

**INFLUENCE OF LEARNING SUPPORT STRATEGIES ON ACADEMIC
PERFORMANCE OF LEARNERS WITH DYSCALCULIA: A CASE OF SELECTED
BRITISH NATIONAL CURRICULUM BASED PREPARATORY SCHOOLS IN THE
NAIROBI COUNTY, KENYA.**

BY

NYAGA SOLOMON NJERU

**UNIVERSITY OF NAIROBI
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**A RESEARCH PROJECT SUBMITTED IN FULFILMENT FOR THE
REQUIREMENTS OF THE AWARD OF MASTER OF ARTS DEGREE IN
PROJECT PLANNING AND MANAGEMENT OF THE UNIVERSITY OF NAIROBI.**

2012

DECLARATION

This research project is original and the work included in it has not been submitted to any other university or institution.


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Date 13 . 03 .

Nyaga Solomon Njeru

L50/61088/2010

This research project has been submitted for examination with my approval as the supervisor of the University of Nairobi.


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Date *f fa LIXHU*

Dr. Christopher.M.Gakuu

Senior Lecturer

School of Continuing and Distant Education

University of Nairobi.

DEDICATION

This research project is dedicated to my wife Grace, my son Jyson and my daughter Zawadi who encouraged me to soldier on with the study despite many challenges that were there and which could have made me to postpone the course. I also cannot forget the input of my father who persuaded me to pursue this degree on many occasions when we had time to talk.

Their prayers and trust in my ability went a long way in helping me to realize what I have today, a research project on learning support for the disadvantaged in the society.

ACKNOWLEDGEMENT

I wish to acknowledge the vast input of my lecturer and supervisor Dr Gakuu for his support and faith in my area of research. He was particularly very instrumental in making me to believe that I could be able to come up with an excellent project report from the proposal.

I also wish to acknowledge the help I got from my colleagues in the 2010 MA Project Planning and Management class who were very instrumental during discussions and also their valuable critic to my organization of ideas on my topic of discussion.

I cannot fail to mention the resourceful input of my lecturer Mr. Oboko. His assistance went a long way in helping me to format and to organize my research project in the expected procedure.

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Abbreviations and Acronyms used in the Study

ADHD. Attention Deficit Hyperactive Disorder

BNC. British National Curriculum

CHK. Chesire Homes Kenya

CTLM Center for Training and Learning Mathematics

DfES. Department for Education and Skills of the UK.

EFL. English as a Foreign Language

IEP. Individualized Educational Program

IQ Intelligence Quotient

KIE. Kenya Institute of Education

KNEC. Kenya National Examinations Council

LD. Learning Difficulty

NDCCD National Dissemination Center for Children with Disabilities

NRCLD. National Research Centre on Learning Disabilities

OECD. Organization for Economic Cooperation and Development

TSC. Teachers Service Commission

UK United Kingdom

VAKT. Visual Auditory Kinesthetic Tactile teaching method

ABSTRACT

Good knowledge of number work for learners in their preparatory school years goes a long way in increasing their confidence for better performance in other disciplines like sciences and humanities. Good performance in mathematics on the other hand is a prerequisite to pursuance of some lucrative career courses at the university level like medicine and engineering. This scenario puts learners with a difficulty of numbers otherwise known as dyscalculia at a disadvantaged position. This is because, these learners are unable to manipulate mathematical concepts under the conditions found in a normal conventional classroom set up. Some British National Curriculum based preparatory schools in Nairobi have endeavored to support these learners by adopting some strategies which are aimed at influencing their performance in numeracy. The support strategies involved include; differentiated teaching resources, differentiated teaching methods, adjusted tests and differentiated tasks and classroom assignments. Research questions seek to find out whether these support strategies actually influence in any way the academic performance of learners with dyscalculia. The literature review about dyscalculia seeks details on different types of specific learning difficulties and what several authors have commented about the support strategies mentioned. Data regarding the effectiveness of the learning support strategies on the academic performance of learners with dyscalculia is collected using the questionnaire. The questionnaire is specifically intended for the attention of trained numeracy support teachers who regularly use the support strategies in twenty BNC based preparatory schools in Nairobi County with an aim of improving the academic performance of learners with dyscalculia. Collected data was analyzed both qualitatively and quantitatively using the factor analysis and conclusions and recommendations will then be made accordingly. The study was then be able to establish whether or not, the learning support strategies influenced the academic performance of learners with dyscalculia.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the study

For a long time now, teachers in schools have tended to accept or excuse children's lack of progress in numeracy work when they would go to great lengths to improve their literacy skills (Jane 2009). Historically, mathematicians have operated as if mathematics was an exclusive club, whose members speak a secret language. They taught mathematics in a rigid, complicated manner, and were proud of it. Egotistically satisfying their "fewer the better attitude," they happily weeded out underachievers. Dean Sharma calls the status quo in mathematics' education, irresponsible and unacceptable, (Sharma 1989), especially in an age where "90% of new jobs require more than A high school level of literacy and mathematical skills." Mathematical educators have also failed so miserably, that although 90% of kids want to go to college, paradoxically, 50% of them also want to drop.out of mathematics classes as soon as possible (USDE 1998). What makes mathematics such a hard nut to crack?

Research has shown that, a good number of learners in conventional schools suffer from a profound difficulty with numbers known as dyscalculia. Jane (2009) defines dyscalculia as a mathematical disability which causes serious difficulties in learning mathematical concepts and facts. The effects of dyscalculia are either unknown or ignored in many conventional preparatory schools. Dyscalculia usually causes a general lack in understanding of how mathematical problems are supposed to be organized in a page (Jane 2009). It is however important to note that, problems with learning and behavior in school going children are not a new phenomenon. Long before 1863, teachers and parents were complaining that some children were difficult to teach and control. They also underachieved academically and they struggled to sit still (Stotzner 1864). In 1897 Stotzner, a German teacher founded a school for the slow learning children. These children did not have mental retardation but according to Stotzner, their memories were too weak to retain letters or numbers and due to the poor motor coordination of their fingers, they had difficulty learning to write. Accordingly, Stotzner understood that the learning problems of these children called for remedial teaching efforts (Stotzner 1864). The researcher endeavors to

investigate the influence of these remedial teaching efforts (as proposed by Stotzner) on the academic performance of learners with dyscalculia.

Notably, there is currently a great deal of interest in dyscalculia the world over. The interest is being seen in academic policy-making bodies and educational circles. There are however, no established bodies of research in the area of dyscalculia and its effects to the preparatory school children. According to Kenyon (2003), little is known about the causes of dyscalculia and as people have not been widely tested for dyscalculia, it is hard to quantify exactly how many people in the world have the condition. Dyscalculia probably affects 5% of the world total population. A recent survey equates this to approximately one pupil per class in an average preparatory school (Ghinn, 2010). Some BNC based preparatory schools in the Nairobi County have indeed been using some learning support strategies in the hope of improving the academic performance of these learners who have dyscalculia.

Unlike dyslexia (a severe reading disorder), dyscalculia in Kenya and many other developing countries has been neglected as a disorder of cognitive development. According to one of the numeracy support teachers, there is no existing individualized educational plan (IEP) based on dyscalculic needs. Whereas English is taught as a foreign language (EFL) in handling dyslexic cases, there is no equivalent in the world of dyscalculia. Most numeracy teachers regard pupils with serious disability in learning of numeracy as idiotic. They encourage them to repeat classes as a means to improve academic outcomes. However, unknown to them, the students could be suffering from a difficulty with numbers and arithmetic (dyscalculia) which is a lesser known learning disorder in the mainstream education system in Kenya (National Research Center on Learning Disabilities NRCLD, 2010).

This situation is worse in Sub-Saharan Africa where most teachers are not even aware of the problem and they classify dyscalculic pupils simply as morons, stupid or merely as low academic achievers. Reached for a comment; a senior staffing officer at the Kenyan Teachers Service Commission (TSC) said that, he was not aware of the prevalence of dyscalculia in the Kenyan Schools. This is contrary to Professor Diana Laurillard of Institute of Education, University of London who says that about five to seven percent of the global population suffers from dyscalculia. She says that, the prevalence of dyscalculia is the same as that of developmental dyslexia which is the much known reading disorder.

Most conventional schools in Kenya do not have established intervention programmes or special education learning support strategies which may help learners with this condition. Consequently, there are many primary school going children who have never had their difficulties in mathematics identified as a developmental cognitive disability as much as challenges of dyscalculia and general mathematical anxiety are felt in both Kenyan primary and secondary schools. Mathematics is one of the subjects that students score poorly in the Kenya Certificate of Primary Education (KCPE) and Kenya Certificate of Secondary Education (KCSE). For instance, in 2010's KCSE, the mean score for mathematics stood at 23.6% (Kenya National Examinations Council (KNEC), 2010). The researcher therefore feels that there should be a more proactive system of teaching mathematics in schools because as Professor Laurillard says that; just because dyscalculia could be inherited, it does not mean that there is nothing that can be done about it (Laurillard 2011).

1.2 Statement of the problem

The classical understanding of dyscalculia as a clinical syndrome uses low achievement on numeracy tests as the criterion for gauging academic performance without identifying the underlying cognitive phenotype. This understanding has been unable to inform pathways to remediation, whether in focused interventions or in larger, more complex context of the mathematics classroom (Shalev, Gross-Tur and Neurol 2001). This kind of assessment ignores performance in terms of reduction of errors in the problem solving process. The assessment also fails to consider the fact that, dyscalculia can be highly selective and that it may affect learners with normal intelligence as well as those with normal working memory (Lander! and Bevan 2005). According to these facts, the researcher endeavors to investigate the influence of learning support strategies offered by some selected BNC based preparatory schools in Nairobi on the academic performance of the learners with a mathematical disorder known as dyscalculia.

Dyscalculic tendencies among learners become more noticeable by the time mathematical processes become more elaborate in the fifth or in the sixth grade of preparatory schools (Kenyon, 2003). Kenyon also points that there are no established bodies of research into this phenomenon. Dehaene on the other hand states that, dyscalculia can be detected at a young age. This means that, measures can be taken to ease arithmetical difficulties faced by younger students in middle preparatory school. He suggests that, the problem of dyscalculia can be

effectively addressed by understanding the way numeracy is taught and the appropriate assessment that can then be given to learners so as to enhance academic progress (Dehaene 1997). It is with this scenario in mind that the researcher endeavors to investigate the influence that differentiated teaching resources, differentiated teaching methods, adjusted tests and differentiated tasks and classroom assignments have on the academic performance of learners with dyscalculia.

1.3 Purpose of the Study

The purpose of the study is to investigate the influence of learning support strategies on the academic performance of students with a learning difficulty in numeracy known as dyscalculia; where academic performance is defined in terms of the performance score and the reduction in the number of errors made in a numeracy problem solving process.

1.4 Objectives of the study

The general objective of the study is to establish whether learning support strategies adopted by some preparatory schools in the Nairobi County influence the academic performance of learners who have a numerical learning disorder known as dyscalculia.

The specific objectives are to:

1. Establish whether differentiated teaching methods influence academic performance of learners with dyscalculia.
2. Establish the extent to which differentiated teaching and learner resources influence the academic performance of learners with dyscalculia.
3. Establish the influence of adjusted tests and assessments to the academic performance of learners with dyscalculia
4. Establish the extent to which differentiated tasks and classroom assignments influence the academic performance of learners with dyscalculia.

1.5 Research Questions:

The study will be guided by the following research questions:

1. Do differentiated teaching methods influence the academic performance of learners with dyscalculia?
2. Does the use of differentiated teaching resources influence the academic performance of learners with dyscalculia?
3. Do adjusted numeracy tests and assessments influence the academic performance of learners with dyscalculia?
4. Do differentiated tasks and classroom assignments influence the academic performance of learners with dyscalculia?

1.6 Significance of the Study

The day-to-day lives of people with a learning disability are usually affected by the way they are perceived and treated by the communities they live in. This is according to an organization in the UK called Mencap. Having limited numeracy ability is a major handicap for a student's life chances because low numerate people ends up earning less and spending less and on average they are likely to be in trouble with the law. In regard to this, the study will hopefully be used by teachers and administrators of the learning institutions that enroll dyscalculic students to make sure that all students regardless of their learning backgrounds get value for their time in school.

Differentiated teaching methods for students with dyscalculia often benefit all students. It is therefore apparent that there is a better way to present the same information to all students using inclusive education (Dehaene, 1997). It is with this information in mind that the researcher feels that this study was truly significant.

1.7 Scope of the study

The study was based on some selected preparatory schools based in Nairobi County where BNC system is adopted. Learning support strategies in these schools are well coordinated and the appropriate screening procedures for learners with dyscalculia are available. Enough time to

interact with the numeracy teachers, low cost involved in data collection and willingness of trained numeracy support teachers to respond accurately to the questions in the research instrument enabled the researcher to carry out his project successfully. This is because; the research instrument was specifically prepared for the numeracy support teachers who were the sole respondents and are also considered an authority in this area of study.

1.8 Limitations of the Study

Dyscalculia is a lesser known learning disability compared to other well known learning difficulties like dyslexia (reading and writing disability) although it occurs in people across the whole intelligent quotient range. Little is known about the causes of dyscalculia and research has it that, it probably affects about 5% of the world's total population (Kenyon 2003). Since dyscalculia is a lesser known learning disorder, it is difficult to effectively assess the number of learners who have the condition using the conventional way of test- based classroom approach (Emma 2009).

Schools in the UK for example, have a long experience of supporting children who experience profound difficulties with literacy (dyslexia). This is not the same with the cases of dyscalculia which has only recently been identified as a distinct condition in Africa. This means that dyscalculia is a fairly new term for many people in Africa including teachers and parents. It also means that there are many people who have never had their difficulties with arithmetic formally identified (Chinn and Ashcroft, 1997). This also means that lack of reliable database of the culprits, inadequate literature and lack of trained numeracy support teachers may pose as the major limitations to a successful study in this area. The researcher therefore endeavors to come up with the required database of learners with dyscalculia and as well as the support teachers by closely working with the institutions that have well established learning support units.

1.9 Assumptions of the Study

The researcher fundamentally assumes that the target population of the numeracy support teachers will represent the general view of the larger population regarding the influence of the learning support strategies to the academic performance of learners with dyscalculia.

He also assumes that the data collection instrument which in this case is a questionnaire will be valid and that the measurements taken will be reliable for an affective analysis of the collected data. He also hopes that the numeracy support teachers will respond to the questionnaires correctly and truthfully so as to capture the situation on the ground effectively so that their responses will answer the research questions that the researcher has.

1.10 Definitions of Significant Terms used in the Study

Ability grouping

This is the art of dividing students into homogenous groups based on their performance in a given subject

Assistive technology

This includes online equipments and others like audio-visual textbooks, spellcheckers and smart boards which are meant to help learners with learning difficulties cope with lessons in a conventional classroom.

Cognition

This is the art of knowing including consciousness of things and judgment about them

Developmental dyslexia

This is a profound reading disability

Differentiated curriculum

This is an approach or a curriculum that is planned according to the needs and ability of a learner with learning difficulty

Dyscalculia

This is a profound arithmetic disorder that causes difficulties in learning concepts, memorizing facts and understanding how mathematical problems are organized in a page.

Dysgraphia

This is a scientific term that refers to all types of written expression disorders.

Dyslexia

This is a reading disability that involves difficulties with accurate or fluent word

Learning disability	recognition or word decoding. This is a learning disorder in which a person has difficulty learning in a typical manner.
Learning support unit	This is a department in a school set aside for supporting learners with specific learning difficulties.
Peripatetic teacher	This is a teacher trained in special education to help learners with learning difficulties.
Resource room	This is a room in a conventional school which is equipped to support learners with learning difficulties like dyslexia or dyscalculia.
Screening	This is a scientifically designed program usually online, of identifying students who have a learning difficulty.
Differentiated teaching method	This is a learning support strategy where special attention is given to students with a learning difficulty in a conventional lesson.

1.11 Organization of the study

The first chapter of the study is organized in a progressive format that starts with the background of the study, the statement of the problem, the purpose and the objectives of the study. This is followed by a list of the research questions, the significance of the study, delimitation of the study, limitation of the study, assumptions of the study and the definitions of the significant terms used in the study.

Chapter two of the study includes a detailed literature review based on the study. Among the items considered, inclusive education gives the significance of the support strategies used. Different types of specific learning difficulties are then analyzed and dyscalculia is addressed in finer details. This chapter also endeavors to explain how differentiated teaching methods, differentiated teaching resources, adjusted tests and assessments and differentiated tasks and classroom assignments may influence the academic performance of learners with dyscalculia.

Chapter three of the study is based on the research design the researcher used while collecting data. A detailed analysis of the study area, target population, the sample and the sampling techniques, the research instrument used including its validity and reliability are also given. An operationalisation table for all variables used is indicated and collection procedures and data analysis techniques are explained.

Chapter four of this study is based on the analysis and interpretation of data collected using the questionnaire. The questionnaire was divided into three sections and the data collected from each one of those sections is analyzed using the Factor analysis. The relevant interpretation from the analysis of data is then made.

Chapter five of this study is based on the summary, conclusions and recommendations that the researcher felt would be necessary for implementation or for further research.

The last part of the study considers the appendices which include the questionnaire for the respondents, the time framework for the study, the research budget and the introductory letter for the heads of the learning support units of the British National Curriculum based preparatory schools in the Nairobi County.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction:

This chapter deals with detailed literature review based on inclusive education, the different types of specific learning difficulties, and the mathematical disorder known as dyscalculia. This is the main area of study in this project. Dyscalculia can be defined as an inability to conceptualise numbers, number relationships (arithmetical facts) and the outcomes of numerical operations (estimating the answer to numerical problems before actually calculating (Sharma 1997). An individual with dyscalculia may have one or more of the following characteristics: does not remember or retrieve mathematical facts; does not use visual imagery effectively and is confused with mathematical operations especially multi-step processes. The learner may lack an intuitive grasp of numbers, and also has problems learning number facts and procedures (Chinn and Kay 2001).

According to Jane (2009) learners with dyscalculia usually suffer from a disorder known as poor number sense. The disorder was originally identified in case- studies of patients who suffered from specific arithmetic disabilities which resulted from damages found in specific regions of their brain. Recent research however suggests that dyscalculia can also occur developmentally as a genetically-linked learning disability which affects a person's ability to understand, remember and/or manipulate numbers and/or number facts like in multiplication tables and it is exhibited as an inability to perform arithmetic operations (Kenyon 2003). In Greek and Latin dyscalculia literally means counting badly and it is characterized by a fundamental inability to conceptualize numbers as abstract concepts of comparative quantities.

According to Dehaene (1997), dyscalculia can be detected at a young age. This means that, measures can be taken to ease arithmetical difficulties faced by younger students in middle preparatory school. He suggests that, the problem of dyscalculia can be effectively addressed by understanding the way numeracy is taught and the appropriate assessment that can then be given to learners so as to enhance academic progress. Difficulties associated with dyscalculia occur mainly when a student struggles to remember specific facts and formulae for arithmetical

calculations and when he tries to master arithmetic facts by the traditional methods which dictate that a student must follow some sequential directions of understanding abstract concepts of time and direction (Dehaene, 1997). Brian Bullerworth a professor in learning support notes that, dyscalculia is not an illness but a special need which requires appropriate learning support. The support is designed to give students an understanding of their condition and also the coping strategies that they can use in the conventional classroom and in their day-to-day encounters with numbers (Butterworth, 1999). There is therefore a knowledge gap that exists as to whether the problem of dyscalculia can be addressed effectively by the use of (specially designed) differentiated teaching methods which the research study endeavors to investigate.

Recent research has shown that, children give up in mathematics the world over when they are in grade five or in grade six and therefore dyscalculic tendencies can therefore be identified easily around this time. Among the items that rank as most influential towards this phenomenon, is to have to answer questions quickly, to memorize facts and to work out mental arithmetic (Chinn 2010). Children with special numerical needs have more problems with aspects of mathematical long-term memory and notably while retrieving basic facts from their memory. They often have poor short term and working memories, both of which are key pre-requisite skills for a good grasp of mental arithmetic (Chinn 2010). Recent research also, in cognitive and developmental neuroscience provides a new approach to the understanding of dyscalculia that emphasizes a core deficit in understanding sets and number work. This is fundamental to all aspects of elementary school mathematics where new interventions to strengthen number processing promise effective evidence-based education for dyscalculic learners (Gabrieli, 2009). The findings of Chinn and Gabrieli play a pivotal role in confirming the need to investigate the influence of differentiated teaching methods on the academic performance of learners with dyscalculia.

The classical understanding of dyscalculia as a clinical syndrome uses low achievement on mathematical achievement tests as the criterion for gauging academic performance without identifying the underlying cognitive phenotype. This understanding has therefore been unable to inform pathways to remediation, whether in focused interventions or in larger, more complex context of the mathematics classroom (Shalev, Gross-Tsur and Neurol 2001). This assessment ignores performance in terms of reduction of errors in the mathematical problem solving process forgetting that dyscalculia can be highly selective and it may affect learners with normal

intelligence and those with normal working memory (Lander! and Bevan, 2005). As such, the researcher defines academic performance of learners with dyscalculia in terms of the performance score and the reduction of errors in a numeracy problem solving process.

According to the Department for Education and Skills of the UK, there are many other reasons why children struggle with numeracy. These include ineffective teaching methods, family backgrounds, poor attendance at school and other learning challenges such as inefficiency in language acquisition. Current research shows that a genetic anomaly may result in a specific deficit in the learning of numerical skills. This anomaly affects the ability to acquire arithmetical skills and it involves a difficulty in understanding simple number concepts, lack of an intuitive grasp of numbers and severe problems understanding number facts and procedures (DfES UK, 2001).

The effects of early and appropriate intervention of the learner's with dyscalculia especially within the age group of six to twelve year olds have yet to be investigated. Fusion wonders whether there is a form of dyscalculia that will resolve, perhaps with appropriate educational learning support strategies (Fusion 1988). With this knowledge gap begging for a resolve, the researcher endeavors to investigate the influence of learning support strategies adopted by some selected preparatory schools in the Nairobi County on the academic performance of learners with dyscalculia.

The chapter also highlights the comments of different scholars based on differentiated teaching methods, differentiated teaching resources, adjusted tests and assessments and differentiated tasks and classroom assignments. The last part of the chapter includes the conceptual framework of this study, the summary of this chapter and the study gap for research which forms the basis of this study.

2.2 Inclusive education

It is widely recognized that if pupils are to realize their full potential from schooling, they will need the full support of their teachers as well as their parents. Attempts to enhance learning support services to students with learning difficulties occupy governments all over the world. The Kenya Institute of Education (KIE) defines inclusive education as a philosophy of ensuring that schools, centers of learning and educational systems are open to all children. This

philosophy advocates that, children should not be excluded from the society's activities due to disabilities, racial or economic statuses. According to the Inclusive Education Act of the UK, it is anticipated that the learning support program should play a crucial role of promoting improved academic performance of students with learning difficulties.

To include pupils of various academic backgrounds in a school set up, the Special Education Needs Act of¹ the UK, 2001 states that there should be no discrimination on grounds of disability and special needs. This has been amended by the Special Educational Needs and Disability Act of the UK, 2001 which states that, a responsible body or institution discriminates against a disabled person in education if for a reason which relates to his disability it treats him less favorably than it treats or would treat others to whom that reason does not or would not apply; and it cannot show that the treatment in question is justified (Disability Discrimination Act, UK 1995).

In Kenya, inclusive education has been extended only to some few approved schools. This is because an education system for learners with specific learning difficulties remains a sensitive debate among many parents, educators and governments. Studies by Melcher and Thomas (1976) found that, in some cultures, children with learning difficulties have been thought of as cursed, insane or simply bad omens to the society. Due to these perceptions, several parents or guardians opt to exclude their disabled school going children from the mainstream primary schools so as to avoid the anticipated public ridicule. These perceptions are however changing and this has led to the emergency of the inclusive education philosophy which aims at teaching pupils with exceptionalities (learning disorders). In support of this, Ndurumo (1992) noted that students with disabilities are capable of benefiting from educators vocational norms if they are given appropriate learner support. The inclusion of children with disabilities in the Kenyan system of education has been achieved through advocating at schools and other educational agencies that the conditions of learning for the disabled children must always be put into account when formulating a teaching curriculum. Through participatory approaches, all stakeholders including children, teachers and parents have been integrated in the identification and formulation process which has led to some sustainable interventions.

A case study by the Leonard Chesire Disability (LCD) foundation based in the Nyanza and Western provinces of Kenya; illustrates how inclusive education has been availed to students

with general disabilities including blindness, lameness and hearing disorders. Notably, very little or no emphasis at all, has been put on identifying and formulating teaching policies for children with specific learning disorders like dyslexia and dyscalculia. Significant progress in Kenya has somehow been made towards identifying children with learning disabilities. According to Karugu (1999}, the estimates of pupils who need special education in Kenya were approximately 2.3 million. The needs of these children have however not been met because most teachers lack the necessary skills and the expertise to support them adequately. The success of the LCD project however, is pegged on the envisaged need to build a bigger capacity of different stakeholders who are to be engaged in the implementation of Inclusive Education Program at a wider level in the country. Notably, a few learner support seminars have taken place in Kenya over the last three or so years including a successful one facilitated by Dr. Steve Chinn in 2009 in the Nairobi County. The seminar endeavored to come up with ways of managing challenges that pupils face in their pursuit for excellence in number work.

According to the Teacher's Service Commission in Kenya, the knowledge of diagnosing a child's conceptual gaps in numeracy is not locally available. Professor Bruce Pennington states that a learning difficulty (LD) is formally diagnosed by defining the gap between a person's intelligence and the skills the person has achieved at each age. He says that the first step in diagnosing a LD is the awareness of the characteristics associated with it. If a seventh grade pupil with an IQ of 120 for example, cannot write a short, simple paragraph, she may have a LD. It is important to note that not all learning problems are necessarily learning disabilities. Many children may be simply slow in developing certain skills so that, what appears as a learning disability may in fact be a delay in maturation. Factors that affect the actual diagnosis of a LD include the student's actual abilities, the reliability of the test instrument, the ability to understand the directions and the questions and level of attention during the testing session (Bruce 1991). Bruce further suggests that a learning difficulty can be diagnosed in different ways. These include testing vision and hearing abilities first to rule out sensory impairment and to assure that the person can see and hear clearly. This is followed by an evaluation of academic skill disorders like reading, number work and writing eligibility using standardized tests to ascertain the presence or the absence of a learning difficulty. Testing intelligence by the use of a psychologist follows. These involve a comparison of pronunciation, vocabulary and grammar of

the pupil to the developmental abilities of same-age peers so as to diagnose speech and language disorders (Bruce 1991).

As clearly noted, dyscalculia and other learning disorders are not widely recognized by many teachers and the institutions they work in. Despite these barriers however, there is an urgent need to achieve a level of numeracy for example, at which learners with dyscalculia can function adequately within the society. In developed countries like the UK for example, a wide range of strategies have been put into place to help teachers manage learners with these difficulties in the conventional classroom set up. Software resources based on brain research showing exactly where the problem is are being circulated to public schools where teachers are also trained on how to use them. A few BNC based preparatory schools in the Nairobi County have adopted some of the learning support strategies with the hope of improving the academic performances of learners with dyscalculia. There remains a knowledge gap as to whether this learning support strategies actually help and it is with this in mind that the researcher endeavors to investigate the influence of these strategies on the academic performance of learners with dyscalculia in this study.

2.3 Specific Learning Disorders (Difficulties)

A learning disorder (LD) is a generic term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. Accordingly, common learning disabilities may not reflect at all on a student's intelligence but it may just mean that the learners requires extra help and possibly the use of a different teaching technique to achieve the same success as the other learners who do not have learning difficulties (Louis and Daniel 2002). The Dorland's Medical Dictionary (1985) defines a learning disability as a classification of several disorders in which a student has difficulty learning in a typical manner, usually caused by an unknown factor or factors .The unknown factor is the disorder that affects the brain's ability to receive and process information. This disorder can make it difficult for a person to learn as quickly or in the same way as someone who is not affected by it. Kenyon, a specialist in learning support says that; people with learning disabilities have trouble performing specific types of skills or completing tasks if left to figure out things by themselves or if taught in conventional ways (Kenyon 2003).

In May 2007, the National Dissemination Centre for Children with Disabilities in the UK stated that learning difficulties usually fall into four broad categories based on the stages of information processing used in learning. These categories include; input, integration, storage and output of the acquired information. The journal explains that, the information perceived through senses such as visual and auditory perception represents the input. Difficulties with visual perception can cause problems with recognizing the shape, position and size of items. The problems may include sequencing which relate to deficits with processing time intervals or temporal perception. Difficulties with auditory perception can make it difficult to screen out competing sounds in order to focus on one of them, such as the sound of the teacher's voice. The stage during which perceived input is interpreted, categorized, placed in a sequence, or related to previous learning is known as integration. Students with problems in these areas may be unable to tell a story in the correct sequence. Although they may be able to understand a new concept, they struggle to generalize it to other areas of learning or to put facts together so as to see the bigger picture. Problems with storage occur within the short-term or working memory, or with long-term memory. Most memory difficulties occur in the area of short term memory, which can make it difficult to learn new material without many more repetitions than is usual. Information comes out of the brain either through words, that is language output, or through muscle activity such as gesturing, writing or drawing. Difficulties with language output can create problems with spoken language, for example, answering a question on demand, in which one must retrieve information from storage, organize the thoughts and put them in words before speaking. The journal also highlights that deficits in any area of information processing can be manifested in a variety of specific learning difficulties and that these disabilities can affect different aspects of learning and functioning. The journal further states that it is difficult to pinpoint their causes, but they may be inherited and often runs in families. Students with a learning disability can be high achievers and can be taught ways to reduce obstacles and barriers caused by their disability. Learning disabilities are also not as a result of inferior instruction, economic disadvantage, environmental factors or cultural differences. An individual may have more than one of these difficulties but the most common learning difficulty is dyslexia (Amanda 2000).

Geary (1993) states that the common specific learning disabilities that are experienced in schools include: Attention Deficit Hyperactivity Disorder (ADHD), Dysgraphia, Dyscalculia and Dyslexia. He points that the symptoms of ADHD include inattention(daydreams excessively,

easily distracted, affects focus, memory and organization), impulsiveness(acts without thinking, poor judgment and problem solving, interrupts without being able to wait for turn); and hyperactivity which involve constant movement, explosive energy, restlessness, fidgety and difficulty working and playing with others (Geary 1993).

Dysgraphia can be defined as a neurological disorder that is characterized by writing disabilities. Individuals with this disability have difficulties with written expression, disorganization in writing, trouble getting good ideas down on paper, poor and distorted handwriting that is hard to read, persistently wrong or odd spelling despite instruction, and production of words that are not correct for example using the word boy to mean a child (Deuel 1994).

The National Numeracy Strategy of the UK defines dyscalculia as a condition that affects the ability to acquire arithmetical skills. Learners with dyscalculia may have difficulty understanding simple number concepts and an intuitive grasp of numbers. The learners may also have problems learning number facts and procedures such that even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence. Notably, low numeracy experience is a substantial cost to nations and improving the standards from the onset, could dramatically improve economic performance of a country. Low numeracy is more of a handicap for an individual's life chances than low literacy. Individuals with low levels of numeracy earn less, spend less, are more likely to be sick, are more likely to be in trouble with the law and need more help in school and the estimated annual cost to the UK government of low numeracy is a whopping £2.4 billion (Gross, Hudson and Price 2009).

Dyslexia on the other hand, is a reading disorder that involves a distinct learning disability characterized by difficulties of single word decoding which reflect insufficient phonological processing. Individuals with dyslexia experience problems in reversing or mis-sequencing letters or numbers within words when reading or writing some letters, translating printed words into spoken words with ease, beginning reading skills and decoding, mastering word identification and understanding words and grammar and reading fluently using comprehension that goes beyond word recognition and limited language skills that affect comprehension (Lewis, Hitch and Waiver 2001). Notably, dyslexic learners have profound difficulty with different forms of language including problems of acquiring reading, writing and spelling techniques (International dyslexia Association, UK).

2.4 Differentiated Teaching Methods

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Differentiation is the process whereby teachers meet the need for progress through the curriculum by selecting appropriate teaching methods to match the individual students' learning strategies within a group situation (Visser 1993). Different learners need to be taught in different ways and different learners take different amounts of time to get to a set or a required standard (Carroll, 1971). This means that even the most "mathematically gifted" learners can be hindered by inadequate mathematics education. A majority of mathematical disorders experienced by individuals with average or superior intelligence are exclusively caused by failure to acquire mathematical fundamentals in school. Worldwide, mathematics has the highest failure rates, and lowest average grade achievements. Almost all students, regardless of school type or grade, cannot perform in numeracy on par with their intellectual abilities. This is not surprising because sequential mathematical instruction requires a perfect command of acquired fundamentals. The slightest misunderstanding makes a shaky mathematical foundation. Because such a minute fraction of the intellectual potential is utilized, scientists believe that even the worst mathematics performances can be improved considerably using compensatory strategies and appropriately organized instructions to remediate the deficiencies (CTLM 1986, 52). Every student with a normal intelligence quotient can learn to communicate mathematically, if taught appropriately. Curricula in the pre-school should focus on the different learning styles or "mathematical learning personalities" and the corresponding teaching methods that address each style (Sharma 1989). The researcher endeavored to authenticate the comments of Sharma and the Center for Teaching and Learning Mathematics by investigating the influence of differentiated teaching on the academic performance of learners with dyscalculia.

Effective teaching methods help learners with dyscalculia to reach the average standard of the class since these techniques are known to work well with them and they also work well with learners who have an average ability in mathematics (Tony 2002). No two students enter a classroom with identical abilities, experiences and needs. Learners with dyscalculia need a carefully designed teaching program that is structured to encourage active participation of all students because this makes mathematics a positive learning experience because number processes are very abstract and tedious. Learners with dyscalculia also, are only able to

understand learning processes by using concrete materials which make mathematical problem solving process transparent and clearer but regardless of the individual differences of learners, they are expected to master the same concepts, principles and skills in the regular conventional curriculum (Butterworth 2003).

Differentiated teaching methods allow support teachers to take diverse student factors into account when planning and delivering numeracy lessons. This is because learners with dyscalculia often find abstract calculation very difficult and if they can be able to understand and link several mathematical concepts to real life situations; this can make a big difference to the way they learn numeracy. Visual imagery and language are important parts of internal mathematical thinking and the connection of mathematical concepts with real objects and events helps to trigger a visual image which helps to make arithmetical sense faster. Students learn best when they make connections between the curriculum content at their level of cognition (Geary, 2004). Greatest learning occurs when students are pushed slightly beyond the point where they can work without assistance (Jennipher 2005) and as such, teaching instructions should be differentiated using the curriculum content, the process and activities of delivery, the expected lesson outcome and by manipulating the learning environment. Jennipher further suggests that the support given to learners with dyscalculia by the support teachers provides several learning options which make them to be able to easily make sense out of the concepts and skills taught in a conventional classroom and Dunn further suggests that, positive effects occur when instruction is matched to learning styles of the learners (Dunn 1996).

The use of multi-sensory lessons helps learners with dyscalculia to understand and to remember mathematical concepts more clearly because, multi-sensory approach of teaching helps to provide vivid associations of two or more senses (say hearing and seeing). This in turn helps the memory of the dyscalculics to attach meanings to otherwise arbitrary words and symbols in an easy way. A multisensory teaching method like VAKT (Visual Auditory Kinesthetic Tactile) help learners with learning difficulties to remember and apply key words used in a numerical statement (John 2008).

Numeracy, more than any other subject is hierarchical, and it is therefore important for learning support teachers to ensure that learners with dyscalculia acquire essential skills and concepts as

they go along. Any teaching method used to help learners with dyscalculia must be meaningful and directed towards purposeful learning and that the instruction provided must be conducive for each learner's needs, ability levels and success of progress. In VAKT lessons, visual relates to seeing what the teacher is doing, auditory has to do with listening skills of the learner and kinesthetic tactile has to do with the skills of feeling on the part of the learner. If learners do not associate values with numerals they may not go on to understand place value and if they do not understand multiplication, they may not remember the related facts. Some students however, might require more explicit teaching style of the principles of counting, meanings of number symbols, memorizing, checking and monitoring procedures of number work to fully understand numeracy (Tony 2002). To effectively teach the entire class, the elements of both learning styles must be integrated and accommodated and to teach with one style exclusively is to leave out a great many students. If mathematical concepts are not matched to students' cognitive and skill levels, then failure will inevitably result, and the child will be forced into a position of needing remedial services to overcome their academic deficiency in mathematics (Sharma 1989).

Effective monitoring of skills and understanding is essential in the learning process of dyscalculics. This is because if knowledge gaps are not identified and addressed properly during the introduction of number processes, difficulties may accumulate and spill over to the lessons in higher classes. This results in compounding a child's difficulties and can lead to negative experiences in the classroom that create a fear of failure and anxiety. Multi-sensory teaching recognizes that the traditional approach, which involves the teacher explaining and the pupil listening, is unlikely to be a very effective approach of teaching learners with dyscalculia. This is due to the fact that, during the lesson, the learner uses one sense only and this may lead to poor understanding of the concepts and as such, the student should be taught in a way that involves the simultaneous use of at least two or more senses (Butterworth 2003).

Reasoning helps learners with dyscalculia to use logic and have good verbal skills with poor spatial skills. Learning number facts related to patterns and relationships are more likely to be effective to the learners because they provide a reliable means of checking and generalizing what they have learnt. Teachers should therefore understand the ways in which learners better understand number work because the art of explaining why mathematical procedures work and when to use them helps students to apply them correctly in different situations (Dowker 2003).

Shalev and Gross (1993) notes that dyscalculia tends to be associated with a negative self-image to a learner. They point that, anything that builds confidence and self-esteem to learners would certainly be helpful. They therefore suggest that, the interactive whole-class teaching recommended in the National Numeracy Strategy (UK) can actually disadvantage dyscalculic learners because it causes them profound embarrassment when they are unable to answer a question or are unable to demonstrate how they worked out a particular solution. Building secure knowledge and understanding at the required pace, they note, is an important teaching method because it ensures enjoyable learning as well as providing a safe environment where learners can take risks in problem solving processes. They further note that, learners with dyscalculia need a focused, one-to-one teaching in order to support them fully in a normal conventional classroom (Shalev and Gross-Tsur, 1993). From the opinions and the comments made by the above mentioned authors, the researcher identifies a knowledge gap which he hope to fill by investigating the influence of differentiated teaching methods on the academic performance of learners with dyscalculia.

2.5 Differentiated Teaching Resources

According to the Wikipedia Free Encyclopedia, Assistive Technology (AT) includes assistive and rehabilitative devices for students with learning difficulties. It also includes the process used in selecting, locating, and using them. Cook and Hussey (2002) points that, AT promotes a greater independence to learners by enabling them to perform tasks that they were formerly unable to accomplish, or had great difficulty accomplishing; by providing enhancements to, or changing methods of interacting with the devices needed to accomplish such tasks (Cook and Hussey 2002). Assistive devices include computer software of customizing graphical user interfaces to alter the colors and size of desktops, short-cut icons, menu bars and scroll bars and according to Behrman (2001), other devices include screen magnifiers, screen readers, self-voicing applications, Text-to-speech and Speech-to-text devices and Grammar checkers (Behrman M 2001). Jane (2010) says that AT can be used to support learners with dyscalculia to cope with the requirements of learning numeracy in a conventional class. She points that recorded lessons are clearer and a learner with this difficulty is able to comprehend what is being taught easily without being intimidated. She also states that, videotaped lessons and demonstration aids would help learners with dyscalculia to make better connections of the

number processes to real life situations because, demonstration aid is useful in making number sense and it boosts easy understanding of abstract number processes (Jane 2010).

Instructional materials, curriculum, teaching styles, assessment procedures, and other facets of a school may be more advantageous to members of some students and disadvantageous to others. As a result teachers may misalign learning opportunities if they use the same materials and procedures with all students because this can undermine the academic success of students for whom the materials and procedures are not a match (Fisher and Berliner 1980). From the information given by these authors, there exists a knowledge gap of establishing whether differentiated teaching and learner resources influence the academic performance of learners with dyscalculia.

2.6 Adjusted tests and assessments

Sharma (1989) states that, differences in cognitive ability affect the students' ability and understanding of specific mathematical concepts. He therefore points that a teacher must not base evaluations of learning mastery, solely on a child's ability to arrive at a correct answer but on the level of cognition, and the strategies the student uses to get to the answer. He further suggests that, the teacher must interview the student on how he reasons through the problem and how he got a wrong answer because there may be a legitimate reason (Sharma 1989). Jane (2009) on the other hand says that, carefully planned adjustments to examinations are necessary in order to produce a more level playing field to all cadres of students in a school set up. She however states that, this must be combined with academic rigour so that assessments or tests are equitable and any unfair advantage or preferential treatment is eliminated (Jane 2009).

According to the Open University of the UK (2005) in a project carried out between 2003 and 2005, reasonable adjustments on assessments and tests are a useful strategy for supporting a learner with a learning difficulty. The adjustments may include providing additional time (say 25% of the total time) for the examination where the teacher also ensures that no penalties are given for poor number processes unless these are being directly assessed and are core to an understanding of the course. According to the findings of this project, other reasonable adjustments to the assessment include changes to the physical environment in which a test is

being taken and also altering the sequence of the examination so that a student with dyscalculia for example, does not have to sit two three-hour numeracy examinations in a day and instead, he should do them on alternative days and at different venues if possible. The project further found that some assessment adjustments may take long to arrange and implement and as such, the adjustment procedures may need to be discussed well in advance with the examination bodies that run and conduct examinations so that the necessary arrangements can be effected.

Findings of the project further pointed that adjusted assessments should include clearly phrased examination questions that use short and unambiguous expressions. The instructions and any other supporting materials used in examinations should also be availed to students in appropriate alternative formats and reading instructors should ensure that the students fully understand what is being asked. This was to be done with an aim of helping learners with learning difficulties to fully demonstrate their knowledge, skills and abilities in examinations. In exceptional circumstances however, the findings suggested that, it may be possible to justify making no adjustment at all to some examination papers so as to maintain the academic standards. Where the core learning outcomes of a course module are aimed at achieving external professional standards for example, no adjustments may be warranted. Finally the research findings of this project recommended that, care must be taken when adjusting assessments because extreme flexibility or open-ended arrangements are likely to be unhelpful and may even be counterproductive. The comments of the authors and the research findings leave a knowledge gap to be filled on whether adjusted assessments and tests influence the academic performance of learners with dyscalculia.

2.7 Differentiated tasks and classroom assignments

Gardner (1983) says that there is a relationship between a students' achievement and a teacher's ability to diagnose the students' skill level and prescribe appropriate tasks and class assignments (Gardner 1983). Jensen (1998) suggests that more effective learning takes place when the amount of task structure provided by a teacher matches a student's level of development (Jensen 1998). On the same note, Byrnes (1996) states that, when students with learning disorders encounter tasks which are structured at moderate levels of difficulty, they are more likely to sustain their efforts to learn even in the face of difficulty than when tasks are too difficult or

under-challenging (Byrnes 1996). Chinn (2004) further points that, learners with dyscalculia are easily intimidated by questions that involve memorizing facts and as such they prefer a choice of tasks that reflect a variety of steps that lead to the desired outcome (Chinn, 2004/

Yeo (2004) on the other hand says that learners with dyscalculia usually work well at a slower pace using simplified learning materials. He further points that, these learners need a little longer to learn; one-to-one explanations and specialized strategies to cope with the assignments (Yeo, 2004). Bird (2007) states that, learners should be given tasks with varied examples so that the support teacher can work effectively with them (Bird 2007). Savage and Hawkes on the same thought suggest that, learners with dyscalculia must be encouraged to read, hear, say, see and touch examples in the given tasks and this is clearly realized when tasks are set using the multi-sensory approach (Savage and Hawkes 2000). The knowledge gap presented by these authors' comments and findings requires an in-depth investigation as to whether differentiated tasks and classroom assignments influence the academic performance of learners with dyscalculia.

2.8 The Conceptual Framework:

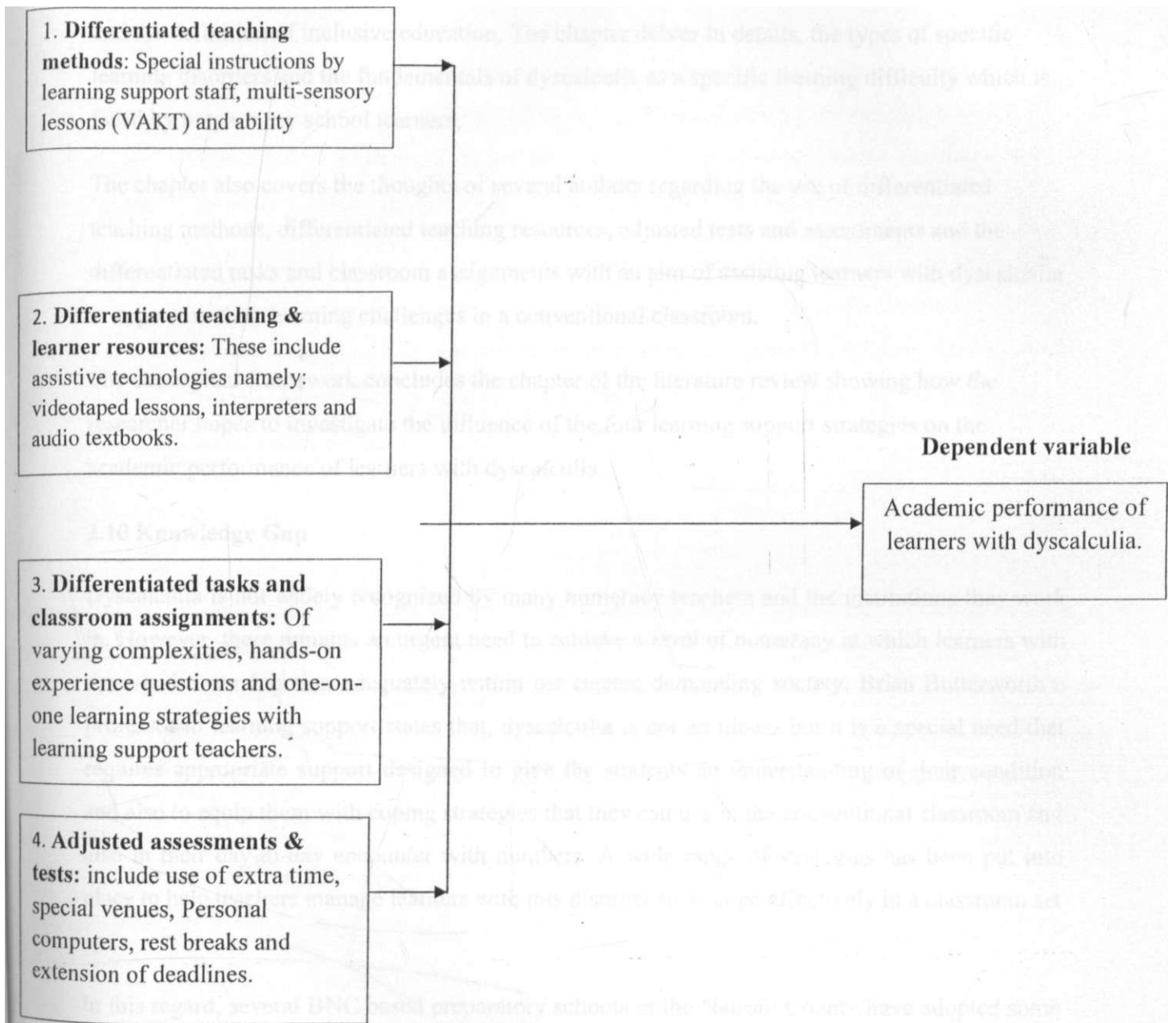
The conceptual framework is based on the learning support strategies which have been adopted by some BNC based preparatory schools in the Nairobi County. The support strategies are the independent variables whose influence to the academic performance of learners with dyscalculia is being investigated. These learning support strategies include: the differentiated teaching and learner resources, differentiated teaching methods, adjusted tests and assessments and the differentiated tasks and classroom assignments.

Parents' and guardians of learners with dyscalculia play an important role towards the successful implementation of the support program in schools. Their cooperation and attitudes and also their cultural inclinations on learning support are useful in realizing the successful implementation of the support program for learners with dyscalculia. The support of the board of directors is considered crucial for effective equipping of the Learning Support Units in schools.

The dependent variable of the study is the performance of learners with dyscalculia in their numeracy tests and classroom assignments. Academic performance is generally defined in terms of the scores achieved in numeracy tests and the reduction of the number of errors a learner with dyscalculia makes in the mathematical problem solving process.

Figure 2.1: The Conceptual Framework

Independent variables



2.9 Summary of the Literature Review

The chapter on Literature Review is generally based on the introduction of learning difficulties and the definition of inclusive education. The chapter delves in details, the types of specific learning disorders and the fundamentals of dyscalculia as a specific learning difficulty which is faced by preparatory school learners.

The chapter also covers the thoughts of several authors regarding the use of differentiated teaching methods, differentiated teaching resources, adjusted tests and assessments and the differentiated tasks and classroom assignments with an aim of assisting learners with dyscalculia to cope with their learning challenges in a conventional classroom.

The conceptual framework concludes the chapter of the literature review showing how the researcher hopes to investigate the influence of the four learning support strategies on the academic performance of learners with dyscalculia.

2.10 Knowledge Gap

Dyscalculia is not widely recognized by many numeracy teachers and the institutions they work in. However, there remains an urgent need to achieve a level of numeracy at which learners with dyscalculia can function adequately within the current demanding society. Brian Butterworth a professor in learning support states that, dyscalculia is not an illness but it is a special need that requires appropriate support designed to give the students an understanding of their condition and also to equip them with coping strategies that they can use in the conventional classroom and also in their day-to-day encounter with numbers. A wide range of strategies has been put into place to help teachers manage learners with this disorder so as cope effectively in a classroom set up.

In this regard, several BNC based preparatory schools in the Nairobi County have adopted some of the support strategies with the hope of improving the academic performances of learners with dyscalculia. There is therefore a knowledge gap that exists as to whether the challenges of dyscalculia can effectively be addressed by the use of these differentiated teaching support strategies. The researcher endeavors to investigate the influence of these strategies on the academic performance of learners with dyscalculia in their numeracy tests and assignments.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter dealt with the aspects involved in collecting data that the researcher used as the basis for his research findings, conclusions and the relevant recommendations that have been submitted at the end of this study.

In general, the chapter on research methodology included the research design, the study area, the target population, the sample and the sampling technique, the research instrument used for collecting data, the validity of the research instrument, the reliability of the research instrument, the data collection procedure, the operationalisation of the variables and the data analysis technique that the researcher used.

3.2 Research Design

The researcher used descriptive statistics based on factor analysis to analyze the collected data. Factor Analysis is a statistical approach that can be used to analyze interrelationships among a large number of variables and to explain these variables in terms of their common underlying dimensions (factors). This statistical approach involves finding a way of condensing the information contained in a number of original variables into a smaller set of dimensions with a minimum loss of information. The technique provided an analysis and an explanation of the opinions and comments of the numeracy teachers who teach mathematics in the selected BNC based preparatory schools in the Nairobi County.

The main purpose of this study was to investigate the influence that learning support strategies adopted by these preparatory schools have on the academic performance of learners with dyscalculia. Factor analysis design was suited for this study because of the structured nature of the questionnaires used. When this design is used, inferences can be used for the study and the researcher sought to obtain information that describes the existing phenomena. He did this by asking the respondents (numeracy learning support teachers) about their perceptions, opinions and attitudes towards the influence of learning support strategies they used on the academic performance of learners with dyscalculia as far as their training and experience is concerned.

The respondents were expected to fill the questionnaires which were both quantitative and qualitative in nature. The quantitative section of the questionnaire enabled the researcher to get responses of the same questions from a number of respondents so that the responses can be quantified for the purposes of drawing the conclusions from them (Bell, 1993). The qualitative section of the questionnaires on the other hand was meant to enable the researcher to collect data in the actual context so that findings and conclusions about the study are made based on the situation on the ground.

3.3 Study Area and the Target Population

Target population is defined as all numbers in a real or hypothetical set of people, events or objects to which the researcher wishes to generalize the results of his research (Borg and Gall 1977). The thirty learning support teachers who work in the numeracy support departments (LSU) of the BNC based preparatory schools in the Nairobi County ideally formed the researcher's target population.

It is important to note that, the proximity of these schools to the city helped to give a bigger variation of the students' enrolment than it would be in other institutions found in the other parts of the country. The researcher also selected these schools due to the fact that they have well established Learning Support Units (LSU) for effective management of learners with dyscalculia.

3.4 Sample and Sampling Technique

Cluster sampling was used as a basis of selecting the numeracy support teachers from the selected BNC based preparatory schools in the Nairobi County. According to Mugenda and Mugenda (1999), this method involves the selection of an intact group where all the members of the group are to be included and act as a unit of observation. Twenty numeracy support teachers in these BNC based preparatory schools in Nairobi were selected using purposive sampling so that their responses would be used to represent the general view regarding the influence of learning support strategies to the academic performance of learners with dyscalculia as it is the case with the Nairobi BNC based preparatory schools. This is in line with Mugenda (1999) assertions that, there are times when the target population is so small such that selecting a sample would be meaningless and that taking the whole population in such cases would be advisable.

The formula for finding the sample size of the number of the numeracy teachers involved in the research study was defined as follows;

$$S = \frac{X^2 NP (1 - P)}{d^2 (N - 1) + X^2 P (1 - P)}$$

Where,

S = required sample size of 20 numeracy teachers.

N = the given population size of 4 BNC based preparatory schools.

P = population proportion (assumed to be 0.50, as this magnitude yields the maximum possible sample size required).

d = the degree of accuracy as reflected by the amount of error that can be tolerated in the fluctuation of a sample proportion **p** about the population proportion **P** - the value for **d** taken as 0.05 in the calculations for a certain number of entries.

X² = Table value of chi square for one degree of freedom relative to the desired level of confidence, mostly 0.95 confidence level.

3.5 Research Instruments

The main research instrument in this study was the questionnaire. This instrument was specifically prepared for the numeracy teaching support teachers who work in the selected BNC based preparatory schools in the Nairobi County. The main purpose of the instrument was to seek the experience, knowledge and skills that these numeracy teachers have concerning the influence the learning support strategies they adapt have on the academic performance of learners with dyscalculia.

The questionnaires further sought to find the opinions of the numeracy teachers in regard to the influence of differentiated teaching and learner resources, differentiated teaching methods (methods of instruction), differentiated tasks and classroom assignments, adjusted tests and assessments and the support given by parents of learners with dyscalculia to their academic

performance. The questionnaires' design was based on the understanding that the numeracy support teachers have the necessary training to handle the learners with dyscalculia.

The questionnaire had three sections. Section one sought to establish the profile of the numeracy support teachers. Section two sought to determine the extent to which the objectives of the study influence the academic performance of learners with dyscalculia as far as the support teachers are concerned. The extent was rated using the following scores: Very high (5), High (4), Moderate (3), Low (2), Very low (1) and None (0).

Section three was made up of open ended questions that sought to give the numeracy support teachers of numeracy freedom to express their personal views about them through comments and suggestions. "

It is worth noting that the questionnaires which are both open ended and closed ended helped the researcher to obtain the responses he wanted as fronted by Orodho, (2003) which was the comprehensive information regarding the influence that the learning support strategies have on the academic performance of learners with dyscalculia.

3.6 Validity of the research Instruments

Validity can be defined as the degree to which results obtained from the analysis of data actually represent the phenomena under study (Mugenda, 1999). The instrument of a questionnaire has been adopted in Kenya from the foreign sources and therefore its validity needs to be tested. Codican (1996) said that an instrument takes a valid measurement if the measurement does what it is intended to do in the study.

A pilot study was conducted to check if the information on the questionnaire was clear and well understood using four Jearning support teachers as is explained clearly articulated in chapter four of this study. Bell (1993) states that, the purpose of a pilot exercise is to get the defects out of the instrument so that the respondents do not experience difficulties in completing it and so that one can carry out a preliminary analysis to see whether the format of the question is in order for accurate data analysis.

3.7 Reliability of the research Instruments

Seamus and Hegarty (1982) states that the reliability of a research instrument has to be tested so as to find out if it will bring out the required information especially if it was designed in an area foreign from where the study is being conducted (Seamus and Hegarty 1982).

To test the reliability of the questionnaire, a pilot study was carried out using four selected BNC based preparatory school numeracy teachers. The pilot study was aimed at achieving the expected reliability of the questionnaire. The four selected numeracy teachers were required to fill the questionnaires so as to establish the reliability of the questionnaire. The four teachers were then omitted from the data collection process of the main study so as to uphold the required ethics of the research. The researcher personally administered the questionnaires to the selected teachers with a view, of identifying areas that needed changing in the wording of the items in the questionnaire. The researcher then collected the filled questionnaires so as carry out a reliability test. The overall reliability of the study of the research instrument according to Cronbach's Alpha on the twenty eight items on the questionnaire was found to be 0.916. Since this value is well over the required minimum of 0.7, the instrument was therefore deemed reliable.

Table 3.8 Operationalisation of variables:

Objectives	Independent Variables.	Indicators	Measurement	Measuring Scale	Type of Analysis	Tools of Analysis
1. Establish how differentiated teaching methods influence the academic performance of learners with dyscalculia.	i. Readers and inscribers for special instructions	No. of inscribers and readers	Positive response to questions	Ordinal	Factor	Mean/Percentage
	ii. Multi-sensory lessons like VAKT	No of hours/week	Score increases and errors reduce	Nominal	Factor	Mean/Percentage
	iii. Ability grouping arrangement	No of times a student is placed				
2. Establish how the use of differentiated teaching resources influences the academic performance of learners with dyscalculia.	i. Audio-visual textbooks	No of books available.	Copies available	Nominal	Factor	Mean
	ii. Differentiated smart boards aids.	No of boards used	Pieces available	Nominal	Factor	Mean
	iii. Visual aids like maps, charts and solids.	No of aids used in a class	Pieces in a class	Nominal	Factor	Mean
	iv. Audio equipments like cassette players.	Regular use of the equip. in a class.	Pieces in a class	Nominal	Factor	Mean
3. Establish the influence of adjusted assessments and tests to the academic	i. Extra time for examinations	Increase of time by a certain	Time in minutes	Nominal	Factor	Mean
	ii. Rest Breaks	Breaks	Time in	Nominal	factor	Mean

performance of learners with dyscalculia.	during examinations. iii.Extended deadlines for handing in numeracy term papers and projects.	included in timetable Extensions indicated on term papers	minutes Time in weeks	Nominal Nominal		
4. Establish the extent to which differentiated teaching tasks and classroom assignments influence the academic performance of learners with dyscalculia.	i.Tasks of varying complexities. ii.Hands-on-experience questions. iii.One on one style of answering questions.	No of steps in solution process. No of questions on paper. Availability of support teacher during lesson	No of steps expected Actual no of question. No. of minutes the teacher assists	Ordinal Ordinal Ordinal	Factor	Mean
Academic performance of learners with dyscalculia in numeracy.	Dependent Variable	Reduction in errors and performance score.	No of errors and marks	Nominal	Factor	Percentage.

3.8 Data Collection Procedures

The researcher sought permission to carry out the study in the selected BNC based preparatory schools from the respective heads of the Learning Support Units. This was done through a formal letter and by calling with an aim of getting the numeracy support teachers to fill the questionnaires. Valid questionnaires were then administered to the numeracy support teachers of the selected BNC based preparatory schools in the Nairobi County. The heads of the learning support units were requested to coordinate the exercise of filling the questionnaires. The exercise took approximately three weeks after which the researcher personally picked them from the respondents in readiness for data analysis.

3.9 Data Analysis Techniques

The data was analyzed using the quantitative and qualitative methods. According to Semakula (2000), quantitative data analysis entails numbers about a situation which are selected by choosing specific aspects of the situation under study.

The questionnaire administered to the learning support teachers of the selected BNC based preparatory schools contained both quantitative and qualitative data. The quantitative data from sections one of the questionnaires was analyzed using descriptive statistics where measures like frequency and percentages and the relevant implication of these values was noted. According to Gay (1976), frequency tables, simple statistical measures like means and percentages are used when the researcher has an intention of communicating research findings to the stakeholders in an easy manner.

The qualitative data from section two of the questionnaire was analyzed using the factor analysis. This is an approach that is primarily used to analyze interrelationships among a large number of variables and to explain these variables in terms of their common underlying dimensions (factors). The statistical approach is also involved in finding a way of condensing the information contained in a number of original variables into a smaller set of dimensions with a minimum loss of information. Higher levels of the measures would indicate a relatively great influence of the mentioned variable(s) on the academic performance of learners with dyscalculia and vice versa.

Section three of the questionnaire was based on the comments of the numeracy support teachers regarding thjp items mentioned below. Their responses were analyzed qualitatively using the factor analysis design. This was done with an aim of gauging the influence differentiated teaching and learner resources, differentiated numeracy curriculum, and differentiated teaching methods, adjusted assessments and tests, adjusted numeracy marking schemes and the support from the schools board of directors had on the performance score and reduction in errors in the numeracy tasks and assignments for the learners with dyscalculia.

The general trend of the results and research findings of the various items in the study instrument provided the clues to the research questions that the study sought answers for and fully analyzed data formed the basis of the research findings, conclusions and the relevant recommendations as articulated in chapter five of this study.

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CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.1 Introduction:

This chapter presents the summary of findings, the analysis and the interpretation of data collected in the study with the aim of establishing whether learning support strategies used in some selected BNC based preparatory schools in the Nairobi County influence the academic performance of learners with dyscalculia.

The researcher developed a questionnaire for numeracy support teachers so as to enable him to come up with wholesome data for the research purposes. The researcher administered the questionnaires to four selected teachers for piloting purposes first. The four teachers were selected using purposive sampling for piloting purposes so as to establish the validity of the questionnaire as a research instrument.

The pilot study carried out was aimed at achieving the reliability of the research instrument. These four members of staff were then omitted from the study so as to uphold the ethics of the study. The overall reliability of the study of the research instrument according to Cronbach's Alpha on the twenty eight items on the questionnaire was found to be 0.916. Since this value is well over the required minimum of 0.7, the instrument was therefore deemed reliable.

In general, this chapter presents the findings of the study starting with the analysis of the profiles of the numeracy teachers using descriptive statistics realized from the data collected in section one of the questionnaires. This is followed by an in-depth analysis of data in section two of the questionnaire using factor analysis and its suitability for this kind of data. This data is based on the comments made regarding the rating of the extent to which learning support strategies influence the academic performance of learners with dyscalculia by the twenty learning support numeracy teachers involved in the research study.

The last part of this chapter presents the findings and the analysis of the comments made by the respondents in section three of the questionnaire. The comments were based on the influence that differentiated teaching and learner resources, differentiated numeracy curriculum programs, differentiated methods of instructions, adjusted numeracy tests, adjusted marking schemes and

the support accorded by the schools' board of directors and parents have on the performance score and the reduction of errors in the numeracy assignments of learners with dyscalculia. This part also presents the summary findings and general discussions for the research that the study sought to find answers for.

4.2 Profile of the respondents

Section one of the questionnaire was designed to assess the demographic characteristics, training and numeracy teaching experience of the respondents. The summary of findings for the profile of all the twenty respondents is presented in Table 4.1 given below using descriptive statistics.

Table 4.1: Profile of the Respondents

Variables		Frequency	Percentage
Gender	Male	16	80
	female	4	20
	Total	20	100
Professional training	Yes	11	55
	no	9	45
	Total	20	100
Workshop/seminar training	Yes	15	75
	no	5	25
	Total	20	100
Numeracy Teaching Grades	Lower preparatory	3	15
	Upper preparatory	12	60
	Both upper and	2	10

		lower		
		missing	3	15
		Total	20%	100
Experience teaching Numeracy	ii	1-3 years	4	20
		4-6 years	3	15
		7-9 years	4	20
		Over 10years	8	40
		missing	1	5
		Total	20	100

As shown in Table 4.1, there are more male (80%) respondents than female respondents (20%). 55% of the respondents have professional training on handling learners with dyscalculia while 44% did not have any professional training. 75% of the respondents have attended workshops/seminars/training on handling learners with dyscalculia while 25% of the respondents reported not to have had any .

In terms of numeracy teaching grades of the respondents, upper preparatory is the largest (60%) followed by lower preparatory (15%) and both upper and lower preparatory (10%). 15% of the respondents did not disclose their numeracy teaching grades.

Table 4.1 further reveals that 40% of the respondents have experience of over 10 years teaching numeracy, followed by those with experience of between 7-9 years (20%) and 1-3 years (20%). The respondents with 4-6 (15%) years of experience were the smallest group and 5% of the respondents did not reveal their levels of experience.

4.3 Factor Analysis

Section two of the questionnaire was designed to assess the rate at which differentiated teaching and learner resources, differentiated teaching tasks and classroom assignments, differentiated teaching methods and differentiated assessments and tests influenced the academic performance of learners with dyscalculia. The summary of findings for the data in this section is presented using factor analysis.

Factor Analysis is a statistical approach that can be used to analyze interrelationships among a large number of variables and to explain these variables in terms of their common underlying dimensions (factors). This statistical approach involves finding a way of condensing the information contained in a number of original variables from section two of the questionnaire into a smaller set of dimensions with a minimum loss of information (Field, 2005). There are two types of factor analysis:-

Principal component analysis which is a method that provides a unique solution, so that the original data can be reconstructed from the results. It looks at the total variance among the variables. The solution generated will include as many factors as there are variables although it is unlikely that they will all meet the criteria for retention;

The second one is Common factor analysis. This family of techniques uses an estimate of common variance among the original variables to generate the factor solution. Because of this, the number of factors will always be less than the number of original variables.

In this research, the principal component analysis with varimax rotation was used to analyze the data using SPSS version 11.5. The results of the analysis are presented in Table 4.1, 4.2 and 4.3 given below. The results comprised of tests carried out on the quantitative data on section two of the questionnaire including Cronbach's Alpha and Factor Analysis.

4.3.1 Statistical Assumptions of Factor Analysis and Preliminary Analysis.

Statistical assumptions of factor analysis and preliminary analysis as used in the study include the fact that:-

Factor Analysis is a linear procedure and any non-linearity can bring a problematic solution. Therefore, careful examination of any departures from linearity is necessary. The smaller the

sample size, the more important it is to screen data for linearity. This assumption was met in line with the kind of data collected by the questionnaire.

Most significance statistics build on the normal distribution, so it is usual for the common underlying distribution to be normally distributed. The dependent variable should be normally distributed for each combination of the independent variables. The dependent variable for this study is the academic performance of learners with dyscalculia and it is considered to have a normal distribution. The smaller the sample size; the more important it is to screen data for normality. Moreover, as factor analysis is based on correlation (or sometimes covariance), both correlation and covariance will be attenuated when variables come from different underlying distributions for example a normal versus a bimodal variable with a correlation less than 1.0 even when both series are perfectly co-ordered. Nonetheless, normality is not considered as one of the critical assumptions of factor analysis.

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Since factors are linear functions of measured variables, homoscedasticity of the relationship is assumed. The researcher should test to assure that the residuals are dispersed randomly throughout the range of the estimated dependent variable. The lack of homoscedasticity may mean that; there is an interaction effect between a measured independent variable and an unmeasured independent variable not in the model; or that some independent variables are skewed while others are not. However, homoscedasticity is also not a critical assumption of factor analysis.

Outliers are a form of violation of homoscedasticity, which can impact correlations heavily and thus distort factor analysis. To deal with outliers, they are removed from the analysis and explained on a separate basis, or transformation may be used which tend to "pull in" the outliers. One may use mahalanobis distance to identify cases which are multivariate outliers, then remove them from the analysis prior to factor analysis. One can also create a dummy variable set for cases with high mahalanobis distance, and then regress this dummy on all other variables. If this regression is non-significant, then the outliers are judged to be at random and there is less danger in retaining them. The ratio of the beta weights in this regression indicates which variables are most associated with the outlier cases. Transformations include the square root, logarithmic, and inverse ($x = 1/x$) transformations. No case was detected as a multivariate outlier in the data collected for this study.

Factor interpretations and labels must have face validity and/or supported by theory because it is difficult to assign valid meanings to factors. For the same set of factor loadings, one researcher may label a factor "work satisfaction" and another may label the same factor "personal efficacy," for instance. A recommended practice is to have a panel not otherwise part of the research project and assign one item to one factor label. A rule of thumb is that at least 80% of the assignments should be correct.

There are several methods to determine the appropriateness for applying factor analysis to a data set. First, it is important to inspect whether the correlation matrix is appropriate for factor analysis. The researcher must look for correlations that are great than 0.3. If several values in the correlation matrix exceed 0.3 then it is appropriate to use factor analysis. The anti-image correlation matrix is used to assess the sampling adequacy of each variable. Only variables with sampling adequacy greater than minimal acceptable significant level of 0.5 are included in the analysis. Both Bartlett's test of Sphericity and Kaiser-Meyer-Olkin measure of sampling adequacy were used to determine the factorability of the matrix as a whole. If Bartlett's test of Sphericity is significantly large among some of the variables, and Kaiser-Meyer-Olkin index is greater than 0.5 then the factorability is assumed.

The exclusion of relevant variables and the inclusion of irrelevant variables in the correlation matrix being factored will affect, often substantially, the factors which are uncovered. Although social scientists may be attracted to factor analysis as a way of exploring data whose structure is unknown, knowing the factorial structure in advance helps select the variables to be included and yields the best analysis of factors. This dilemma creates a chicken-and-egg problem because it is not just a matter of including all relevant variables. Also, if one deletes variables arbitrarily in order to have a "cleaner" factor solution, erroneous conclusions about the factor structure will result.

Underlying dimensions shared by clusters of variables are assumed because if this assumption is not met, the "garbage in, garbage out" (GIGO) principle applies. Factor analysis cannot create valid dimensions (factors) if none exist in the input data. In such cases, factors generated by the factor analysis algorithm will not be comprehensible. Likewise, the inclusion of multiple definitionally-similar variables representing essentially the same data will lead to tautological results.

Absence of high multicollinearity was assumed because some researchers employ factor analysis precisely because measured indicators display multicollinearity, whereas the factors based on them will be orthogonal. On the other hand, multicollinearity increases the standard error of factor loadings, making them less reliable and thereby making more difficult the process of inferring labels for factors. To avoid this, some researchers advocate the combining of collinear terms or elimination of collinear terms prior to factor analysis. Other researchers go so far as to advocate foregoing factor analysis in the face of multicollinearity, instead of simply picking the most meaningful of the collinear indicators, admitting multicollinearity, and proceeding with analysis with the comfort of knowing just what the selected indicator represents rather than having to rely on a factor whose exact meaning is difficult to assess. To detect multicollinearity in a factor analysis, KMO statistics may be used, or data may first be screened in regression analysis using variance inflation factor (VIF) or tolerance. KMO statistics and correlation matrix were used in this study to detect multicollinearity and collinear terms were eliminated prior to factor analysis.

Singularity in the input matrix, also called an ill conditioned matrix, arises when two or more variables are perfectly redundant. Singularity or no perfect multicollinearity prevents the matrix from being inverted and prevents a solution. All variables that exhibited singularity in this study especially in the section two of the questionnaire were dropped from factor analysis.

Prior to conducting factor analysis on the collected data, it was considered useful to check the reliability of the scale used to confirm that the scale used consistently reflect the scale they are measuring. The most common measure of scale reliability is Cronbach's Alpha. This test was run on the quantitative data and the result of Cronbach's Alpha demonstrated an alpha of 0.85. The result of 0.85 is acceptable within a normal context of statistical test where the general guideline says that an alpha value above 0.7 indicates good reliability.

Kaiser Meyer Olkin (KMO) and Bartlett's Test of Sphericity tell us about the appropriateness of running factor analysis on this kind of data. The former measures sampling adequacy while the latter is a test of sphericity. Bartlett's test of sphericity is a test statistic that examines the hypothesis that the group variances are the same and that dependent variables are uncorrelated in the population. The KMO statistic varies between 0 and 1. A value of 0 indicates that the sum of partial correlations is large relative to the sum of correlations, indicating diffusion in the pattern

of correlations (hence, factor analysis is likely to be inappropriate). A value close to 1 indicates that the patterns of correlations are relatively compact and so factor analysis should yield distinct and reliable factors. Values of 0.5 are barely acceptable, values between 0.5 and 0.7 are considered mediocre while values between 0.8 and 0.9 are good values. Finally, values above 0.9 are considered excellent. For this data the set value is 0.54, which falls into the range of being mediocre; so factor analysis is appropriate for the data collected for this study. Another condition to assess the appropriateness of running factor analysis is to ensure that Bartlett's test of sphericity is significant (that is $p < 0.05$) and table 4.2 given below presents the results of the statistical test on this data which support the use of factor analysis.

Table 4.2 Results of KMO and Bartlett's test of sphericity

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.547
Bartlett's Test of Sphericity	Approx. Chi-Square	89.949
	Degrees of freedom	36
	Sig.	.000

On the basis of the acceptable result reported above, factor analysis was done. The principal components were computed using a correlation matrix based on the assumption that the variables were not comparable or standardized.

Factor analysis was run on the sample. The extraction method used is Principal Component Analysis (PCA) with Varimax rotation method. In running factor analysis on the sample, not all factors are retained in the analysis. References need to be made to the eigenvalue and Scree Plot of the data. An eigenvalue of 1.0 is used to identify the number of factors at this stage of analysis. The eigenvalues associated with each factor represent the variance explained by that particular linear component and SPSS also displays the eigenvalues in terms of the percentage of

variance explained (so, factor 1 explains 29.25% of total variance). It should be clear that the first few factors explain relatively large amounts of variance (especially factor 1) whereas subsequent factors explain only small amounts of variance. SPSS then extracts all factors with eigenvalues greater than 1, thus leaving three factors. The eigenvalues associated with these factors are again displayed in the columns labeled *extraction sums of squared loadings*. The values in this part of the table are the same as the values before extraction except that the values for the discarded factors are ignored. Hence the table is blank after the fifth factor. In the final part of the table labeled *rotation sums of the squared loadings*, factors after rotation are displayed. Rotation has the effect of optimizing the factor structure and one consequence for these data is that the relative importance of the three factors is equalized.

Table 4.3 below presents how the items were grouped to three factors based on selection criteria of an eigenvalue greater than 1.0. This preliminary analysis resulted in a solution of three factors selected for further analysis and one factor being dropped. The factors that were selected included the differentiated teaching methods, differentiated teaching and learner resources and the adjusted assessments and tests. The factor of differentiated tasks and classroom assignments was dropped as the eigenvalue was less than one.

Table 4.3 Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.633	29.253	29.253	2.633	29.253	29.253	2.292	25.472	25.472
2	2.473	27.478	56.731	2.473	27.478	56.731	2.196	24.405	49.877
3	1.489	16.545	73.276	1.489	16.545	73.276	2.106	23.399	73.276
4	.916	10.173	83.449						
5	.686	7.623	91.072						
6	.505	5.614	96.686						
7	.137	1.523	98.209						
8	.095	1.051	99.260						
9	.067	.740	100.000						

extraction Method: Principal Component Analysis.

In addition to analysis of eigenvalue, an inspection of the Scree Plot can also give a useful insight to the relative importance of each factor. Typically in Scree Plot there would be a few factors with higher eigenvalues and many factors with relatively lower eigenvalues. Figure 4.1 presents the Scree Plot derived for the data collected in this study.

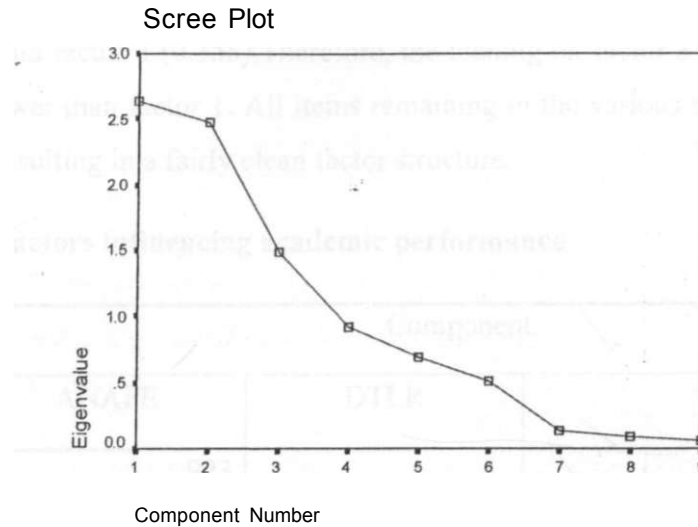


Figure 4.1 Scree Plot

The cut-off point for selecting factors should be at the inflexion point of the curve. As can be seen in Figure 4.1, the clearest point of inflexion would be at component (factor) number 4 and subsequently the graph starts to tail off. However, references need to be made to both the eigenvalue and Scree Plot of the data. Field (2005) explained that Kaiser (1960) recommended that all factors with eigenvalue greater than 1 should be retained and consequently, three factors (independent variables) have been retained for this study based on the results of the eigenvalue analysis shown in Table 4.3.

The rotated component matrix (RCM) was examined for items in the section two of the questionnaire which did not load strongly on any factor (<0.4), or were too complex (which loaded highly or relatively equally on more than one factor). This resulted in nineteen items being dropped leaving nine items for the analysis of the data collected in the questionnaire. The above factors (found in section two of the questionnaire) are further tested with the varimax rotation method. The factor rotation matrix will group the scales which are most highly loaded (correlated) with the first factor and arranged in descending order to their size of correlation. Next, scales which load strongly with the second factor will be clustered to form the second factor, and the process will continue for all the three factors. The result of the rotated solution is presented in Table 4.4 and the results indicate that all the scales exhibit factor loading above 0.5. Normally, researchers accept a loading of an absolute value of more than 0.3 to be important. In the circumstances where the scale has an acceptable loading of more than one factor, one of

these loadings can be reduced to the factor with the highest value. In this study, ANAFE6 loaded on factor 1 (0.879) and factor 3 (0.355). Therefore, the loading on factor 3 is eliminated because the value is much lower than factor 1. All items remaining in the various scales loaded together on the target factor resulting in a fairly clean factor structure.

Table 4.4 RCM on factors influencing academic performance

	Component		
	ANAFE	DTLR	DTM
anafe5	.923		
anafe6	.879		.355
anafe3	.767		
dtlr3		.909	
dtlr4		.908	
dtlr5		.660	
dtm6			.905
dtm5			.881
dtm2			.503

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a Rotation converged in 5 iterations.

Table 4.5 Scales for factor analysis

- ANAFE3 Effect of personal computers in examinations for pupils with dyscalculia over and above the regular examination arrangements on the performance score in their assessment and tests.
- ANAFE5 Effect of having rest breaks during examinations for pupils with dyscalculia over and above the regular examination arrangements on the performance score in their assessment and tests.
- ANAFE6 Effect of having rest breaks during examinations for pupils with dyscalculia over and above the regular examination arrangements on reduction of errors in their assessment and tests.
- DTLR3 Effect of using differentiated smart boards and other teaching aids for pupils with dyscalculia over and above regular teaching materials on performance score in their tasks and classroom assignments
- DTLR4 Effect of using differentiated smart boards and teaching aids for pupils with dyscalculia over and above regular teaching materials on reduction in errors in their tasks and classroom assignments
- DTLR5 Effect of using visual aids e.g. maps, number charts and 3-dimensional aids for pupils with dyscalculia over and above regular teaching materials on performance score in their tasks and classroom assignments
- DTM2 Effect of using special instructions for pupils with dyscalculia over and above regular classroom teaching methods on reduction in errors in their tasks and classroom assignments
- DTM5 Effect of using ability grouping for pupils with dyscalculia over and above regular classroom arrangement on the performance score in their tasks and classroom assignments
- DTM6 Effect of using ability groupings for pupils with dyscalculia over and above

regular classroom arrangement on reduction of errors in their tasks and classroom assignments

4.3.2 Findings and Interpretation of the Factors

From Table 4.4, the scales listed under factor 1 comprised of scales related to adjusted numeracy assessments and tests (ANAFE3, ANAFE5 and ANAFE6). Therefore, the scales grouped under factor 1 can be described as adjusted numeracy assessments and tests. The second factor is loaded by three scales, which are DTLR3; DTLR4 and DTLR5. These scales represent the differentiated teaching and learner resources. Finally, three scales (DTM2, DTM5 and DTM6) loaded on factor three relate to differentiated teaching methods.

Multiple Regression analysis is a statistic technique used to investigate the relationships between a dependent variable and one or more independent variables. Simple linear and multiple linear regressions are the most common regression models applied. Multiple linear regression was used in this study to investigate the relationship between academic performance and the three independent variables in the section two of the questionnaire that emerged from the principal component analysis.

This model includes academic performance as the dependent variable (AP), and adjusted numeracy assessments and tests (ANAFE), differentiated teaching and learner resources (DTLR) and differentiated teaching methods (DTM) as the independent variables. Table 4.6 given below shows the results obtained from the multiple regression analysis and as shown, adjusted numeracy assessments and tests is the strongest predictor of academic performance ($p = 0.67$, $p=0.000$). This is followed by differentiated teaching methods ($P = 0.495$, $p=0.000$). Differentiated teaching and learner resources is the weakest ($P = 0.474$, $p=0.000$). All the relationships were statistically significant ($p<0.001$). However differentiated teaching tasks and classroom assignments did not emerge from the results of factor analysis and was not included in the regression model.

Table 4.6 Coefficients of factors

Model		Unstandardized Coefficients		Standardized Coefficients	Sig.
		B	Std. Error	Beta	
1	(Constant)	3.228E-15	.000		1.000
	ANAFE	1.000	.000	.670	.000
	DTLR	1.000	.000	.474	.000
	DTM	1.000	.000	.495	.000

a Dependent Variable: A_j

4.4 Findings for the comments of respondents

Section three of the questionnaire was designed to assess the comments of the numeracy support teachers. Overall there was a positive influence on the academic performance of learners with dyscalculia with regard to the comments summarized as follows;-

Regarding the use of differentiated teaching and learner resources, the respondents agreed that this factor increases performance score and reduces errors by effectively distinguishing students with different learning abilities thus increasing personalized attention, by providing resources according to the learner's level and ability and by breaking down the assignments into manageable tasks for the learners.

For the availability of a reliable and an up-to-date differentiated numeracy curriculum, most of the respondents commented that there was no set curriculum content that was differentiated for learners with dyscalculia. They however felt that, a differentiated curriculum would help learners with dyscalculia to capture information as well as instructions more accurately. This would help to cut down on errors at the initial stage of learning; the learners would become fully informed on the latest developments as well as in their regular assessments and evaluations. Finally the support teachers would be able to plan and control their work effectively and hence improve the academic performance of learners with dyscalculia.

For the effective use of differentiated methods of instruction in a conventional classroom, the respondents felt that, this would encourage and assist learners in understanding the concepts clearly, it would improve the learners levels of accuracy, it would make the learning process interesting by capturing the learners' attention, it would expose learners to multiple methods of learning, it would cater for individual strengths and weaknesses and it would also ensure that tasks are assigned to the learners in terms of their capabilities. This would have an overall effect of improving the academic performance of learners with dyscalculia.

For the use of adjusted numeracy assessments and tests, the respondents felt that, this factor helped in reducing errors in the problem solving process and in improving performance scores of learners with dyscalculia. This was because; actual level of the learners at different times was assessed, feedback to the learners and teachers on the effectiveness of the instruction methods was provided and the learners' confidence was effectively boosted.

According to the respondents, the use of adjusted marking schemes for assessments and tests motivated learners with dyscalculia. This is because the learners felt that this would be tailored to their learning needs.

Most of the respondents reported that there was little support from their mother institutions through the school's board of directors, parents and guardians of the learners but they agreed that supporting conditions-make learners with dyscalculia to feel appreciated and encouraged and hence motivated to learn.

4.5 Summary of findings for the research questions

The findings of the study as guided by the four research questions were as follows:

1. Differentiated teaching and learner resources influence academic performance of learners with dyscalculia.
2. Differentiated teaching methods influence the academic performance of learners with dyscalculia.
3. Adjusted numeracy assessments and tests influence the academic performance of learners with dyscalculia.

4. Differentiated teaching tasks and classroom assignments have no influence on the academic performance of learners with dyscalculia.

Overall, differentiated teaching and learner resources, differentiated teaching methods and differentiated assessments and tests have a significant influence on the academic performance of learners with dyscalculia. Differentiated assessments and tests was the highest indicator of influence on the academic performance of learners with dyscalculia.

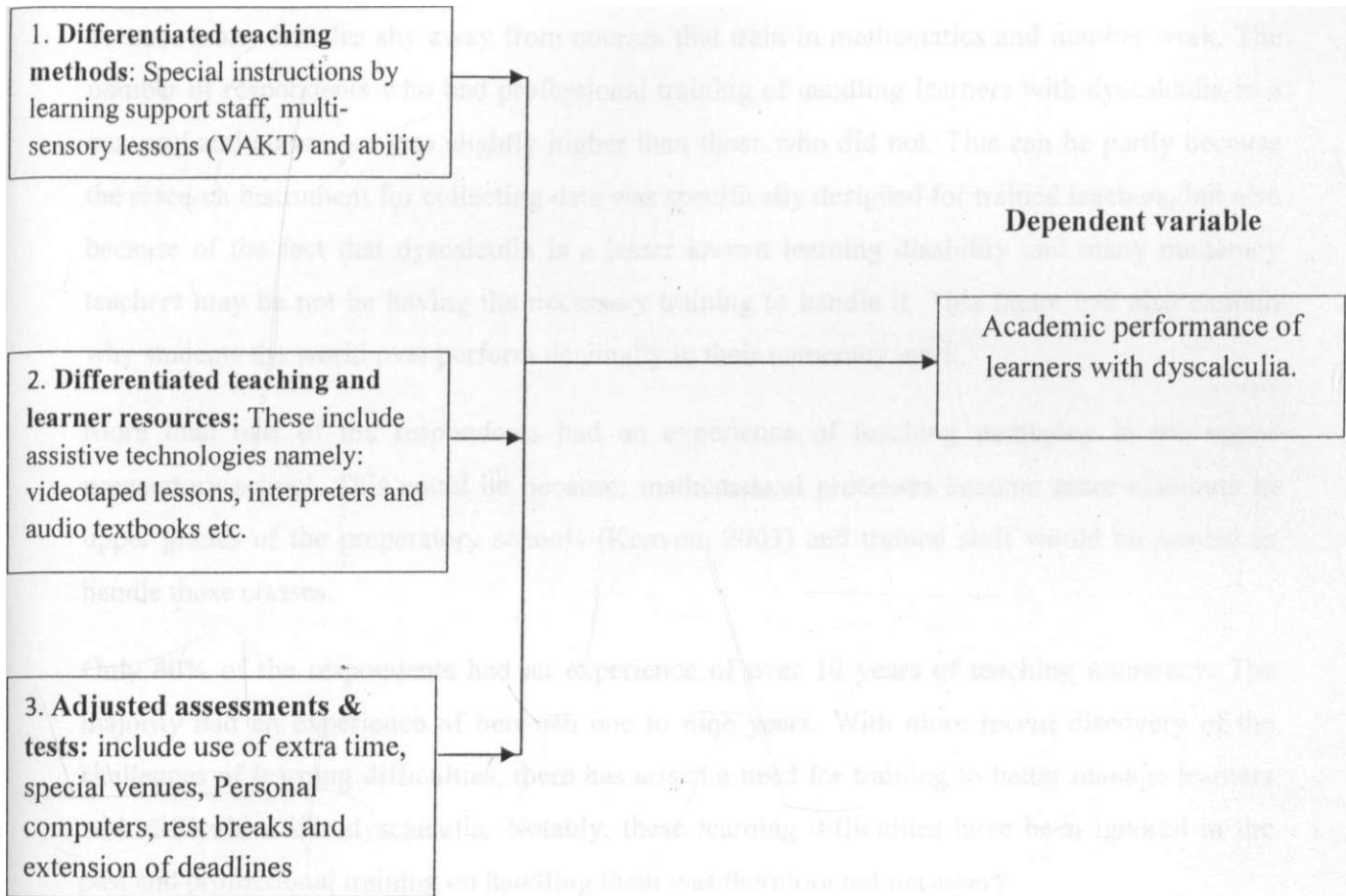
It was however noted that differentiated tasks and classroom assignments did not have any influence on the academic performance of learners with dyscalculia. This is because, as seen in Table 4.6, all the relationships were statistically significant ($p < 0.001$) nevertheless, differentiated teaching tasks and classroom assignments did not emerge from the results of factor analysis and was not included in the regression model.

The researcher therefore came up with a new conceptual framework given below that reflects the general findings for the research questions. Notably the independent factor of differentiated tasks and classroom assignments does not influence the academic performance of learners with dyscalculia and as such it is omitted from the framework.

The result clearly indicates that differentiating tasks and classroom assignments for learners with dyscalculia in a conventional classroom is not a worthwhile exercise and as such, more energy should be channeled to differentiating teaching methods and also in adjusting assessments and tests so as to realize the full potential of the learners. These factors have far more reaching effects according to the study in as far as supporting learners with dyscalculia is concerned.

Fig 4.2: The flow conceptual framework

Independent variables



4.6 Discussion of the Results for the Study

From the results of the study, there were more male respondents than females. This could be because many females shy away from courses that train in mathematics and number work. The number of respondents who had professional training of handling learners with dyscalculia in a conventional classroom was slightly higher than those who did not. This can be partly because the research instrument for collecting data was specifically designed for trained teachers, but also because of the fact that dyscalculia is a lesser known learning disability and many numeracy teachers may not be having the necessary training to handle it. This factor can also explain why students the world over perform decimally in their numeracy work.

More than half of the respondents had an experience of teaching numeracy in the upper preparatory school. This could be because; mathematical processes become more elaborate in upper grades of the preparatory schools (Kenyon, 2003) and trained staff would be needed to handle those classes.

Only 40% of the respondents had an experience of over 10 years of teaching numeracy. The majority had an experience of between one to nine years. With more recent discovery of the challenges of learning difficulties, there has arisen a need for training to better manage learners with difficulties like dyscalculia. Notably, these learning difficulties have been ignored in the past and professional training on handling them was therefore not necessary.

From the research questions 1-4, it is clear that differentiated assessments and tests had the greatest influence and as such it was the strongest predictor of the academic performance of learners with dyscalculia. This is could be because; numeracy teachers may be limited on ways of assessing the progress of the learners other than using marked tests. This can also be explained by the fact that, adjusted tests ensures that actual levels of a learner are assessed at different times and the teachers have adequate feedback for the appropriate course of action.

Differentiated teaching methods and use of differentiated learner resources was also noted to have a significant influence on the academic performance of these learners. This may be explained by the fact that the challenges posed by dyscalculia to a learner are manageable. This is also in line with the comments of Carroll (1971) who said that different learners need to be taught in different ways and time to get to a required standard. With differentiated teaching

methods like the use of VAKT lessons, there is an exposure to multiple methods of learning a factor that makes learning interesting and appropriate for a learner with challenges of a learning disorder.

The variable of differentiated tasks and classroom assignments did not have any significant influence on the academic performance of learners with dyscalculia. This could be because adjusted assignments may have extreme flexibility leading to counter productivity and also lacking the expected objectivity.

There was no reliable and up to date differentiated numeracy curriculum for learners with dyscalculia according to the study. This can be explained by the fact that dyscalculia is a lesser known learning disorder as compared to other well documented disorders like dyslexia. Due to this, there is also no personalized education plan for a learner with dyscalculia as it is the case with say a dyslexic within the conventional schools.

The respondents also reported that they got little or no relevant support from the schools board of directors and also from the parents and guardians of learners with dyscalculia. This could be because, dyscalculia has not been formally accepted as a challenge to students in many conventional schools and most parents and guardians and even teachers have tended to classify these learners as low academic achievers.

Another reason for this scenario could be the prohibitive costs of the assistive technology required in a modern learning support unit in a preparatory school. The board may feel that there are more pressing needs like sports equipment, laboratory gadgets and infrastructure as compared to readers or differentiated smart boards which are expensive to install.

The preparatory schools in the Nairobi County that have well established learning support units for learners with dyscalculia are very few. The researcher got respondents from four BNC based preparatory schools. This could be because few learners go through proper diagnosis to ascertain whether they have the disorder or not and also few conventional schools invest effectively for the expected support system for these kinds of learners. Table 4.7 given below gives the summary of the results and findings from the study. Table 4.8 given further below gives the summary of the academic performance of learners with dyscalculia according to different strategies used by teachers to support them. Differentiated assessments and tests is the biggest predictor.

Table 4.7 Summary of the results from the Study

Purpose	Test	Result
To assess the demographic characteristics, training and numeracy teaching experience of the respondents.	Descriptive Statistics	There were more male respondents than females. Those who had professional training of handling learners with dyscalculia were more and most of the respondents had a teaching experience of between one to nine years.
Investigate the influence of differentiated teaching and learner resources on the academic performance of a learner with dyscalculia	Factor Analysis	There was a significant influence on the academic performance.
Investigate the influence of differentiated teaching methods on the academic performance of a learner with dyscalculia	Factor Analysis	There was a significant influence on the academic performance.
Investigate the influence of adjusted assessments and tests on the academic performance of a learner with dyscalculia	Factor Analysis	There was a significant influence on the academic performance and this was also the strongest predictor in this influence.
Investigate the influence of differentiated tasks and classroom assignments on the academic performance of a learner with dyscalculia	Factor Analysis	There was no significant influence on the academic performance.

To assess the general comments of the numeracy support teachers

Factor
Analysis

Differentiated teaching and learner resources ensure personalized attention and assignments are broken down to manageable levels according to the learner's ability of conceptualizing. Availability of a reliable and up-to-date differentiated numeracy curriculum helps the learners to capture information more accurately and teachers are able to deliver more effectively. Effective use of differentiated methods of instruction helps the learners to achieve a high level of accuracy in their problem solving process. Use of adjusted numeracy tests, assessments and marking schemes ensures that actual level of learners is assessed at different times and feedback on the effectiveness of delivery of the teachers is realized.

Support by the schools board of directors, parents and guardians of learners with dyscalculia though little, but yet it would go a long way in ensuring that the learners feel appreciated and more of the support resources would be availed to the Learning Support Units.

Table 4.8 Summary of results of Academic performance

Variable	Indicator	Academic Performance (%)	Interpretation
Differentiated Assessments and Tests	Use of personal computers in tests	50	Helps in gaining high grades
	Rest breaks and added time	90	Learners are able to complete the tests
Differentiated teaching and learner Resources	Use of differentiated smart boards	65	Makes the lessons clearer in class
	Use of visual aids like number charts and shapes	85	Makes learners to understand due to different approaches used
Differentiated teaching Methods	Use of special instructions and instructors	33	Gives learners more confidence
	Use of ability groupings in a conventional classroom	85	Helps learners to learn at their own manageable pace.

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides the summary of the study; conclusions deduced from the findings of the study and the recommendations the researcher suggests for possible action and for further research.

5.2 Summary of the study

The study was mainly set to up to investigate the influence of learning support strategies that some selected BNC based preparatory schools in the Nairobi County have adopted on the academic performance of learners with dyscalculia.

With regard to the learning support strategies, four independent variables were investigated.

These strategies include; differentiated teaching and learner resources, differentiated teaching tasks and assignments, differentiated teaching methods and adjusted numeracy assessments and tests.

To achieve the goal of the study, four research questions were adopted by the researcher so as to investigate fully the influence if any, that the four learning support strategies may have on the academic performance of learners with dyscalculia. The four research questions include;

1. Do differentiated teaching methods influence the academic performance of learners with dyscalculia?
2. Does the use of differentiated teaching and learner resources influence the academic performance of learners with dyscalculia?
3. To what extent do adjusted numeracy assessments and test influence the academic performance of learners with dyscalculia?
4. Do differentiated tasks and classroom assignments influence the academic performance of learners with dyscalculia?

To realize the goal of the study, the researcher extensively reviewed literature based on inclusive education and how it has impacted on the accommodation of learners with difficulties in the school mainstream of learning. The researcher also reviewed literature based on Specific Learning Difficulties that are experienced by students in their learning process, mathematical disorder referred to as dyscalculia, comments of several authors about differentiated teaching methods, differentiated teaching and learner resources, adjusted assessments and tests, and the differentiated tasks and classroom assignments. The researcher also drew a relationship of the influence that differentiated methods, differentiated teaching and learner resources, adjusted assessments and tests and differentiated tasks and classroom assignments have on the academic performance of learners with dyscalculia by the use of a conceptual framework. He concluded by stating the study gap for which he felt the study would hopefully fill.

While collecting data, the researcher used mainly ex-post-facto (Survey design) research to examine relationships in the independent variables namely the use of differentiated teaching methods, differentiated teaching and learner resources, adjusted assessments and tests and differentiated tasks and classroom assignments in retrospect. This is because; he did not hope to manipulate the variables. The target population comprised of the numeracy support teachers based in some selected BNC based preparatory schools in the Nairobi County.

To obtain the sample of these numeracy support teachers, the researcher employed purposive sampling and also simple random sampling procedures. The study used the questionnaire for the numeracy teachers. These questionnaires were first pre-tested using a pilot study involving four numeracy teachers who were henceforth excluded from the main study. The purpose of the pilot study was to identify any inadequate and ambiguous items so as to realize its reliability. Validity of the questionnaire was ascertained by the Cronbach's Alpha analysis on the quantitative data and the result demonstrated an alpha of 0.85. The result of 0.85 is acceptable within a normal context of statistical test where the general guideline says that an alpha value above 0.8 also indicates good reliability.

The research instrument which in this study was a questionnaire had three sections. Section one sought to establish the profile of the numeracy support teachers. Section two sought to determine the extent to which the objectives of the study influenced the academic performance of learners with dyscalculia in as far as the support teachers are concerned. The extent was rated using the following scores: Very high (5), High (4), Moderate (3), Low (2), Very low (1) and None (0). Section three was made up of open ended questions that sought to give the support teachers of numeracy freedom to make their comments regarding the items given in regard to their influence on the academic performance of learners with dyscalculia.

The collected data was then analyzed using descriptive statistics, factor analysis and multiple regression analysis. In the descriptive statistics, frequencies, percentages and means were used to analyze the data based on the profile of the respondents. Factor analysis and multiple regression analysis were employed for the data based on the rate of contribution of the four independent variables on the influence of the academic performance of learners with dyscalculia. Multiple regression analysis was particularly useful in the investigation of the relationship between academic performance which was the dependent variable of the study and the three independent variables that emerged from the principal component analysis.

5.3 Findings and discussions of the profile of the respondents

From the analysis done on the data collected from the profile of the respondents it was clear that there were more male (80%) respondents than female respondents (20%). It is therefore clear that few female teachers take up the challenge of teaching numeracy in the Nairobi County Schools. 55% of the respondents have professional training on handling learners with dyscalculia while 44% did not have any professional training. 75% of the respondents had attended workshops/seminars whose training is based on handling learners with dyscalculia while 25% of the respondents reported not to have had any.

In terms of numeracy teaching grades of the respondents, upper preparatory had the largest bulk(60%), followed by lower preparatory (15%) and both upper and lower preparatory returned (10%). 15% of the respondents did not disclose the numeracy grades they teach.

The analysis further reveals that 40% of the respondents have experience of over 10 years in teaching numeracy, followed by those with experience of between 7-9 years (20%) and 1-3 years

(20%). The respondents with 4-6 (15%) years of experience were the smallest group while 5% of the respondents did not reveal their levels of experience.

5.4 Findings and discussions on the rating by respondents

The numeracy support teachers involved in this study felt strongly that adjusted numeracy assessments and tests rated the highest in contributing towards the academic performance of learners with dyscalculia in the selected BNC based preparatory schools in the Nairobi County. It was also clear that very few if any felt that differentiated tasks and classroom assignments had any contribution towards the academic performance of learners with dyscalculia.

According to the multiple regression analysis carried out on the data in section two of the questionnaire, adjusted numeracy assessments and tests was the strongest predictor of academic performance with ($P = 0.67$, $p=0.000$), followed by differentiated teaching methods with ($P = 0.495$, $p=0.000$) and, finally differentiated teaching and learner resources was the weakest with ($P = 0.474$, $p=0.000$). All the relationships were statistically significant ($p<0.001$). However differentiated teaching tasks and classroom assignments did not emerge from the results of factor analysis and as such it was not included in the regression model.

5.5 Findings and discussions on the comments of the respondents.

The comments of the respondents concerning the influence of differentiated teaching and learner resources were that they had a positive influence on the academic performance of learners with dyscalculia. This is because all learning abilities, appropriate learning resources and assignments were ensured.

Effective use of differentiated methods of instructions in a conventional classroom, use of adjusted numeracy assessments and tests and use of adjusted numeracy marking schemes had a very positive influence towards the academic performance of learners with dyscalculia.

The respondents however commented that there was little support from the board of directors, parents and guardians of learners with dyscalculia. They also commented that there was no set differentiated curriculum for numeracy that catered for learners with dyscalculia. This notwithstanding, they felt that the availability of a differentiated numeracy curriculum would

help the learners with dyscalculia to capture instructions more accurately and hence reduce on the number made on the problem solving process.

5.6 Conclusions of the Study

The following conclusions of the study were drawn in regard to the four independent variables under investigation on their influence on the academic performance of learners with dyscalculia. According to the in-depth analysis carried out on the data collected for the study, it was clear that differentiated teaching and learner resources, differentiated teaching methods and adjusted assessments and numeracy tests had a significant influence on the academic performance of learners with dyscalculia. However, it was also clear that differentiated teaching tasks and classroom assignments did not have any influence on the academic performance of learners with dyscalculia.

5.7 Recommendations of the Study

The following areas have been identified for recommendations according to the findings observed from the study.

It was observed that adjusted numeracy assessments and tests greatly influenced the academic performance of learners with dyscalculia. Numeracy support teachers should therefore endeavor to differentiate assessments and tests in a conventional classroom so as to cater for learners who struggle with the mathematical disorder of dyscalculia. The support teachers should also look out for various ways of differentiating tests so as to realize the full potential of learners with dyscalculia in their academic pursuit.

The study further advocates for more use of differentiated teaching methods as well as use of differentiated teaching and learner resources which also have a big influence on the academic performance of learners with dyscalculia. The use of VAKT lessons and more assistive technology would therefore be of great use in helping learners with dyscalculia to cope with the challenging in the school's learning process. It is therefore recommended highly that schools invest on the teaching resources like the assistive technology gadgets like readers and others so as to adequately cater for learners with dyscalculia.

It was noted from the profile analysis of the respondents that just about half (45%) of those who were interviewed have had no professional training towards the expected handling of learners with dyscalculia in a conventional classroom. The researcher therefore recommends highly that numeracy support should go for professional training in terms of in-service courses or seminars so as to be fully prepared for the task of handling learners with dyscalculia in their classroom scenarios.

The school board of directors, parents and guardians of learners with dyscalculia were noted to have offered little support to the numeracy support teachers in their pursuit to help learners with dyscalculia to maneuver in the classroom set up. It is therefore recommended that sensitization forums on the need to accommodate and support learners with dyscalculia be organized more regularly in the conventional schools so that all stakeholders are involved in assisting these learners to cope with the challenges posed by dyscalculia to their learning process.

One of the challenges the researcher faced was to come up with a sizeable sample for collecting the kind of data required for this study was lack of enough schools with established learning support units. It is therefore recommended that learning support strategies should be expanded to many other schools so that many other learners with dyscalculia are helped to cope with their academic challenges. The number of trained numeracy support staff was also relatively low and as such proper training systems should be put into place.

The government through the ministry of education should invest more on screening procedures to make sure that all learners with learning difficulties are identified and appropriate assistance is availed promptly.

5.8 Recommendations for further research

The following areas are recommended for further research:

1. Further research should or could be conducted on the experiences that differentiated teaching strategies have learners at higher levels of secondary schools and that they would have if at all they were to be adopted in colleges and universities.
2. The attitude, background and medical history of a learner with dyscalculia should be fully investigated before recommending a certain type of a learning support strategy. This

would be necessary to eliminate chances of any other underlying disorder that may be affecting the normal learning of numeracy by a learner.

3. A research needs to be carried out to determine exactly when during the school life of a learner should the learning support strategies be adopted and at what time should the disorder be attended to medically.
4. The numbers of schools currently using these learning support strategies are far too few and there is need to sensitize as many stakeholders as possible so that the numerical life of many pupils is not put into jeopardy because of ignorance on this issue. A research study therefore needs to be carried out to ascertain why many conventional schools do not have laid down systems of supporting learners with dyscalculia.

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APPENDICES

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Appendix 1:

Introductory Letter to the Heads of Learning Support Units (Departments)

Dear respondent,

I am a post-graduate student at the University of Nairobi pursuing a Masters Degree in Project Planning and Management.

My study is based on the Influence of Learning Support Strategies on the Academic Performance of Learners with a learning difficulty in mathematics known as Dyscalculia. Academic performance in this case is defined in terms of the performance score in numeracy tests and classroom assignments and the reduction of errors by a learner with dyscalculia in his problem solving process.

I kindly request you to distribute the filling of these questionnaires by the trained numeracy support staff in your department.

The information provided will be treated with strict confidentiality and it will only be used for the intended purpose of this study. As such, the respondents should not write their names or any other personal identification on the questionnaire.

Your cooperation in this regard will be highly appreciated.

Thanking you in advance.

Yours sincerely,

Solomon Njeru Nyaga.

Appendix 2:

Questionnaire for Numeracy Learning Support Teachers

The information sought in this questionnaire is meant for research only. The sources will be kept confidential. Do not write your name or the name of the school anywhere on this questionnaire.

The questionnaire has three sections. Please respond to all sections appropriately.

SECTION 1:

Please tick appropriately using (V) in the boxes provided:

1. What is your gender? Male • Female •

2. Are you a professionally trained learning support teacher of numeracy?

Yes • No •

3 Please provide the following details about your pre-service training:

College	Year	Duration	Qualification
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4. Have you attended any in service seminar/ workshop or post-training course on handling learners with dyscalculia?

Yes • No •

5. If your answer to Q4 is yes, how long ago was your most recent training?

6. Which grades do you teach numeracy in your current school?

- (i) Lower Preparatory School •
- (ii) Upper Preparatory School •
- (iii) Both (i) and (ii) •

7. How many years have you taught numeracy using the learning support strategies?

- (i) 1-3 years •
- (ii) 4-6 years •
- (iii) 7-9 years •
- (iv) Over 10 years •

SECTION TWO:

Indicate how you rate the contribution of the listed items to the academic performance of learners with dyscalculia in your school.

A good academic performance is indicated by reduction in errors in student work or increase in scores (grades) in tests and assignments.

Rating	Very High	High	Moderate	Low	Very Low	None
Score	5 -	4	3	2	1	0

Indicate by circling the appropriate answer e.g. (3 for moderate

	Item						
A.	Differentiated Teaching and Learner Resources:						
1.	Effect of using Audio-Visual textbooks for pupils with dyscalculia over and above regular textbooks on the performance score in their tasks and assignments.	5	4	3	2	1	0
	Effect of using Audio-Visual textbooks for pupils with dyscalculia over and above regular textbooks on reduction in errors in their tasks and assignments.	5	4	3	2	1	0
2.	Effect of using differentiated smart boards and other teaching aids for pupils with dyscalculia over and above regular teaching materials on performance score in their tasks and assignments.	5	4	3	2	1	0
	Effect of using differentiated smart boards and teaching aids for pupils with dyscalculia over and above regular teaching materials on reduction in errors in their tasks and assignments.	5	4	3	2	1	0
3	Effect of using Visual aids e.g. maps, number charts and 3-dimensional aids for pupils with dyscalculia over and above regular teaching materials on	5	4	3	2	1	0

	performance score in their tasks and assignments.						
	Effect of using Visual aids e.g. maps, number charts and 3-dimensional aids for pupils with dyscalculia over and above regular teaching materials on reduction in errors in their tasks and assignments.	5	4	3	2	1	0
4	Effect of using Audio equipments including cassette players, personal computers and spellcheckers for pupils with dyscalculia over and above the usual teaching aids on performance score in their tasks and assignments.	5	4	3	2	1	0
	Effect of using Audio equipments including cassette players, personal computers and spellcheckers for pupils with dyscalculia over and above the usual teaching aids on reduction in errors in their tasks and assignments	5	4	3	2	1	0
B. Differentiated Teaching Tasks and classroom Assignments							
1	Effect of using tasks with varying complexities for pupils with dyscalculia over and above regular classroom assignments on the performance score in their tasks and assignments.	5	4	3	2	1	0
	Effect of using tasks with varying complexities for pupils with dyscalculia over and above regular classroom assignments on reduction in errors in their tasks and assignments.	5	4	3	2	1	0
2	Effect of using sums that require hands-on-experience for pupils with dyscalculia over and above regular classroom questions on the performance score in their tasks and assignments.	5	4	3	2	1	0
	Effect of using sums that require hands-on-experience for pupils with dyscalculia over and above regular classroom questions on reduction in errors in their tasks and assignments.	5	4	3	2	1	0

3	Effect of using one on one style of answering worksheet questions for pupils with dyscalculia over and above the regular classroom arrangement on the performance score in their tasks and assignments.	5	4	3	2	1	0
	Effect of using one on one style of answering worksheet questions for pupils with dyscalculia over and above regular classroom arrangement on reduction in errors' in their tasks and assignments. *	5	4	3	2	1	0
C.	Differentiated Teaching Methods:						
1	Effect of using special instructions e.g. use of readers and inscribers for pupils with dyscalculia over and above regular classroom teaching methods on the performance score in their tasks and assignments.	5	4	3	2	1	0
	Effect of using special instructions e.g. use of readers and inscribers for pupils with dyscalculia over and above regular classroom teaching methods on reduction in errors in their tasks and assignments.	5	4	3	2	1	0
2	Effect of using multi-sensory lessons e.g. VAKT for pupils with dyscalculia over and above regular classroom lessons on the performance score in their tasks and assignments.	5	4	3	2	1	0
	Effect of using multi-sensory lessons e.g. VAKT for pupils with dyscalculia over and above regular classroom lessons on reduction of errors in their tasks and assignments.	5	4	3	2	1	0
3	Effect of using ability grouping for pupils with dyscalculia over and above regular classroom arrangement on the performance score in their tasks and assignments.	5	4	3	2	1	0
	Effect of using ability grouping for pupils with dyscalculia over and above regular classroom arrangement on reduction of errors in their tasks and assignments.	5	4	3	2	1	0

D.	Adjusted numeracy assessments and tests:						
1	Effect of having extra time in examinations for pupils with dyscalculia over and above the regular examination arrangements on the performance score in their assessments and tests.	5	4	3	2	1	0
	Effect of having extra time in examinations for pupils with dyscalculia over and above the regular examination arrangements on reduction of errors in their assessments and tests.	5	4	3	2	1	0
2	Effect of personal computers in examinations for pupils with dyscalculia over and above the regular examination arrangements on the performance score in their assessments and tests.	5	4	3	2	1	0
	Effect of personal computers in examinations for pupils with dyscalculia over and above the regular examination arrangements on reduction of errors in their assignments and tests.	5	4	3	2	1	0
3	Effect of having rest breaks during examinations for pupils with dyscalculia over and above the regular examination arrangements on the performance score in their assessments and tests.	5	4	3	2	1	0
	Effect of having rest breaks during examinations for pupils with dyscalculia over and above the regular examination arrangements on reduction of errors in their assessments and tests.	5	4	3	2	1	0
4	Effect of extending deadlines for handing in numeracy term papers and projects for pupils with dyscalculia over and above the regular procedure on the performance score in their assessments and tests.	5	4	3	2	1	0
	Effect of extending deadlines for handing in numeracy term papers and projects for pupils with dyscalculia over and above the regular procedure on reduction of errors in their assessments and tests.	5	4	3	2	1	0

SECTION THREE:

Kindly comment on how the following items may influence the performance score and the reduction of errors in tasks and assignments given to learners with dyscalculia in your school.

1. Use of **differentiated teaching and learner resources**.

2. Availability of a reliable and up to date **differentiated numeracy curriculum program** e.g. use of **readers** and **inscribers**.

3. Effective use of **differentiated methods of instruction** in a conventional classroom.

4. Use of **adjusted numeracy tests and assessments** for assessment.

5. Use of **adjusted marking schemes** for numeracy tests and assessments where method marks are adequately awarded.

6. Support accorded by the school board of directors, parents and guardians of dyscalculics and learners with dyscalculia to the learning support unit of your school.

Thanking you.