primary school system in Cameroon which ends at primary six. At this level, it is believed that pupils have gained skills in mathematical problem solving, reading, writing as well as spelling fluency with minimal assistance; Thirdly, in this class, most teachers orient the pupils towards their first ever certificate and end of course examination which is the Common Entrance Examination

(CEE) into colleges and the First School Leaving Examination (FSLE); Many of these children irrespective of their special needs nurse hopes and aspirations of entering college and pursuing their dreams.

The random sampling technique was used to select the school involved in the study. Using the hat and draw technique, the names of all 26 government primary schools in Buea were written each on pieces of papers and placed in a hat. After mixing thoroughly, one paper was randomly withdrawn by a nine year old girl to represent the school for the study. This school had the following enrolment of primary 3 pupils: (Males- 38, Females-36, and Total=74). The rational for using the random sampling technique was to give all 26 government primary schools in Buea, equal chances of being selected.

13. INSTRUMENTS FOR DATA COLLECTION

Three instruments were be used to collect data for this study.

Interview Guide: The interview guide designed by the researcher helped the researcher collect, background information from the school and more specifically, information on teachers' knowledge of children with ADHD in particular, how they interacted with them and what interventions they used to address academic achievement problems. It was divided into two sections, A and B with 15 items.

Behaviour Rating Scale: A behaviour rating scale adapted from the DSM-IV-TR, 2000, provided the major characteristics of children with ADHD (inattention, hyperactivity and impulsivity). Each major characteristic behaviour had sub characteristics, which were meant to identify specifically, children who possessed those characteristics in primary 3 classrooms. A total of 23 items constituted the behaviour rating scale with items, 1-8 targeting inattention; 9-16 targeting hyperactivity and 17-23 targeting impulsivity.

Test: A test constructed by the class teachers and checked by the researcher was administered to every class 3 pupil in both the experimental and control groups. The test was made up of three sections. Section A: This tested mathematical skills, involving problem solving in the areas of addition, subtraction, and multiplication, and division, identification of geometric objects, intersection and union of sets. Section B: This tested English language, precisely reading skills. A short reading passage was presented for each child's reading ability to be tested and a reading exercise where children were expected to fill blank spaces with appropriate articles from the bracket. Section C: This tested their spelling abilities. The children were given mostly words present in the passage earlier given for reading to find out if they had the ability to retain information. Each exercise ran for 10 minutes and was scored on a total of 20 marks .

Token Economy: Poker chips were used as tokens in this study (See appendix M). Tokens are units of systematic reinforcement given to increase desired pupil behaviour(s**),** which later are exchanged for a reward/reinforcer (See appendix O). During the token economy condition, the teacher started each of the lessons by giving the pupils the following instructions, "During today's Mathematics/English lessons, you will have the opportunity to earn token(s) for "good" academic behaviour, that is, successfully completing exercises in mathematics, reading and spelling". When you earn a token, it will be recorded against your name slot on the token chart. These recordings will be done throughout the week during mathematics and English language lessons. The teacher then started each lesson as normal and delivered tokens to pupils' contingent upon desirable academic behaviour. The magnitude and size of the reinforcer(s) was determined by the number of tokens the pupils had earned to exchange.

Exchange of Tokens: The tokens earned by the children were exchanged at the end of each week, precisely Friday. After each exchange, the tokens were collected from the children, to control for the effects of saving tokens for larger reinforcers at a later time. Children who had 15 or more tokens at the end of the week exchanged them for 8 items, children who had between 10-14 tokens exchanged them for 6 items, children who had between 6-9 tokens exchanged them for 4 items, children who had between 1-5 tokens exchanged them for 2 items and those who did not have any tokens at the end of the week were unable to receive any items. Items consisted of cheese balls, football, candies, biscuits, chocolate, exercise books, pens, pencils, erasers, sharpeners, bangles from the reward box. Additionally, children were encouraged to go home and tell their parents what they did to earn their reward, so as to benefit from more social rewards like praise. Since they had to show their parents, they were not permitted to eat or use their rewards in school, they had to put them in their schoolbags

to go home with them at the end of the day. Choice of backup reinforcers was a focus in the study to reduce satiation and maintain the reinforcing efficacy of the tokens; as such it was constantly modified based on the preferences from the children. .

14. PROCEDURE FOR DATA COLLECTION

Visit to Schools

Contact visit was then made by the author to meet the head teacher and teachers of the schools to explain the purpose of the study. The Head teacher gave express permission for data to be collected from the class teachers of primary 3. Each class teacher of primary 3 was also contacted and explanations given as to the purpose of the study and also their role of evaluation in the research work.

Validation of Instruments

Face Validity: Face validity is the suitability, sensibility, or relevance of the test and its items as they appear to the persons answering them (Holden, 2010). After constructing the items, the teacher made test items in mathematics, reading and spelling and the Interview Guide for teachers; they were presented to the supervisors for scrutiny, cross checking and to judge their relevance looking at the variables of the study. Adjustments were made following the supervisors' remarks and corrections.

Content Validity: It refers to the appropriateness of the content of an instrument (Biddix, n.d.). Whether the measures (test items, observations etc.) accurately assess what you want to know (Trochim, 2006). This involved taking representative questions from each of the sections of the curriculum and evaluating them against the desired outcomes. The content validity was submitted first to the teachers of these classes for scrutiny and amendments and later to the supervisors who checked the content and evaluating them in terms of their relevance to the variables, research questions and the objectives of the study (number of items, comprehensiveness of instruments, Logical presentation of instruments in getting intended variables, appropriateness of the content, adequacy of items in relation to the content, clarity of directions, etc.) . The content and format were consistent with the variable and the sample of subjects to be assessed. The instruments were then handed over to an expert on Educational Measurement and Evaluation who used statistical techniques to determine the usefulness or relevance of the various items on each instrument. The literature provided in the area of token economy, ADHD and academic achievement were also checked for content validity.

Reliability of Instruments

After presenting the sample tests, the interview guide for teachers to the supervisor of the thesis for scrutiny and corrections, a statistician was consulted for the organization of a statistical package appropriate for this study. A pilot test was conducted on a much smaller sample (8pupils comprising 5boys and 3girls) to ensure that the items on the instruments were within the reach of the respondents.

Table1.2. *Reliability Analysis*

Scale	Cronbach's Alpha	N_{cases}	N_{items}
Mathematics	0.818	8	2
Reading	0.461	8	2
Spelling	0.527	8	2

Cronbach's Alpha reliability coefficient was satisfactorily consistent following the trend of performance from pre-test to post-test for mathematics and spelling (Alpha>0.5) but relatively low for reading (Alpha=0.461) but not critically below 0.5 which is the threshold. Implying that the internal consistency assumption is not violated and this is supported by the positive value of the covariance. No remarkable changes were made on the master plan of activities for the implementation of the token economy intervention program after conducting the pilot study

Data Analysis

The data were generated into the software SPSS version 21.0 (IBM Inc., 2012) for statistical analyses both descriptively and inferentially. Descriptively, data was analyzed using measurements of central tendencies (Mean) and measurements of dispersion (Standard Deviation, range and mean difference). Categorically, variables were described using frequencies and proportions. Scale (continuous) variables such as test scores were described. The scale variables were screened for normality using

Kolmogorov-Smirnov and Shapiro-Wilk tests for normality (Nana, 2012) as to decide whether parametric or non-parametric test should be used for analysis. Four of the variables did not significantly depart from the theoretical normal distribution at the 0.05 level (P>0.05) and 6 out of 8 at the 0.01 level (P>0.01),

15. FINDINGS

Research Hypothesis

H_{O1} Token economy has no significant effect on the academic achievement of children with ADHD in mathematics.

Ha_1 Token economy has a significant effect on the academic achievement of children with ADHD in mathematics.

Table1.3. *Pre-Test and Post-Test Performance in Mathematics between the Control and the Experimental Group*

Mathematics	Stats	Group		Mean Difference	Independent-Samples t Test
		Experimental	Control		
Pre-test	N	10	10	-0.8	t=-0.452 df=18 P=0.657
	Mean	10.10	10.90		
	Median	10.00	10.50		
	Std. Deviation	4.012	3.900		
	Minimum	5	5		
	Maximum	17	17		
Post-test	N	10	10	4.1	t=3.8 df=18 P=0.001
	Mean	14.90	10.80		
	Median	15.00	10.50		
	Std. Deviation	1.663	2.974		
	Minimum	11	7		
	Maximum	17	17		
Mean Difference		4.8	-0.1		
Paired-Samples t Test		t=3.969 df=9 P=0.003	t=-0.089 df=9 P=0.931		

The mean score for mathematics moved from 10.1 at pre-test to 14.9 at post-test and this change was statistically significant (Paired-Samples t Test: P<0.05), unlike the control group whereby the performance dropped from 10.9 average to 10.8 average though statistically no change was realized (Paired-Samples t Test: P>0.05). At pre-test, the experimental and the control group were almost at same level (Independent-Samples t Test: P>0.05) but at post-test, the average score for the experimental group was significantly higher as compared to that of the control group (Independent-Samples t Test: P<0.05). . This shows that the token economy intervention had a significant effect and is effective in enhancing academic achievement for primary three school pupils with ADHD in. The null hypothesis is thus rejected and the alternative confirmed.

Table1.4. *Comparing Progression in Mathematics between Experimental and Control Group*

			Mathematics		Total
			Progression	No progression	
Group	Experimental	n	8	2	10
		%	80.0%	20.0%	100.0%
	Control	n	3	7	10
		%	30.0%	70.0%	100.0%
Total		n	11	9	20
		%	55.0%	45.0%	100.0%

Cramer's V: V=0.503; P=0.025

Comparing progression between experimental and control group, it was seen that the proportion of pupils who had a positive change in performance in mathematics was significantly higher (Cramer's V: P<0.05) in the experimental group (80%; n=80) as compared to the control group (30%; n=3), seen in table 1.4, figure 4.

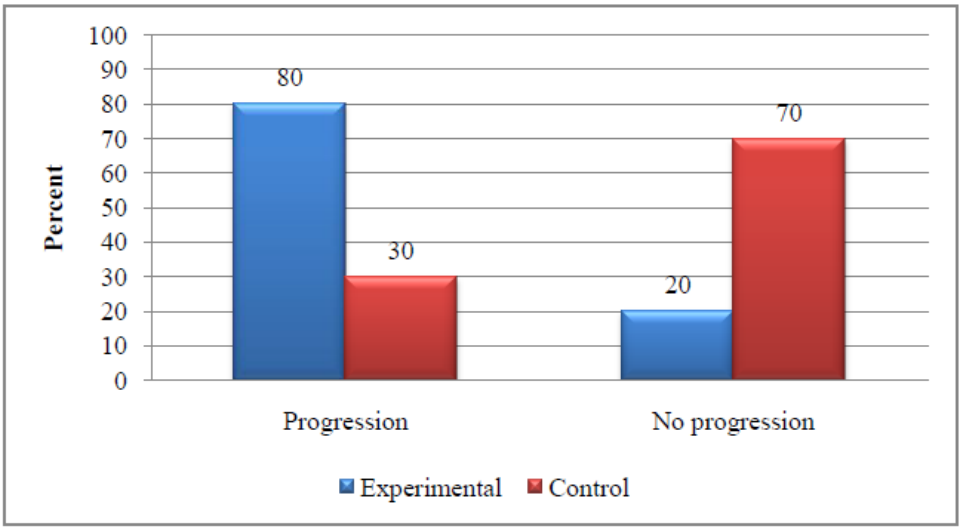

Figure1.5. *Comparing Progression in Mathematics between Experimental and Control Group*

Table1.6. *Comparing Progression in Mathematics by Gender*

Group				**Mathematics**		**Total**	**Cramer's V**
				Progression	**No progression**		
Experimental	Gender	Male	n	4	1	5	V=0.000 P=1.000
			%	80.0%	20.0%	100.0%	
		Female	n	4	1	5	
			%	80.0%	20.0%	100.0%	
	Total		n	8	2	10	
			%	80.0%	20.0%	100.0%	
Control	Gender	Male	n	1	5	6	V=0.356 P=0.260
			%	16.7%	83.3%	100.0%	
		Female	n	2	2	4	
			%	50.0%	50.0%	100.0%	
	Total		n	3	7	10	
			%	30.0%	70.0%	100.0%	

Comparing progression between the male and the female, the difference was not statistically significant in both the experimental and the control group (Cramer's V: P>0.05) though the females in the control group had the higher proportion (50.0%; n=2) of those who progressed as compared to 16.7% (1) for the males (table 1.6).

16. EMERGING DISCUSSIONS

The first objective was to determine the effect of Token Economy on mathematics achievement of children with ADHD. In this regard, the researcher hypothesized that Token economy had a significant effect on the academic achievement of children with ADHD in mathematics. The findings were in line with the initial assumptions of this study and consistent with the researcher's expectations. Findings revealed that token economy had a significant effect in enhancing academic achievement in mathematics. The finding is in line with McGinnis, Friman, and Carlyon (1999) who examined the effect of token rewards on "intrinsic" motivation for doing mathematics. This study used a multi-element baseline design to analyze the effects of token rewards delivered contingent upon completion of mathematics problems by two middle-school boys. Results showed that, time spent on mathematics task and number of work pages completed increased (with high accuracy) during reward conditions and were maintained during fading and withdrawal. The finding is also in line with Swain and McLaughlin 1998 who examined on the effect of token reinforcement on mathematics accuracy of middle school students in special education. Children were awarded points for a number of behaviours and response costs for other behaviours were also implemented. A bonus contingency, or the opportunity for students to earn additional points if they achieved a certain score on the assessment of mathematics accuracy, was another aspect of the study. Mathematics accuracy was higher during the bonus contingency portion of the token-reinforcement as compared to the baseline period.

Millersmtih, Weber & McLaughlin, 2001 also had a similar finding. They examined the effect of TE and a mathematic manipulative in increasing a child's ability in adding basic facts to ten. The participant was an 11-year-old girl with intellectual disabilities. The results of this study indicated the effectiveness of token economy and the math manipulative. As the outcomes revealed, the student's corrects increased with the use of token economy and mathematics manipulative. A return to baseline failed to reduce the student's performance indicating maintenance of behaviour change over time. The finding is also in line with Alter, Wyrick, Brown, & Lingo 2008 who investigated the effect of token economy and chaining on a nine-year old male student with ADHD who had mathematics problem solving skills. This student had difficulty specifically with mathematics word problems, and often would not even attempt to complete them. Results revealed that his on-task behaviour increased when token economy was actually implemented, and token economy proved to be effective. This also goes in line with the idea of Leblanc (2004) who studied the link between intrinsic motivation and external rewards. He looked at token economy as a way of increasing pupils' intrinsic motivation by way of external reinforcement and suggested that to have achievement, motivation is a necessary ingredient. This view further tie with Bafile (2014) who stated that, incentive programs can be an effective classroom management tool for teachers with ADHD pupils in their classrooms.

A contrary finding was recorded by Carlson, Mann, & Alexander (2000) who examined the effects of reward and response cost on the performance and motivation of 40 children with ADHD and 40 controls in a mathematics task. Participants completed a mathematics task under one of three (reward, response cost, no contingency) conditions. The study revealed that, for children with ADHD, response cost improved accuracy on the mathematics task relative to reward and resulted in higher motivation in the second half of the behavioural measure.

17. RECOMMENDATIONS

Based on the findings, it is recommended that:

- Consideration could be given for early intervention programmes to be carried out by school authorities. This will help in the emotional and social development of children with disabilities generally and specifically those with ADHD, thus preventing academic, social or emotional problems from occurring later on in life.
- Primary school authorities could support a culture in which behaviour intervention programmes like token economy could constitute a regular component of their curriculum to be used on children with disabilities in general and those with ADHD in particular to permit them achieve academically.
- Teachers should consistently use token economy to motivate their children with ADHD during their classroom lessons so as to keep them focused and improve on their achievement. To achieve this, it is further recommended that the government should through the school authorities empower teachers financially to enable them purchase tokens used for motivating their children.

18. CONCLUDING REMARKS

This study revealed that TE significantly enhanced academic achievement in mathematics, reading and spelling among primary three school pupils with ADHD. It was concluded based on this central finding that the token economy as utilized in this study is an effective strategies for enhancing academic achievement among primary three school pupils with ADHD. This is evidently clear from the mean scores in which significant difference was observed between the experimental and the control group at post-test. On the finding in relation to the effect of TE on academic achievement of primary three school pupils with ADHD in mathematics, it was concluded that TE was effective in enhancing academic achievement in mathematics. This was clearly seen from the pre-test and post-test mean scores. The conclusion was that the technique was found to be effective on the post-test scores of the respondents. Considering the finding in relation to the effect of TE on academic achievement of primary three school pupils with ADHD in reading, it was concluded that TE was effective in enhancing academic achievement in reading. This was clearly seen from the pre-test and post-test mean scores. The conclusion was that the technique was found to be effective on the post-test scores of the respondents. Considering the finding in relation to the effect of TE on academic achievement of primary three school pupils with ADHD in spelling, it was concluded that TE was effective in enhancing academic achievement in spelling. This was clearly seen from the pre-test and

post-test mean scores. The conclusion was that the technique was found to be effective on the post-test scores of the respondents.

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