

**LEARNING STYLES, AVAILABILITY, AND UTILIZATION OF
INSTRUCTIONAL MATERIALS AS CORRELATES OF GRADE 6
LEARNERS' MATHEMATICS PERFORMANCE IN BUFFALO CITY**

BY

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DECLARATION

I, Kemi Olajumoke Adu, student number 201510102, solemnly declare that this dissertation titled “Learning Styles, Availability, and Utilization of Instructional Materials as Correlates of Grade 6 Learners’ Mathematics Performance in Buffalo City” is my original work. All sources used or quoted in the study have been indicated and acknowledged by way of reference.

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Date 11/04/2020

DECLARATION ON RESEARCH ETHICS CLEARANCE

I, **Kemi Olajumoke Adu** student number **201510102**, hereby declare that I am fully aware of the University of Fort Hare Policy on Research Ethics, and that I have taken every possible precaution to comply with the regulations pertaining to it. I have obtained an ethical clearance certificate from the University of Fort Hare Ethics Committee, for which the reference number is **PYL021 SADU01**



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ABSTRACT

Mathematics is the foundation for the economic and technological development of any nation. It has been asserted that Mathematics is expected to help in accelerating social, economic and technological progress of any society. Performance of this subject is very important and there are different types of learners; such auditory, visual, and kinesthetic. Auditory learners appreciate listening to the teachers and sit down close to the teachers in class. Visual learners like to see things physically during teaching. They learn by materials like charts, graphs, and pictures. Kinesthetic learners learn by doing. Students can prefer one, two, or three learning styles; all these are subject to the availability of instructional materials. The Primary school level is very important in any educational system and any lack at this level would permeate to other levels of the educational system. Hence, this thesis examines the Learning Styles, Availability, and Utilization of Instructional Materials as Correlates of Grade 6 Learners' Mathematics Performance in Buffalo City. The study adopted the positivist paradigm and employed the quantitative approach in investigating the phenomenon. The thesis made use of correlational research design as it attempted to find out the effects of learning styles and instructional materials on learners' performance in Mathematics. Stratified sampling was used to select participants. Stratified sampling is a process of dividing the sample frame into strata to obtain relatively homogenous subgroups; this gave us 1225 Grade 6 learners selected across 35 schools in Buffalo City as the sample of the study. Three instruments which are Students' Learning Styles Scale (SLSS), Availability and Utilization of Instructional Materials Inventory (AUII), and Mathematics Achievement Test (MAT) whose reliability co-efficient are; 0.87, 0.78 and 0.89 respectively. The data collected were analysed using descriptive and inferential statistics. The findings of the study revealed among others; students learning style (visual, auditory, and kinesthetic) have a significant relationship on Grade 6 learners Mathematics performance ($B = -.113$, $t = -3.886$, $p < 0.05$). Students learning style ($\Delta R^2 = .012$, $\Delta F(1, 1223) = 5.047$, $p < 0.05$) emerged as the best predictor of Grade 6 learners Mathematics performance in Buffalo City, while the availability and utilization of instructional materials ($\Delta R^2 = .000$), $\Delta F(1, 1223) = .018$, $P > 0.05$), and gender ($\Delta R^2 = .000$, $\Delta F(1, 1223) = .036$, $p > 0.05$) emerged as better predictors. The study further

revealed that, Grade six learners with visual learning style ($\bar{x}$ = 13.242, SD = 5.565) had the best performance in Mathematics at Buffalo City, followed by learners with auditory learning style ($\bar{x}$ = 12.996, SD = 3.883), and learners with Kinaesthetic learning style ($\bar{x}$ = 11.525, SD = 3.800). The study concluded that one of the most fundamental issues to consider in improving Mathematics performance is the understanding of the learners' learning styles and effective use of appropriate instructional materials for teaching Mathematics.

Keywords: Availability, and Utilization of Instructional Materials, Grade six Learners, Learning Styles, Mathematics Performance.

DEDICATION

This thesis is dedicated to the glory of Almighty God and to my lovely husband and our children, Alice, Rachael, Paul and Silas.

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CHAPTER ONE

INTRODUCTION/BACKGROUND TO THE STUDY

1.1 INTRODUCTION/BACKGROUND TO THE STUDY

Technological and economic development of any country can be attributed to the knowledge of Mathematics. To fast-track the socio-economic and technological growth of any society, there is need for a solid foundation in Mathematics (Azuka, 2014). Mathematics is a science subject that is taught at any level of education. The inadequacy of this subject at tertiary level is a result of the weak foundation at primary school level. Therefore, primary school level is very essential in education system of any nation. (Kolawole, 2010). According to Michael (2013), Mathematics can be broadly interpreted as something a person does in order to solve real-life situations. It can also be likened to a tool to solve problems, such as in Science and Geography. There is an array of instructional materials that the teacher can choose from a primary school level for effective teaching and learning that will be appropriate for the level of the students (learners) being taught. These materials are germane, as they facilitate the teaching and learning process at whatever level of instruction (Michael, 2013).

From one continent to another, the teaching and learning of Mathematics vary. Therefore, the practice of Mathematics teaching and learning shall be briefly examined from different contexts. Instructional materials like textbooks, charts, graphs, workbooks, and pictures are among the most important artifacts in Mathematics education. “These materials should arouse students’ interest in learning Mathematics, help students to study Mathematics actively, develop students’ potential in creativity through the process of learning basic knowledge, improve students’ mathematical thinking when trying to understand the essence of Mathematics knowledge, and raise students’ awareness to apply Mathematics knowledge in everyday lives” (Lepik, 2015:6)

Instructional material is an integral part of teacher's daily activities, the selection of appropriate curriculum materials will eventually lead to effective use of pedagogy and assist in discharging the subject matter to learners. Teachers play a pivotal role in this context. They need to translate the use and implementation of the instructional material (textbook and other written resources) throughout the year while teaching to achieve the desired learning outcome (Adu, 2018). They provide ideas and practices, which frame classroom activity via text and diagrammatic representations (Adu, 2018). The written curriculum materials such as the textbook, worksheet, charts, graphs, calculator, marker, postcard, are available for use with the guidance of the teacher. Out of the written curriculum materials enunciated above, textbooks are most widely used since it is directly linked to the teaching and learning of any subject (Adu, 2018).

In general, the critical resources for learning of Mathematics content and Mathematics instructional decision making are called curriculum materials for Mathematics. These include: computer software, textbooks, geoboard etc. are of immense contribution to better performance of Mathematics across different level of education (Adu, Duku & Adu, 2016). Teachers are expected to be familiar and adapted to the use of these critical resources to guide their classroom instructions and daily activities. (Stein & Kim, 2009). There is, therefore, a sense in which the Mathematics textbook is used "as source of problem and exercises, as reference book, and as a teacher in themselves" (Adu, 2018). Mathematics textbooks are very important because most teachers depend on them for making decision on what to teach, how to teach, and what tasks and classwork to give to learners at different stages of classroom teaching. Therefore, we can agree that Mathematics textbooks can create challenges to both the teachers and learners.

Abidin, Rezaee and Abdullah (2011), described two groups of learners in their perpetual behaviour, these groups are intuitive and sensing learners, intuitive learners tend to be imaginative and abstract, such learners like to be innovative and do not like repetition. On the other hand, sensing learners are methodical and concrete; they like to do practical work facts memorizing and contented with

standards procedures and rules. Learners have different ways of receiving information, some verbal while some visual. The verbal learners prefer medium for information transfer. Receiving teaching in form of demonstration, diagrams, pictures, video and films are favoured by visual learners. Apart from visual and verbal learner, there are also active and reflective learners in another category. The active learner as the name implies like to be fully involved in classroom activities. They play an active role in group discussion and interacted, examining and employing knowledge with others. They benefit from role play, teamwork and dialogue. The reflective learners do have a deep thinking and employ self-examination. They are more disposed to contemplate on any perceived information.

Learning behaviours are determined by learning styles and this influences effective teaching and learning. The learning environment has a way of influencing the preference of learning style and behaviour exhibit by the learners. Learners have a different way of perceiving, interacting and respond to this environment (Abidin et al. 2011). Teachers need to be conversant with the features and characters displayed by their learners; they also need to examine the variations in their students on the features of their learning styles, because the information about learner's preference can help teachers become more sensitive to the differences learners bring to the classroom (Abidin et al. 2011). Adjustments can then be made to accommodate the learners' varied needs.

It has also been shown that in any learner, there are different hemispheres of the brain, which, contain different perceptions avenues. Different pattern of perception among the learners are because of the cells in their brain as claimed by some researchers (Iyunade, 2014). There are different types of learners, such auditory, visual, and kinesthetic. The auditory appreciate listening to the teachers and sit down close to the teachers in class. Visual learners like to see things physically during teaching. They learn by materials like charts, graphs, and pictures. Kinesthetic learners learn by doing. Students can prefer one, two, or three learning styles; all these are subject to the availability of instructional materials (Iyunade, 2014). Since there are different learning

styles, it is important for teachers to utilize instructional materials and integrate in their curriculum activities what is closely related to each of these learning styles so that all students are able to achieve the desired goals. Teachers must be able to use their professional prowess to accommodate learners with all these preferences in order to help all students learn (Cuaresma, 2008).

When we think about a typical classroom situation, it is rare to find all three of these approaches (visual, auditory and kinesthetic) to learning incorporated into a class. While it may seem impossible to do this, it can be done through teacher thoughtful planning and preparation. These force teachers to conceptualize the class differently with a focus on the variety of ways in which students learn. The various inventories of learning styles allow teachers to gain insight into which areas they can use further development in and which are already well developed (Cuaresma, 2008). One of the most significant improvements in education has come from a considerable amount of research done in the area of learning styles, which recognizes that the students in classrooms have a variety of different learning profiles. Some of the magnitudes, which have been investigated in the area of learning style, are perceptual learning styles, field dependence/independence, analytic/global learning styles, and reflective/impulsive learning styles. Some of the benefits of increasing learners' awareness of their own learning styles: "higher interest and motivation in the learning process, increased student responsibility for their own learning, and greater classroom community but little work could only be identified on the correlation of learning styles, instructional materials and learner academic achievement" (Cuaresma, 2008: 23).

Rawashdeh et al. (2010) explored learning styles in relation to academic success (achievement) and this study has pointed out an association amongst different learning styles and academic achievement in various subjects founded on various scales of learning styles. Adeyemo et al. (2013) found that the effect of learning styles on academic achievement correlates positively with high scores in Mathematics and Physics. Aljaberi (2015) conceded that learners exhibited a clear deficiency in mathematical problem-solving abilities and found that learners' ability to solve mathematical problems diverges in their learning styles.

There are many other studies in the relevant literature, which report the positive effects of considering learning styles in teaching and learning. Researchers and many scholars are of the opinion that one of the important factors in the learning process are learning styles. They succinctly described the facilitator of effective learning for learners is when learning styles are incorporated (Graf, Kinshuk & Liu, 2009:3). The availability of instructional materials and positive learning styles of the students can increase academic achievement and promote introspection of the students towards the content of the curriculum (Reid 2005:14; Sadeghi, Kasim, Tan & Abdullah, 2012:116). If students know their own learning styles and apply them to the learning process, these students should learn both more easily and more rapidly with the desired outcome duly achieved.

Another positive influence identified in the literature is that if students are expected to learn, retain complex information, become academically successful, be motivated to learn and to approach learning appropriately, identification of and responsiveness to their learning style preferences is necessary. This is especially true when the teachers' teaching styles do not match the learning styles of the students (Allcock & Hulme, 2010:67; Hlawaty, 2009:24; Romanelli, Bird & Ryan, 2009:2). Educational researchers and theorists mentioned above also generally agree that students learn in different ways. Therefore, it is important to consider the students' learning styles to help them learn more easily and effectively (Bostrom 2012:11; Kinshuk, Liu & Graf, 2009:740).

Other authors have also highlighted many positive effects that can be gained by considering learning styles in the classroom. Several authors (Orhun, 2013; Bostrom, 2012; Dunn & Dunn, 2011), stated that teachers become more enthusiastic to reflect on their professional philosophy of education when they are aware of the concept of learning style and that their learners possess different styles. These authors also add that teacher mindfulness is often sensitized to the point that it increases self-directed and autonomous learning. Regardless of the teachers' teaching style, learners need to accept responsibility of their own learning. The delivery of the subject matter is,

therefore, more value driven, personal, social justice and equity is promoted.

Several authors (Breckler, Teoh & Role, 2011:26; Duman, 2010:2078; Wang, Wang, Wang & Huang 2006:208) highlighted the fact that knowledge of learning styles and availability of instructional materials for Mathematics can help to improve instructional planning, lesson delivery and implementation of curriculum contents. They also believed that one of the significant factors that promote academic achievements is students' learning styles. (Wang *et al.*, 2006:208). Orhun (2007:323:331) supported this view by adding that when students are taught by means of approaches and the use of instructional materials that complement their learning styles, and when they become aware of their own learning styles, their academic achievements significantly increase. Other authors (Cagiltay, 2008:422; Cutolo & Rochford, 2007:2) corroborate the views stated above. They maintain that once students know their individual learning styles and adapt certain learning styles depending on which teaching methods and instructional materials they meet during their education; their academic performance may improve. Based on the views of these authors the understanding of learning styles could make teachers to become more flexible in their teaching and the way in which they choose instructional materials. A better understanding of learners' learning styles might also enhance their pedagogical content knowledge, the presentation of information and designing of course materials. This view is affirmed by Mestre (2010:814) who states that students who are aware of their learners' learning styles find it easier to communicate their needs and processing information

Doren (2007) believed the learners could only get to correct conclusion on Mathematics by deploying resources with the help of appropriate and positive learning styles. As she pointed out, 'although kinaesthetic experience can improve discernment and deep thinking, also is involve action by imitation that is by doing, but the understanding does not travel through the fingertips and up the arm on like the visual and verbal learners who prefer seeing things and hearing things respectively directly from the teacher (Doren, 2007: 7).

Similarly, in another study carried out by Bansilal (2015), visual learners are like kinaesthetic and are the largest group in any situated classroom (Nel & Nel, 2013). The visual learners prefer the presentation of information to them in class by means of diagrams, graphs and other physical resources that they can see, touch and feel (Fleming, 2015). Auditory learners, who usually make up 20% or less of a class (Nel & Nel, 2013), prefer information that is spoken and heard, and they thus learn through lectures and group-discussions (Fleming, 2015; Juškevičienė & Kurilovas, 2014). Learners with a reading/writing learning style prefer information displayed as words and they learn effectively by reading and writing (Fleming, 2015; Juškevičienė & Kurilovas, 2014). These learners appreciate physical resources (Prithishkumar & Michael, 2014), and make notes during their study (Fleming, 2015; Khanal, Shah & Koirala, 2014). Kinaesthetic learners learn best by moving, doing and acting (Amran, Bahry, Yusop & Abdullah, 2011; Juškevičienė & Kurilovas, 2014). They are very active and not reflective as alluded to above, they do not like being hazy, they are hyperactive, as they flourish on investigation (Bennett, 2013; Leopold, 2012) rather than 'chalk and talk' teaching (Şimşek, 2014).

There are some factors influencing learning style, such as demographic variables like gender, culture, age, and school. This connotes that the relationship between learning style and Mathematics performance is not that simple (Kiwanuka et al 2015; Ren, 2013; Joy & Kolb, 2009; Naik, 2013; Hlawaty, 2009; Leung, McGregor, Sabiston & Vriliotis, 2014). Therefore, the learning style that is effective for learning in History or Literature may not be useful for learning Mathematics.

The revised curriculum for secondary school in Malaysia, called Curriculum Bersepadu Sekolah Menengah (KBSM), recognizes that where possible individual needs should be taken into consideration in any local education context, since it is certain that learning styles can be fully integrated into the teaching services. In addition, learners differ from one another in the way they learn. They have different strength and weakness; therefore, unique intelligence and learning styles need to

be considered in the teaching process (KBSM 2011). However, without proper research in this area, it is difficult to illustrate the contribution and positive intervention of learning styles with students' overall academic achievements. The present study (Abidin et al. 2011) was conducted primarily within the framework of the Learning Styles Survey (LSS) in order 1) to identify the learning styles profile of upper secondary students in an Islamic school in Malaysia, and 2) to examine students' learning styles with respect to their overall academic achievement. It attempts to help teachers understand the preferred learning styles of their students so that they would be able to develop effective instructions that make the most of their students' abilities.

To accumulate a general profile of a class and to use teaching styles to meet the needs of the learners, teachers to understand the connection among their instructional materials, methods of teaching and the way their learners learn. As such, the concept of learning styles will challenge teachers to rethink their methods to improve students' academic achievement in Mathematics with the assistance of adequate instructional materials. After all, as (Abidin et al. 2011) assert, effective practices and educational decisions must derive from an understanding of the ways that individuals learn with necessary instructional materials. Teachers need to be aware of the learning style patterns their students bring to the classroom.

Yusta, (2015) emphasized the fact that learning styles can be enhanced if there are adequate resources. This will enable learners to take an active involvement in the learning activities and afford teachers opportunity of having a greater variety of ways for the dissemination of ideas and knowledge. Learning style with commensurate relevant resources that are clearly and well organized provides wide range of opportunities for learning (Lewin & Stuart, 2009). Concrete materials that are operational facilitate learners' internal concept and this leads to intellectual development according to Yusta and Talaka (2009) posited that the instrument for social development has an intrinsic value of education. Therefore, schools need

adequate instructional materials to improve education; hence, they should increase budget allocation to support buying materials to assist learners, which will result in increased performance.

There has been an expansion in the type of instructional materials used by the teachers due to increased diversification and ethnic background of the learners. The composition of the students nowadays shows that they come from different ethnic and cultural background. Therefore, schools need different training programmes so that the teacher can have adequate knowledge to cope with this diversity. Throughout the world, learning styles have become an increasingly relevant pedagogic concept. This has been because the diversity of students engaged in education has continued to expand. These changes and advances in technology have led many teachers to reconsider learner-centred methods of teaching than the conventional method. The importance of considering students' learning styles in the design and delivery of course content is being strained (Romanelli *et al.* 2009:1).

In general, instructional materials such as textbooks, texts, and computersoftware, digital, print, audio, video, or hands-on materials, such as manipulative.and geoboards are built into mathematical and instructional intentions andpossibilities for school Mathematics (Adu, 2018). For students to learn Mathematical contents, instructional materials are very essential. Instructional materials also determine teachers' mathematical instructional decisions and teachers are familiarized to using them to guide teaching. There is, therefore, a sense in which the instructional materials are used "as a source of solving the problem and giving class exercises, such as reference book, and as a teacher in themselves" (Adu, 2018:11). Teachers often rely heavily on instructional materials and learners' readiness (style) for many decisions, such as what assignment to give learners, how to teach and what to teach and exercises to assign to their students. It is reasonable to agree that the instructional materials as important as they are can create challenges for both teachers and learners.

Teaching and learning are two sides of a coin. They are activities that are carried out simultaneously in a classroom setting because of the former complement the latter. Learning in all levels is considered fundamental human rights as it represents basic human need. Therefore, a deliberate attempt has to be made to highlight the significance of promoting the process of learning among learners in our society. It was in recognition of this that the United Nation Economic Social and Cultural Organization (UNESCO) (2006) described learning as a relatively permanent change in the behavior of a learner after being exposed to a programme of instruction.

Every child follows its own unique way to learn and process information with the availability and utilization of instructional materials. They learn the material in different ways. Some learn by oral repetition, some may learn by writing it out, while others may learn through practical work. Individuals thus differ in the way they learn. Learning style can be described as a set of factors, behaviours, and attitudes that facilitate learning for an individual in each situation. It is the ability of learners to perceive and process information in learning situations (Iyunade, 2014). How learners perceive, interact with instructional materials, and respond to the learning environment because of learning style whose characteristics are cognitive, affective, social, and physiological behaviours serve as relatively stable indicators (Iyunade, 2014).

Generally, each learner has consistent and distinct preferred ways of organisation, retention and perception. The brain structure has been discovered to have influence on language structure acquisition since student learn differently from each other. Each person is born with certain tendencies toward styles and this is called biological or inherited characteristics that are also influenced by maturity level, development, personal experience and culture. There are overall patterns that provide direction to learning and teaching by using instructional materials. Styles and availability of instructional materials influence how students learn, how teacher teach, and how the two interact. Style can be considered a 'Contextual' variable or construct because what the learner brings to the learning experiences is a part of the content as well as the important features of the learner's experience itself (Iyunade, 2014).

Similarly, Instructional materials enables teacher to disseminate concepts and ideas with ease, they appeal to the senses of the learner at a particular period, and it is used to facilitate teaching and learning (Munchi, 2008). The learner can see, touch, smell or taste thereby making learning more meaningful. This is in line with the Chinese proverb that states that what I see-I remember, what I hear- I forget and what I do-I understand. Mathematics is designed to enable the learners to develop an interest in science and technology, acquire basic knowledge and skills in science and technology, and apply their scientific and technological knowledge and skills to meet societal needs. If these objectives will be achieved, then efforts should be made to provide adequate instructional materials to learners and to encourage its effective use. Despite the emphasis placed on the use of instructional materials in teaching and learning process, most students still find it difficult to cope with the study of Mathematics in schools. This may have resulted from lack of or underutilization of instructional materials by teachers.

Opera (2012) saw instructional materials as information carriers designed specifically to fulfil objectives in teaching and learning situation. Okeke (2015:289) is of the view that instructional materials are;

All the physical (Synthetic and material that are real and spontaneous) resources meant to be used by the facilitator in the process of teaching and learning. These materials may be used singly or in combination. In some cases, they could be used in an informal or formal way.

This shows that teachers vary the methods of utilizing instructional materials during instruction to effect changes in the behaviour of the learners. Certainly, the appropriate use of instructional materials goes a long way in improving teaching and learning, arousing interest and enhancing students' affective responses. Obara (2012:16) observes that;

Learning experiences that stimulate or appeal to limited senses of receiving information would not be enough for the teacher to convey meaningful information to stimulate the learner for the development of cognitive, affective and psychomotor skills or competencies reminiscent of learning.

This calls for the use of varied instructional materials during the teaching-learning process. The effectiveness of learning depends on what learners look at and listen to which influence their behaviour. The organization and use of instructional materials are important for maximum teaching and learning as well as help in the retention of learnt concepts. To this, Mkpa (2015:15) opined that, "Learners remember 20% of what they hear, 30% of what they see, 50% of what they hear and see, 70% of what they hear, see and talk about, 90% of what they hear, see, talk about and do".

Minor and Tyler (2005) described instructional materials as covering a wide range of visual and audio media, from simple chalkboard drawing to complex overhead transparencies and computer. Instructional materials that are educational inputs are of vital importance to the teaching of any subject, in the primary school curriculum. Wales (2011) and Nwichi (2013) succinctly described the use of instructional materials as what would make discovered facts glued firmly to the memory of the learners.

Ogundiran (2015) also added that a well-planned and creative use of visual aids in the delivery of lesson should do much to banish indifference, supplement inadequacy of books as well as arouse learners' interest by giving them something practical to see, do and at the same time helping to train them to think abstractly. On this, Savoury (2014) suggested again a catalogue of useful visual aids that will help in teaching learners in public primary school such visual aids include pictures, postcards, diagrams, maps, film, strips, and models. Savoury said that selection of instructional materials, which are related to the basic contents of a lesson, helps in the understanding of such a lesson by the learners. It also makes the lesson attractive and

thus motivating learners to learn. Savoury encouraged the use of pictures, which will help the learners in grounding their thoughts and feelings. Savoury further said that pictures are used as alternatives to real objects where it is impossible to show learners the real objects, these pictures work effectively than imagined objects.

Availability and utilization of instructional materials with commensurate learning styles are not enough it is also vital to have sufficient and adequate human resources in terms of teacher quality for the teaching of all subjects in the primary school curriculum. Without the teachers as an executing factor, the goals of education can never be achieved. In order to achieve a just and egalitarian society as spelled out in National policy of Education according to Ibe-Bassey (2008), to promote sound and effective teaching with suitable materials schools should be properly and uniformly equipped. In addition, the school should be equipped with qualified teachers and libraries among others, and learners should be ready to learn and be in schools.

Learning of real information in lesser time than verbalisation is more effective with the availability of instructional materials, Mba (2014) agreed that what help learners most is the instructional materials especially pictures which can arouse and help further study; learners become more active and interested in the topic being taught when instructional materials are available and use appropriately. Adequate presentation of lesson and development of emotional impact of the learners are also enhanced. That instructional material affects learners' attitude towards what they are exposed to in the class. What the teachers make out of the available instructional material determines its usefulness. Teachers who are referred to as facilitators might not make anything out of this because of their perceived role in class. They do direct learners on what to look for and use these materials, however, intended learning outcome may not be achieved and the stipulated objectives of using such materials will be defeated.

According to Iyunade (2014), for the young learners to perform well in their academics especially in Mathematics as a subject, the instructors (teachers) must be resourceful, dependable, experienced, and able to plan the instructional materials to be used for learning and understand how to teach the young ones.

Iyunade (2014) also pointed out that a systematic way of planning and designing instruction will make the learners to learn more effective, and that, the model for designing instructional materials should include; (a) instruction outcome must be identified; (b) instruction should be developed; and (c) for instruction to be effective it must be evaluated. It is however observed that the little experience of the teachers and their clueless on pedagogy and andragogy make adaptation of perfect setting of classroom activities difficult.

Hence, to teach learners and making learning objectives easier and clearer, there is need for the proper use and mediation of instructional materials. Meanwhile learning resources and materials cannot be divulged with objects, environment and persons, which can be used to influence or help in any learning activity. A careful explanation of a subject may not absolutely lead to a better understanding of that particular subject by primary school learners due to their age, whereas, the use of teaching aids or instructional materials provides clarity on issues that are of learning interest to them (Iyunade 2014).

In all societies, schools have important tasks and missions expected of them by the society. Schools should provide learners that will improve the society and contribute their quota to the development and betterment of the society. It is the role of the schools to assist the students to learn those ways of thinking, feeling and acting. This enables them to participate constructively and effectively in the society and achieve their potentials as individuals. Since learning is achieved through the person's interactions with the objects of his environment, it is therefore essential that good planning with adequate resources be made to help the person attain the desired change.

There is, therefore, every possibility that learners might perform excellently in their academics when there are instructional materials that are proportionate with appropriate learning styles. This will encourage the learners because they will be motivated since learning will become interesting. Showing learners their strengths and weaknesses by making them aware of their learning styles, will help them to grasp more knowledge in difficult areas. Furthermore, for lifelong learning to be achieved, there is need for adequate knowledge of learning styles (Adu, 2018).

Nwichi (2013) described instructional materials as covering a wide range of visual and audio media, from simple chalkboard drawing to complex overhead transparencies and computer". Instructional materials, which are educational inputs, are of vital importance to the teaching of any subject, in the primary school curriculum. Wales (2011) and Nwichi (2013) believed the use of instructional materials and positive learning styles would make discovered facts glued firmly to the memory of learners.

Koert (2007) also added that a well-planned and imaginative (learning style) use of visual aids in lesson should do much to banish indifference, complement insufficiency of instructional materials as well as arouse learners to think abstractly, with the help of practical works given them to see and to do. The ability of teachers to select proper materials and interpret accordingly by translating the learners' thinking process using objects and symbols especially in the teaching of Mathematics have a lot of influence on learners' performance (Adu 2016).

In Brunei, instructional materials and other commensurate learning styles need to be considered for effective teaching and learning of Mathematics. Learning styles differ from learner to learner. Some learners are visual, audio and kinaesthetic. An instructor may be in support of visual learners by using physical objects that promote dynamic understanding of difficult concepts in Mathematics. Mathematics instructor who categorises his or her learners as visual provides learners with illustration using objects in the classroom that the learners can feel, see and touch (Bansilal, 2015).

Some learners are having more than one learning styles. Bansilal (2015) found that learners with more than one learning style performed better than their counterparts with one style. They are classified as high achievers while those with one style are classified as low achievers (Shahrill, Mahalle, Matzin, Hamid & Mundia, 2013). Nevertheless, the preferred learning styles have some associated factors that influence it like age, gender and grade level of learners. Females are more effective in auditory and visual than males while males are more effective in kinaesthetic than their female counterparts (Botes & Miji, 2010). This shows that demographic variables have a lot of influence on learning styles (Botes & Miji, 2010). Similarly, lower form level is more effective on visual and audio than their colleagues in higher form level are.

In Finland, the common instructional material used for effective teaching of Mathematics and Science is textbook. However, teachers do have supplementary and assessment materials including some manipulatives. The Finnish education officers evaluate these materials before approval is given. There are widely used textbook series for Grade 4 and 8. Publishers are also subjected to scrutiny to meet the standard of the prescribed contents of all subjects. They were guided by what is placed on the national education website before publishing the books. Schools and teachers are then free to choose from the series they find suitable especially for practical subject like Science and Mathematics, but for the sake of consistency, teachers in the same school use the same publishers (Hautamäki & Kupiainen, 2014). In South Africa too, schools use the same publisher for mostly all subjects (Hautamäki & Kupiainen, 2014). Learning styles have different conceptualizations. There are broad definitions of learning styles in particularly; any definition given to learning styles must cover attitudes, beliefs, cognitive, learning strategies and metacognition. The Finnish theoretical and understanding of learning is associated with measurable outcome of modifiable attitudes that support the use of aptitude development and education (Mullis, Martin, Goh, & Cotter, 2016).

In Australia, individual schools are responsible for selecting Mathematics and Science textbooks. To achieve good standards stated in the curriculum, the textbooks chosen by the school must adequately cover the contents of the subject. Teaching Mathematics and Science in Australia report showed that Australian students and teachers of secondary schools were relatively well equipped with science laboratories, and reference instructional materials (Australian Government, 2016). Due to the generalist nature of primary education in Australia, most primary schools did not have enough instructional materials (Thomson, Wernert, Underwood, & Nicholas, 2008).

The use of calculators in Mathematics is widespread in Australian schools. The Australian national report on TIMSS 2007 Mathematics indicated that 95 percent of teachers at the fourth-grade level allowed the use of calculators in the classroom, mainly to check answers, solve complex problems, and explore number concepts. (Mullis, Martin, Foy, & Arora, 2012) Similarly, 99 percent of Australian teachers at the eighth-grade level allowed the use of calculators, mostly for routine computations, checking answers, and solving complex problems. Computers are widely available in Australian schools, with approximately two-thirds of fourth-grade students and nearly 90 percent of eighth-grade students attending schools where there was at least one computer for every 1 to 2 students (Thomson, Wernert, Underwood, & Nicholas, 2008). The ways in which computers are used varies from classroom to classroom.

In addition to computers in classrooms, digital technologies have revolutionized distance education programs, such as Australia's Schools of the Air, which serves students in remote and isolated communities. Where radio was utilized formerly (hence "School of the Air"), broadband satellite networks now allow Web conferencing and similar interactive technologies (Mullis et al., 2012). The poor academic achievement and negative attitude of learners towards Mathematics are not only influenced by learning styles but the teaching styles as well. In other words, the mismatches between teaching and learning styles have a way of raising its ugly head in affecting effective classroom interaction and hence leads to poor performance in Mathematics (Mullis et al., 2012). When the learners are taught by using fascinating instructional materials in accordance with their learning styles, and when they consider their own styles while

studying, their academic achievements seem to improve. In this regard, learning style is viewed as "the way in which individuals begin to concentrate on, process, internalize, and retain new and difficult information" (Hawk & Shah, 2017:9).

In Canada, the ministry of education in each jurisdiction evaluates, approves, and recommends instructional materials such as textbooks and equipment for teacher and student use. Canadian schools have manipulatives and resources in various forms like audio, video, digital, print and hands-on materials. As mandated or recommended, the ministry approves an instructional resource (such as a textbook) to support 85% of the curriculum contents of different subject's area. In most jurisdictions, the final selection of instructional materials takes place at the school level. School authorities under their local learning and teaching resources policies further evaluate ministry-recommended instructional materials.

Furthermore, authorized resources are generally available in other subjects apart from Mathematics, and in order to meet the standard instructional design, recognizing diversity, promoting respect that is vital to learners and congruency, they must be reviewed. Some ministries of education do not prescribe compulsory laboratory materials, equipment, or time allocations for science education. School authorities are responsible for the maintenance of science materials and laboratories and for ensuring that laboratory worker is trained in safety practices properly (Council of Ministers of Education, Canada, 2012). For proper identification of and responsiveness to Mathematics lesson activities, learners need to be motivated. That is why for them to become academically sound and able to retain complex information their style preferences are very essential (Bostrom, 2012:11).

In the United Kingdom, the catalogue of useful visual aids to help with the teaching of learners in public primary schools include visual aids such as pictures, postcards, diagrams, maps, films, strips, models and the identification of materials, that are suitable for the content of the subject to enhance a better understanding and make learners more active (Savoury, 2014). Not only that, such selection of the right materials makes learners to be motivated and makes lesson more attractive to them.

Learning styles can be promoted with the use of pictures, which will help the children in grounding their thoughts and feelings. Savoury (2014) further said that to show learners the real objects, pictures are very important materials to use. These pictures are very effective than imagined objects. To commensurate the instructional materials with the quality of teaching all school subjects, there is need for adequate human resources in term of the instructors (teachers) quality of pedagogy. Without the teachers as an implementing factor, the goals of education might never be achieved.

Moreover, the organisational structure in which teachers carry out their responsibilities can bring to the surface issues that help administrators think more deeply (Abidin et al., 2011). The study from Abidin et al. (2011), seeks to investigate the learning styles of the Muslim students studying in an Islamic school in northern Malaysia. The main language is the Malay Language, followed by Arabic as the second most important medium of instruction. Additionally, the students have a heavy workload of a minimum 21 subjects to study with a 35 minutes slot per lesson. This is much larger than what is practiced in the national type secondary schools. Nevertheless, this Islamic school has achieved a commendable result in the Sijil Pelajaran Malaysia (SPM) examination, which is the standardized government examination every year.

In Nigeria, to achieve a just and egalitarian society as spelt out in the Nigerian National Policy of Education, schools should be properly and uniformly equipped with instructional materials such as suitable textbooks, qualified teachers and equipped libraries in order to promote sound and effective teaching (Ibe Bassey, 2008). Adu (2018) stressed that scarcity of instructional materials will disallow an educational system from responding more fully to new demands. Adu (2018) also highlighted the importance of having appropriate personnel plan and adequate facilities to support the educational effort. She opined that quality of education and its efficiency and productivity depend solemnly on good instructional materials. Despite the numerous advantages or effects of the use of instructional materials in teaching and learning, it is embarrassing to note that many teachers and schools in Nigeria still limit the teaching process to textbook, chalks, and chalkboards, with the teachers at the center.

They disregard the fact that to promote academic performance of the learners in primary schools there is need for availability and utilization of instructional materials. The attitude of teachers towards the use of media has attracted the interest of many researchers; Russell (2011:5) observed, that: "The use of media in instruction depends on the attitude of the teacher and how media resources can facilitate the academic performance of the public primary school learners in the teaching and learning process". Savoury (2004) submitted that it is most disheartening to note that most public primary schools in various local government areas in Nigeria do not know the scope and content of educational technology and proper management strategies of any available instructional materials to enhance better teaching and learning of all subjects especially Mathematics and Sciences.

Some teachers see technological advancements as a competitive threat that will invade their authority in the classroom and so they avoid using them. Another problem facing or infringing on the academic performance of the learners in public primary schools, includes non-use of instructional materials, lack of funds to acquire some of the materials whose improvisation might be difficult, lack of adequate room facilities for storage and security facilities. Other factors include inadequate regular electricity supply to sustain specific audio-visual resources that require specific room temperature. Erratic supply of electricity has a damaging effect on some of these teaching facilities. Added to this problem, includes inadequate specialists in the discipline (Fafunwa, 2004).

Minor and Tyler (2005) stressed some other factors that infringe on the appropriate use of instructional resources such as unavailability of useful materials. Inadequate room facilities and budgets, poor planning, poor communication, unfamiliarity with audiovisual materials and methods of teaching. Minor and Tyler (2005) further stressed that many teachers do not pay much attention to understanding the immediate problem affecting the learners in the subject they teach. For example, teachers handling Mathematics in the primary schools, dealing on the topic like multiplication signs for primary six learners, must come to the class with visual aids, showing each of the multiplication signs to drive his lessons home. Where the teacher fails to use these

instructional materials, the learners will find it very difficult to understand the lesson because they cannot see or reason conceptually. To ensure that the goals of primary education were met in Nigeria, the policy document recommended that primary education should be tuition-free, universal and compulsory. It also recommended that teaching and learning must be practical, learner-centered, exploratory and experimental and should be handled by teachers with appropriate documents. Similarly, the provision of educational resources centers is needed to boost the availability of teaching materials (Esu & Ntu- Kidem, 2013).

In Ghana, according to Esu and Ntu-Kidem (2013), the use of instructional materials and commensurate learning style at lower level has become an accepted fact not only in Ghana but also in the world over. However, what has not been accepted is the “Modus Operandi” of the use and management of instructional materials within the classroom. This implies that teachers’ differences in implementing and managing of instructional materials in our primary schools has been suggested as one of the problems facing teaching and learning. Ideally, no effective teaching and learning of an education programme can exist without equipment, facilities, and materials. They are indispensable to good teaching and learning. Teachers handling science subjects and Mathematics complain of lack of equipment and materials to carry out practical exercise with learners. Because of this, some teachers avoid the practical aspect of the topics that need visual materials in Mathematics while concentrating their attention on the theoretical aspects. Some try to verbalize their teaching on the theoretical aspect. Moreover, by so doing render the lesson in the abstract. To develop problem-solving skills and positive attitude, the use of instructional materials in teaching and learning is very imperative. In addition, instructional materials assist learners to acquire and develop functional knowledge and manipulative skills.

In Kenya, the allocation of resources to different sectors especially education consistently has shown the unalloyed commitment of the government over the years (MOEST 2005, Sessional paper no. 1). However, challenges like quality, equity, accessibility, relevance, efficiency and management of these materials are still bedeviled the government of Kenya with all the notable achievements attained as

alluded to above. Eshiwani (2013) affirmed that the school-based factors that influence the performance of learners include learning styles, qualified teachers, the availability of teaching and learning materials to mention but a few. However, in Kenya, because schools are located dispersedly in different but large environment, resources are not evenly distributed. The Kenyan government since the year 2003 has come up with the measure to reduce the variation of teaching and learning materials through the Kenya education support program and school infrastructure and material program. Each learner purchased materials with some amount of money allocated to them. Despite this, studies continue to report serious shortages of textbooks in Kenyan classrooms. Policy issues related to the production of teaching-learning materials and procurement of textbooks and other teaching-learning materials have been put in place to ensure availability of textbooks and other learning materials in schools, not still effective though.

The Kenyan government is committed to the provision of quality education and training as a human right, (Kenyan Education Act, 2013). Kenyan's greatest asset lies in its people. Its potential lies in their creativity, work ethics, education, and entrepreneurial skills among others, (Kenya vision 2030, 2009). The overall policy goal for the government is to achieve EFA in order to give every Kenyan the right to education and training to better his socio-economic status (MOEST, 2005).

The Kenya government in collaboration with the government of Japan began the project of strengthening Mathematics and science project, (SMASSE), in 2008. This trickled down to Primary schools in the year 2013. The project was taxed with the provision of teaching and learning materials and training teachers on how to improvise them where necessary. Seeing, touching and listening, which are characteristics of instructional materials, are the gateway to human learning in this 21st century.

Manipulative materials are concrete materials such as geoboards, pattern blocks, chip trading boards, counters, algebra tiles, attribute pieces, fraction bars, and Cuisenaire rods that students arrange in some way to represent a variety of mathematical relationships (Apondi, 2015). Common instructional materials include chalkboards,

charts, graphs, diagrams, exhibits, flat pictures, photographs, maps, models object motion pictures, textbooks, reference books, computers, etc. (Mundi & Alfred, 2006). Yet, teaching with instructional materials, especially with the newer technologies that suit today's information technological society is the trend in contemporary society. It is now a common knowledge that advances in technology have brought instructional materials – especially the projected and electronic materials to the forefront as the most radical tools of globalization and social development, which have affected the classroom teaching-learning situation positively. Despite the important role that Mathematics plays in the society, there has been poor performance in Mathematics in Kenya National Examination (Aduda, 2003). Several factors have been attributed to poor performance in Mathematics among which are poor methods of teaching (Aramide & Bolarinwa, 2010), poor interest in Mathematics (Bodo, 2004) and lack of appropriate instructional materials in teaching Mathematics at all levels of education (Gambari, 2010).

The use of instructional materials in teaching and learning at the primary school level help the learners to explore experiment, create and interact with the environment intensively. Copious uses of instructional materials help to provide learners with an enabling environment to learn Mathematics (Meremikwu, 2008). Instructional materials make teaching and learning more effective. Esu, Enukoha, and Umoren (2014) stated that instructional materials are necessary ingredients in the development of any curriculum. Esu et al (2014) asserted that to increase the effectiveness of Mathematics teaching as a way of preparing learners for adulthood and future responsibilities are the aims of using instructional materials. Textbooks and other learning materials may influence learners' learning styles as well as teachers' beliefs about Mathematics (Collopy, 2013). There has been poor performance in Mathematics in Kenya despite the crucial role, that Mathematics play in the society because Mathematics is a basic requirement for entry qualification to science-based courses such as medicine, architecture, pharmacy, and engineering among other degree programs (Aduda, 2003).

In Uganda, the use of instructional materials is to provide learners with conducive environment to learn Mathematics. Instructional materials make teaching and learning more effective. The use of instructional materials in teaching and learning at the primary school level help the learners to explore experiment, create and interact with the environment intensively (Meremikwu, 2008). Apondi (2015) stated that instructional materials are necessary ingredients in the development of any curriculum. Esu et al. (2014) asserted that textbooks and other materials for learning do influence the beliefs of teachers about Mathematics and the main aim of instructional materials in the teaching of Mathematics is to increase the effectiveness of teaching Mathematics as a means of preparing learners for future responsibilities as adults (Collopy, 2013).

In Tanzania, to ensure that there is adequate provision of resources is one of the teachers' first responsibility. Adequate instructional materials enable learners to follow the sequence of lesson preparation executed by the teachers and learners will subsequently understand the lesson (Orodho, Waweru, Ndichu & Nthinguri, 2013). Adequacy and effective use of resources can make a big difference to a school and the learner (Yusta, 2015). To ensure the provision of adequate and effective instructional materials, teachers must not settle for what is good enough but what is better (Yusta, 2015). Availability and adequacy of a wide variety of instructional materials can stimulate the interest and actively engage learners with learning difficulties in Mathematics (Herward, 2009).

Use of instructional resources for teaching Mathematics in Tanzania is an important aspect of the teaching and learning process. The selection of particular instructional materials that determine the outcome of the whole process of learning and this will influence its success or failure in achieving certain learning outcome. Since the introduction of Free Primary Education in Tanzania which has brought the distribution of funds to buy education instructional materials to all integrated primary schools; the performance of Mathematics has not improved. Koski (2010) stated that the use of the term textbooks includes workbooks, worksheet and other instructional materials that are designed to convey exercises, problems, lessons, and information to students.

They are very essential to effective teaching and learning. Therefore, he recommended that after using any instructional materials, it is advisable to display them in the classroom for learners to manipulate during their own time and this is being influenced by their styles of learning.

Inappropriate learning styles, shortage of instructional materials especially Mathematics textbooks that focus on prescribed curricula, teachers' lack of mathematical cognition of learners and the use of different skills are part of the factors that lead to poor performance in Mathematics (Siyepu, 2013). The prolonged mismatch between teaching and learning styles can also be another factor that militate against good performance in Mathematics and eventually leads to negativity towards a like Mathematics. Many learners have phobia for Mathematics as a result of what I have said above (Adu et al., 2016). Academic achievements seem to improve when the learners consider their own learning styles while studying and they are taught in accordance to their learning styles. Henning (2013) also found that many teachers do not understand the mathematical cognition of learners. Poorly resourced schools also have teachers with poor qualifications, while better resourced schools are able to attract good quality teachers with higher qualification (Visser, Juan & Feza, 2015). Kibet, Muthaa, and Nkonke (2012) supported this view when stating that insufficient teaching materials were found as one of the factors to impact negatively on learners' academic performance in Mathematics.

Ahmed, Clark-Jeavons, and Oldknow (2014) investigated the learner's ability to make the transition from practical work and pictorial images to mathematics that is more abstract. Many of the 11 to 12-year-old learners in the project had difficulty in moving 'from the concrete or pictorial representations to the more formal (general) aspects of mathematics' (Ahmed *et al.*, 2014: 2). The research showed that many learners were unable to link these stages in the learning process. They suggested that some of these difficulties derive from the use of particular instructional materials, which are used within a 'representational' approach. In this approach, learners would work with an external representation (e.g. Multibase10) in order to give meaning through 'internal'

representations to an aspect of Mathematics (in this example, aspects of place value). Ahmed *et al.* suggest that there is an assumption here, on the part of the teacher, that specific mathematical meaning is embodied in the external representation: this may be true for the teacher, but not necessarily the learner. Doren (2007:3) believed for ideas to be modelled there is need for physical examples and materials to be displayed by the teacher.

In South Africa, Mathematics aim is to produce labour force apart from better citizenship and for furthering of education. Nevertheless, there are different cultural diversity in many classrooms in South Africa; therefore, teacher needs to understand learner's cultural background in order to determine the strategy to be used. Due to cultural diversity seen in the classroom, it has also become necessary to address the issue of learning styles in classroom teaching. Teachers also need to understand and be familiar with learners' racial group and specific learning style that can promote the teaching of Mathematics (Bostrom, 2012). For teachers to be effective in Mathematics teaching they should understand what learners know and need to learn, and then challenging and supporting them to learn it well.

As alluded to above, the success of Mathematics enables learners to enrol for some careers in the field of science (natural) and accountancy. The major challenge and the reason why South Africa adopted Mathematics literacy was because of continuous poor performance in Mathematics, however, mathematical literacy does not allow learners to study some lucrative courses like medicine, pharmacy, engineering and so on. Therefore, it is expedient to note that Mathematics is a fundamental indicator of good careers (Reddy et al. 2013). This has been a great concern for many researchers; especially the high enrolment rate of students in mathematical literacy as a result of phobia and deficiency in Mathematics and this has become Mathematics education crisis in South Africa (Adu, 2018).

In 2012, The World Economic Forum (WEF) identified the quality of Mathematics in South African education as the lowest out of 62 countries (Wallace, 2013). Evidence shows that South Africa continues to perform worse in Mathematics than many low-income African countries. The Trends in International Mathematics and Science Study (TIMSS) also shows that South African learners perform poorly when compared to other participating countries (TIMSS, 2011). It is clear that there is a continuing crisis in South African education “and that the present system is failing most of South Africa’s learners” (Spaull, 2013:3).

There are important reasons for placing emphasis on assessing and improving Mathematics results (Wallace, 2013). The performance of South African schools in Mathematics and science affect the country’s economic growth and points to the quality of the human capital pool. Mathematics plays an important role in determining learners’ success or failure as citizens (Ndlovu, 2011:420). Society views Mathematics as the foundation of the scientific and technological knowledge that is crucial for the social and economic development of a nation (Mbugua, Kibet, Muthaa, & Nkonke, 2012:87). This makes Mathematics one of the most important school subjects in the curriculum worldwide and a compulsory subject in primary and secondary schools in most countries (Mbugua et al., 2012: 87). Currently, South Africa must import much of the scientific and technological expertise that is essential for its economic development (Makgato & Mji, 2006). The country is in dire need of appropriately qualified Mathematics teachers and the current education system will not be able to produce enough numbers of students qualified to go into this field of study (Makgato & Mji, 2006:254).

To address these issues and improve the quality of basic education, the South African Department of Basic Education (DBE) introduced the Annual National Assessment (ANA) (DBE, 2014). The ANA comprises standardized assessments aimed to measure and improve learners’ performance in Mathematics and home language from Grade 1 to 6 and Grade 9 (South Africa. Department of Basic Education, 2014:14). Similarly, to the systemic evaluation, the ANA results “are used to report on the policy

goals of access, equity and quality as indicators of the 'health' of the education system [and] targets a more diagnostic interpretation of learner achievement" (South Africa. Department of Basic Education, 2014:14). Spaul (2013:3) argued that these tests are important in improving the quality of education in South Africa, but the fact that they are invigilated, marked by the learners' own teachers and lack of external verification reduce their value.

The instructional material commonly used in South Africa is textbooks, textbooks are designed to complement the teacher's effort in the delivery of instruction and serve as a guide to complement what they learn in school. According to United Nations Educational and Scientific Organization (UNESCO) 2016 report, textbooks are particularly relevant to improving the performance of the learners' especially those from poor countries with overstuffed classrooms, and a sizeable number of unqualified teachers coupled with the shortage of instructional materials and time. Mathematics textbooks, as all textbooks, must be in accordance with the subject curriculum. The subject curriculum contains the pedagogical content on offer for each subject for a school year and serves as the basis of the work schedule design (Baranyai & Stark, 2011). In South Africa, textbooks are selected according to the prescription of the curriculum by the Department of Basic Education, which is called the Curriculum and Assessment Policy Statement (CAPS) (Adu, 2018).

The Romania curricula is structured in a unitary way and is built in a block like output descriptors, pedagogical content, methodological, learning activities, evaluation and assessment methods (Fodor, 2015). The subject curriculum contains the pedagogical content offered for each subject and aligned with the acceptable curricula by the government. Mathematics textbooks recommended are well aligned with the contents of each subject curriculum. Meanwhile this is subjected to review by taken into consideration the curricula structured and the unified blocks (Fodor, 2015).

For textbooks to fulfil its purpose under unified block of curricula structures, they must meet certain stipulated criteria like language of writing, simplicity, user friendly, elaborate workbook, etc. in Romania, there is reform in education which makes textbooks to spread because textbooks give teachers direction and guidance and allow learner to discover themselves (Fodor, 2015). On the contrary, in Hungary, it is not always possible to choose from several Mathematics textbooks, as there are study years for which only one Mathematics textbook has been designed. The criteria that textbooks should meet in these two countries are summed up as are appropriate look/design (esthetical criterion), style, correct and high- quality language use, structure, as well as content and approach (Fodor, 2015).

Studies carried out over the past 25 years on how curriculum is actualised in schools, the role of curriculum materials and teachers' interaction with curriculum materials have been investigated (Adu et al., 2016). Understanding what the teachers do in Mathematics classroom with the use of materials depend on the curriculum contents of Mathematics (Remillard, 2009). The rate at which teachers use materials is determined by the value of such materials (Fodor, 2015). In this sense, teachers' understanding of the use of textbooks and other relevant written resources plays an important role in exploring the pedagogies used in the classroom.

Research has shown that when teachers interact with curriculum materials, they do so in dynamic and constructive ways, rather than in a straightforward process (Brown, 2009). Teachers frequently make changes to the curriculum intentions and modify the changes according to the structure and the purpose of lessons. In the adaptation to these changes, the availability, quality, and flexibility of the curriculum materials plays a critical role in teachers' decisions. In general, teachers transform the curriculum ideas, lesson plans, and mathematical tasks into real classroom activities (Remillard, 2009). In doing this, there will be effective teaching and learning to enhance desired outcome.

The integrated analysis of how the teacher use instructional materials in classroom teaching and learning required teachers' understanding. Brown (2009) identifies a way of interaction between teacher and curriculum materials, which involves multiple steps. According to this interaction, teachers first *select* materials. However, others often decide the selection. Second, they *interpret* these materials in planning and during instruction regarding their perception of materials. Third, they *reconcile* their perceptions of the intended plan with their own goals and with the limitations of the setting. Fourth, they *accommodate* the students' interests, experiences, and limitations. Finally, they *modify* the setting according to their own decisions and to their students' capacities. These steps partly reflect the dynamic and constructive relationship between teachers and textbooks.

The value of textbooks in primary school Mathematics education is hotly debated (Zevenbergen, Dole, & Wright, 2013), and more than any other subject area, Mathematics teacher relies heavily on their use (Johansson cited in Jamieson-Proctor & Byrne, 2008). The mandated use of a set textbook series across grades or classes in a school is not uncommon in Australia; with some schools employing them as pseudo-curricula (McNaught, 2005). While quality textbooks are usually published with teacher-manuals, which provide a range of teaching activities that include the textbook as a resource, it is not unusual for these manuals to be unavailable for teachers, and for the textbook to form the basis for Mathematics lessons (McNaught, 2005).

Textbooks are traditionally connected with a transmission model of teaching (Boaler, 2008). This model focuses on a procedural approach to the teaching of Mathematics, and subsequently promotes a procedural rather than conceptual understanding of Mathematics, which has limited value when students are placed in unfamiliar situations (Boaler, 2008). This approach also focuses on the production of correct solutions rather than the thinking processes involved in coming to a solution (Wood, Williams, & McNeal, 2006). It often sees the culture of the Mathematics classroom embodied in correctness, precision, prompt recall, and speedy task

completion.

In 2000 and 2007, Grade 6, learners in South Africa participated in the Southern and East African Consortium for Monitoring Educational Quality (SACMEQ) studies. Around eighty percent (80%) of the Grade 6 learners who participated in the numeracy test reached the lower half of the eight levels of competence in Mathematics (SACMEQ, 2013). With this test focusing on the Mathematics achievement of Grade 6 learners, Kotze and Strauss (2007) analysed the scores per level as indicated in table 1.1 below.

Table 1.1: Percentage of EC Grade 6 learners reaching the Mathematics competence levels

Levels	1	2	3	4	5	6	7	8
%	11.6	52.1	25.5	7.2	1.7	1.6	0.0	0.3

(SACMEQ II Research Report, 2013)

The poor performance in Mathematics, and in grade 6, which has continued to become a great source of concern in South Africa and the Eastern Cape Province, in particular, is also reflected in the Annual National Assessment results, which are as shown in Table 1.2

Table 1.2: Annual National Assessment Results

Year	2014	2015	2016
National	27	39	43
Provincial	8.1	16.2	23.3

(DBE, 2017).

According to Bosman and Schulze (2018), most South African learners are English second language learners, who struggle to learn Mathematics through English as a medium of instruction. Poor performance in Mathematics may also be related to the teaching style of the teacher and learning style of the learners. The lengthen mismatches between the two can contribute to poor academic achievement and

negativity towards Mathematics. On the contrary, when the learners are taught in accordance with their learning styles and when they consider their own styles while studying, their academic achievement seem to improve.

Considering materials or resources used in teaching Mathematics, Visser, Juan, and Feza (2015) believed availability or scarcity of key school resources impacts educational outcomes, with higher levels of resources being linked to better educational outcomes. Instructional resources play a significant role in the teaching and learning of Mathematics to Grade 6 learners. Grade 6 learners need visual resources such as pictures, diagrams of buildings, projectors, charts, real objects, books, newspapers cuttings, colored objects, bottle-tops, and counting sticks to make a tremendous enhancement of lesson impact on the learners and compatible with the teaching style. Learners can retain information by applying the materials more effectively (Bosman & Schulze, 2018).

Availability and adequacy of a wide variety of instructional materials stimulate learning styles and interest that make learners actively engage with Mathematics lesson and in turn make a big difference to a school and the learner. Orodho, Waweru, Ndichu, and Nthinguri (2013) asserted that in South Africa, adequacy of instructional resources such as textbooks enable learners to follow the teacher's sequence of the lesson presentation and subsequently aids in the understanding of the lesson.

1.2 STATEMENT OF THE PROBLEM

Aljaberi (2015) asserts that learners exhibited a clear deficiency in mathematical problem-solving abilities and found that learners' ability to solve mathematical problems varies in their learning styles. Siyepu (2013) noted that poor performance in Mathematics seems to be caused by a shortage of Mathematics textbooks that focus pertinently on prescribed curricula, whilst Henning (2013) also found that many teachers do not understand the mathematical cognition of learners and fail to understand the learning styles that can be aligned with their teaching styles. Several researchers (Breckler, Teoh & Role, 2011; Naik, 2013) found that prolonged

mismatches between the teaching style in a subject like Mathematics and the learning styles of most learners could contribute to poor academic achievement and negativity towards a subject (Visser, Juan & Feza, 2015). Kibet, Muthaa, and Nkonke (2012) supported this view when stating that insufficient teaching materials were found as one of the factors to impact negatively on learners' academic performance in Mathematics.

The teaching of Mathematics in South African schools has many challenges. The Trends in International Mathematics and Science Study (TIMSS, 2011) showed that South African learners have the lowest performance among all 21 middle-income countries that participated (McCarthy & Oliphant, 2013).

Table 1.3 highlights the overall Mathematics performance for Grade 6 learners in South Africa and the Eastern Cape in particular, which is below expectation.

Table 1.3 Overall Mathematics performance (SACMEQ II Research Report 2013)

	EC	FS	GAU	KZN	MPU	NC	LP	NW	WC	SA
Mean	449.5	447.7	552.3	510.3	433.6	461.1	446.2	419.8	591	486.2
SE	10.72	5.99	25.97	17.45	10.8	8.23	18.77	10.58	23.89	7.18

From the above table, the overall Mathematics performance mean score obtained by Grade 6 learners was 486.2. This is below the pre-determined score of 500. Only three provinces (Gauteng, KwaZulu Natal, and Western Cape) exceeded the mean. The standard error of sampling (SE) of the means as reflected in the table 1.3 above were large which implies that results should be interpreted with due caution. However, Eastern Cape is among the provinces that failed to meet target mean score (competence level).

Spaull (2013) reveals the report of the Department of Basic Education (DBE; 2011) that the quality of basic education is still well below what it should be. The percentage of learners reaching at least a 'partially achieved' level of performance varies from 30% to 47%, depending on the grade and subject considered. The percentage of learners reaching the 'achieved' level of performance varies from 12% to 31%. East London

education district within the Eastern Cape Province was listed among poorly performing districts in Mathematics in Grade 6, this is an issue of concern (ANA, 2012).

This study therefore critically examines the effects of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance in Buffalo City Education District.

The following main and subsidiary research questions are posed to guide this study:

1.3 RESEARCH QUESTION

1.3.1 Main Research Question

How do learning styles, availability, and utilization of instructional materials serve as correlates of Grade 6 learners' Mathematics performance?

1.3.2 Sub-Research Questions

1. What is the relative effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance?
2. What is the composite effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance?
3. Which of the variables (learning styles, gender, availability and utilization of instructional materials) would predict Grade 6 learners' Mathematics performance?

1.4 HYPOTHESES

The following three (3) null hypotheses were generated to be tested at 0.05 level of significance:

1. There is no significant influence of Grade 6 learners learning style (visual, auditory, and kinesthetic) on their mathematics performance.
2. There is no significant relationship between availability and utilization of instructional materials on Grade 6 learners' performance in Mathematics.

3. There is no significant difference between male and female Grade 6 learners' performance in Mathematics.

1.5 RESEARCH OBJECTIVES

It is envisaged that the following objectives will be achieved in this study:

1. To examine the relative effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance.
2. To investigate the composite effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance.
3. To find out which of the variables (learning styles, gender, availability and utilization of instructional materials) would predict Grade 6 learners' Mathematics performance.

1.6 PURPOSE OF THE STUDY

The purpose of this study is to explore learning styles; availability and utilization of instructional materials serve as correlates of Grade 6 learners' Mathematics performance.

1.7 SIGNIFICANCE OF THE STUDY

This study might help the learners to identify the different learning styles that could increase their educational experiences. It also helps the learners to develop behavior and attitudes they need for future development. It might also help the teacher to be aware of the application of appropriate teaching methods that could increase their students' success.

The result of this study might help to provide evidence for teachers to incorporate instructional materials in teaching and learning in order to improve the standard of Mathematics in the schools. The study might also provide an insight to teachers and

learners so that they may not rely on the Government for production of instructional materials but find a way of producing the materials locally. It might help to improve the careful use of the existing materials and even their maintenance and sustainability. The study might as well change children's attitude in Mathematics since the use of instructional materials during teaching and learning make the lessons very interesting. It would help the government to improve the production of instructional materials in not only in Mathematics but in other subjects as well.

The study would also provide empirical evidence on how the use of concrete materials to teach some concepts in Mathematics. National and international community might be benefited from the empirical findings of this study by comparative study and benchmarking the use of instructional materials and appropriate learning styles for the betterment of Mathematics performance and effective teaching and learning of Mathematics in the classroom. Buffalo City Education District might benefit tremendously on how to address the challenges of instructional materials.

1.8 DELIMITATION OF THE STUDY

The study would determine the effect of learning styles and availability and utilization of instructional materials on Grade 6 learners' Mathematics performance in Buffalo City Education District. It covers a class level (Grade 6 being the strategic grade and the last level of intermediate phase) in the sampled schools in the district.

1.9 OPERATIONAL AND CONCEPTUAL DEFINITION OF KEY TERMS

Learning style: For the purpose of this study, learning style is the method the learner adopts to facilitate effective learning of the subject matter that is the cognitive acquisition. Learning style as defined by Orhun (2013) is the process by which each learner begins to concentrate process and retain new and difficult information.

Instructional materials: These are materials that concretized teaching for effective acquisition of knowledge, in this study, instructional materials are tools or materials locally made or imported that could facilitate lesson enhancement and impact on learners' intelligent (Abdullahi, 2013).

Availability and Utilization of instructional resources: This is referring to the condition at which the materials are being obtainable or accessible to be adequately used at any point in time (Abdullahi, 2013). In this study the frequent use of instructional resources such as a calculator, chart, computer, magnetic board, textbook, newspaper cutting, pamphlets, pictures, simple abacus, puppets, bottle-top, counting sticks etc. to teach Grade 6 learners Mathematics and investigate how many of these resources are available.

Academic performance: the short and long-term educational goal achievement is referred to as academic performance (Werang, et al 2014). In this study, the performance of Grade 6 learners in Mathematics will be used by giving them Mathematics Achievement Test (MAT).

Mathematics: This refers to the study of numbers, equations, functions and geometric shapes that are taught in schools (Gambari, 2010). Grade 6 Mathematics learners are the participants for this study.

1.10 CHAPTER DEMARCATION

Chapter One: Introduction and background to the study

This chapter explored international and national literature on the effects of learning styles, availability, and utilization of instructional materials on grade 6 learners' Mathematics performance in Buffalo City Education District, which dovetailed into the South African context. The problem statement, research questions, research objectives, significance of the study and its scope as well as operational and conceptual definition of terms were discussed.

Chapter Two: Theoretical framework and Literature review

This chapter explains the theoretical framework that underpins this study, which is the Constructivist Learning Theory, Constructivist teaching is based on the belief that learning occurs, as learners are actively involved in a process of meaning and knowledge construction as opposed to passively receiving information. Through interaction with the physical situations, or concrete objects, a child's physical experience accumulates, and he can conceptualize, think creatively and logically. Also, Kolb's Experiential Learning theory is used, which is, learning that requires qualities such as self-initiative and self-evaluation. For experiential learning to be timely effective, it should employ the completely learning wheel, from goal setting to experimenting and observe, to reviewing and finally to action planning. The researcher also reviewed some existing literature that are relevant and related learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance such as, the concept of Mathematics, conceptualization of learning styles, instructional materials and Mathematics performance, learning styles and Mathematics performance, different types of learning styles etc.

Chapter Three: Research methodology

This section describes the methods and procedures that are to be used to collect data. The researcher described the research paradigm, research approach, research design, population, sample and the sampling techniques employed instruments for data collections, validity and reliability of instruments as well as data analysis procedures before discussing the ethical considerations.

Chapter Four: Data analysis, findings, and discussion

The chapter analyzes and presents data collected on the learning styles, availability, and utilization of instructional materials on grade 6 learners' Mathematics performance in Buffalo City Education District.

Chapter Five: Summary, conclusion, and recommendations

This chapter summarizes the entire study and draws conclusions from the study. The chapter proffers recommendations to different education stakeholders.

1.11 CHAPTER SUMMARY

In this chapter, it was noted that learning styles, availability, and utilization of instructional materials influence the teacher's decisions regarding the instructional approaches used in the classroom. Positive learning styles are equally important for the success of both the teachers and the learners. Teachers use the available instructional materials to promote expected learning outcome and positive desire in learning to love the subject and the contents. However, shortage of relevant instructional materials and its utilization affect learners to comprehend the teaching of Mathematics. The chapter proceeded to identify the significance of the study and the need for the Department of Education in South Africa to address some challenges bedeviling the use and availability of instructional materials in terms of inadequacy and mismatches between teaching styles and learning styles. The next chapter deals with literature review and theoretical framework.

CHAPTER TWO

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 INTRODUCTION

In the previous chapter, it was noted that learning styles, availability, and utilization of instructional materials influence the teacher's decisions regarding the instructional approaches used in the classroom. This chapter explains the theoretical framework that underpins this study, which is constructivist learning theory and Kolb's experiential learning theory. The researcher also reviewed some existing literature that are relevant and related to learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance such as, the concept of Mathematics, conceptualization of learning styles, instructional materials and Mathematics performance, learning styles and Mathematics performance, different types of learning styles etc.

2.2 THEORETICAL FRAMEWORK

This study is based on the constructivist learning theory, which originates from the work of cognitive scientists like Jean Piaget, John Dewey, Jerome Bruner, and Vygotsky among others and Kolb's Experiential Learning.

2.2.1 Constructivist Learning Theory

Constructivist teaching is based on the belief that learning occurs, as learners are actively involved in a process of meaning and knowledge construction as opposed to passively receiving information. Through interaction with the physical situations, or concrete objects, a child's physical experience accumulates and he is able to conceptualize, think creatively and logically. The child, therefore, develops skills to solve abstract problems. According to this theory, learners are the makers of knowledge and meaning to all school tasks.

Constructivists teaching fosters critical thinking and creates motivated and independent learners who have problem-solving skills. Constructivists suggest that learning is more effective when a student is engaged in the learning process with learner-centered methods rather than attempting to receive knowledge passively. When learners are allowed to use and construct their personal understanding based on the skills acquired, allow them to learn best. Piaget's theory focuses on how learners interact with their environment to develop complex reasoning and knowledge. As learners interact with their environment and new objects, they learn and develop ideas. According to Piaget, knowledge is the interaction between the individual and the environment. He further asserts that experimenting and manipulation of physical objects is the main way by which children learn (Akinoso, 2012).

According to Bosman and Schulze (2018), Jerome Bruner's theory concurred with Piaget's that learning is promoted by direct manipulation of objects, for example, in Mathematics education, the use of algebra tiles, coins and other items that could be manipulated. After a learner has the opportunity to directly manipulate the objects, s/he should be encouraged to construct visual representations, such as a drawing of a shape or a diagram. John Dewey rejected the notion that schools should focus on repetitive memorization and proposed a method of directed living where students would engage in real-world practical workshops in which they would demonstrate their knowledge through creativity and collaboration. He called for education to be grounded in real experience (Akinoso, 2012).

According to Bosman and Schulze (2018), learning always occurs and cannot be separated from a social context, they affirm that knowledge construction occurs within a social context that involves student- student, and student- expert collaboration on real-world problems or tasks that build on each person's language, skills, and experience shaped by individual's culture. In the classroom, constructivist view on learning point towards several different teaching practices. In the most general sense, it usually means encouraging students to use active techniques (experiments, real-world problems) to create more knowledge with availability of instructional materials and commensurate learning styles, then to reflect on and talk about what they are

doing, and how their understanding is changing. The teacher makes sure s/he understands the students pre-existing conceptions and guides the activity to address them and then build on them. Students in the constructivist classroom ideally become “expert learners”. This gives them ever-broadening tools to keep learning. With a well-planned classroom environment, the students learn how to learn. Constructivism transforms the student from a passive recipient of information to an active participant in the learning process. Always guided by the teacher, the students construct their knowledge actively rather than just mechanically ingesting knowledge from the teacher or instructional materials like textbook.

Constructivism has been embraced by nearly every educational reform initiative in the last two decades and includes a number of different theories which all view learners as active participants in construction of knowledge and understanding (Ertmer & Newby, 2013; Hartle, Baviskar & Smith, 2012; Slavin, 2009). Learners’ prior knowledge by means of scaffolding is enhanced by learner-centred constructivist teaching. When the learners are presented with new information that their current constructs cannot account for, they need to relate the information to their own personal experiences to enhance understanding. However, knowledge is not only individually but also socially constructed, according to Vygotsky (1978), and the teachers can improve the learners’ knowledge and insight by means of efficient support in line with group learning.

Mathematics teachers are confronted with the learning style preferences of the learners in the class and this is a great task of creating formidable constructivist learning environment. The Dunn and Dunn model (Bosman & Schulze, 2018) is considered to be one of the most influential learning style models that has been developed (Englander, Terregrossa & Wang, 2013; Hermond, 2014). According to Bosman and Schulze (2018), how learners remember, internalise, focus on and manage new materials are characterized as a learning style. The interaction of these elements occurs differently in each person and may vary with gender, age and culture (Bostrom, 2012). The Dunn and Dunn model consists of five learning style stimuli and several elements within each stimulus. These are the following: environ- mental

(sound, light, temperature and room design); emotional (motivation, persistence, responsibility and structure); sociological (learning alone, in a pair, with peers, with a teacher and mixed); physiological (perceptual intake while learning, chronological energy pattern and mobility needs); and psychological processing (impulsive or reflective, and global or analytic) (Dunn & Burke, 2013). The teachers may have little power over some of these elements in the classroom, except for sound, individual versus group learning, as well as learner mobility - which relate to the kinaesthetic, individual and group-learning styles with instructional materials.

2.2.2 Kolb's Experiential Learning

Experiential learning theory defines learning as the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming the experience.

- Setting a positive climate for learning
- Clarifying the purpose of the learner(s)
- Organizing and making available learning resources.
- Balancing intellectual and emotional components of learning and
- Sharing feelings and thoughts with learners but not dominating.

Kolb proposed a four-stage learning process with a model referred to, experiential learning (McGill & Beaty, 2005). Kolb's experiential learning is a four-stage cyclical theory of learning. It is a holistic perspective that combines experience, perception, cognition, and behaviours. Kolb theory was built upon earlier work of John Dewey and Kurt Levin. Kolb believes that learning is the process whereby knowledge is created through the transformation of experience. The theory presents a cyclical model of learning, consisting of four stages below; one may begin at any stage but follow the sequence.

- concrete experience (or "do")
- reflective observation (or 'observe')
- abstract conceptualization (or "think")
- active experimentation (or "plant")

Kolb's four-stage learning cycle shows how experience is translated through reflection into concepts, which in turn used as guides for active experimentation and the choice of new experiences.

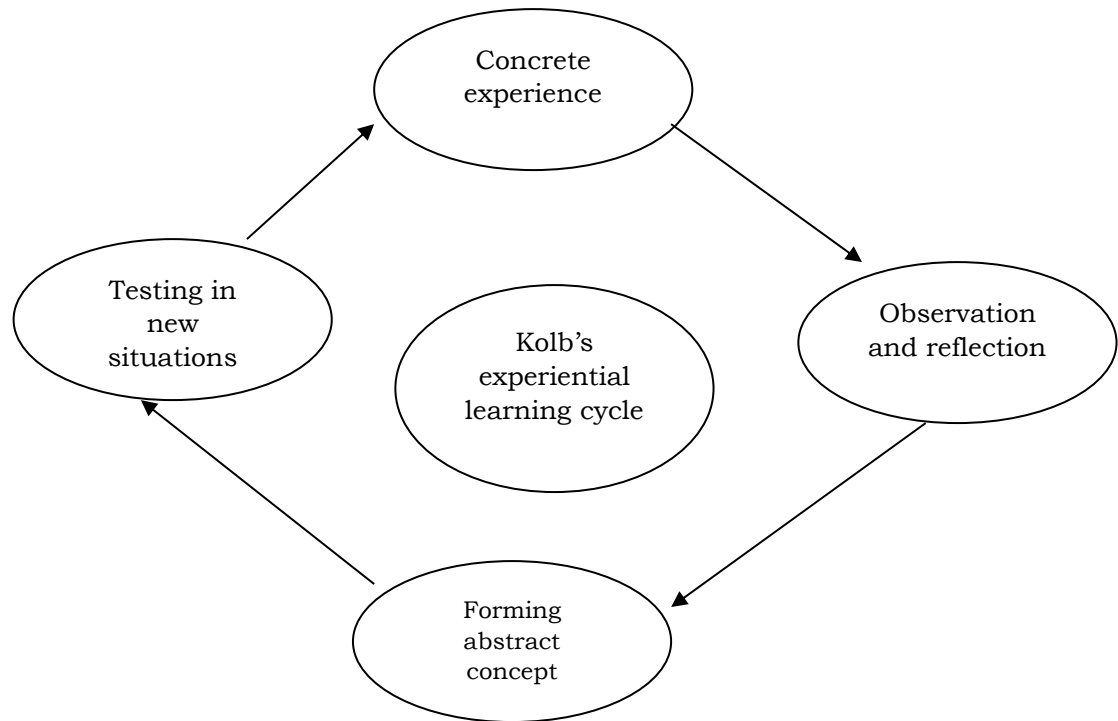


Fig 2.1 Source: Kolb's Experiential Learning Cycle (Akinoso, 2012).

Experiential learning requires qualities such as self-initiative and self-evaluation. For experiential learning to be timely effective, it should employ the completely learning wheel, from goal setting, to experimenting and observe, to reviewing and finally to action planning. This complete process allows students to learn new skills in many subjects especially Mathematics, new attitudes and new ways of thinking. Learning through fun (instructional materials) helps the learner to retain information for a longer period and students are encouraged to direct involvement in the experience, in order that they gain a better understanding of the new knowledge and retain the information for a longer time. Kolb experiential theory, which involves four-stages of learning, “do, observe, think and plant”, helps students to participate actively in learning (Akinoso, 2012:24).

Among the various learning style models, Kolb's Experiential Learning Model (ELM) and Learning Style Inventory (LSI) (Learning-Centred Process-Based Approach /Information Processing Style) has been widely utilized and modified to address the various educational contexts. Kolb proposes a four-stage hypothetical learning cycle. Individuals will show a preference for or will cope with some stages better than others will and learning is seen as continuous, interactive process (Nzesei, 2015). The four stages of the ELM are described as:

- Concrete experience (CE; experiencing) which favours experiential learning;
- Abstract conceptualization (AC; thinking) where there is a preference for conceptual and analytical thinking in order to achieve understanding;
- Active experimentation (AE; doing) involving active trial-and-error learning; and
- Reflective observation (RO; reflecting) where extensive consideration is given to the task and potential solutions before there is any attempt at action. The four learning orientations form two orthogonal bipolar dimensions of learning.

The first dimension is comprehension- the grasping of information from experience-and is constituted by the bipolar orientations CE-AC. The second dimension described is transformation-the processing of grasped information- and is constituted by the remaining orientations AE-RO. Relative positioning along these dimensions defines the learning styles described by Kolb as convergence, divergence, assimilation and accommodation. The individual who adopts a convergent approach uses abstract conceptualization to drive active experimentation. Action is based on abstract understanding of the task and projected strategies for successful completion of the task. Diverge learners combine reflective observation with concrete experience to devise an often-creative solution. Multiple potential strategies for learning and problem solving are used to describe creative learners (Nzesei, 2015).

Assimilators, concerned primarily with the explanation of their observations, favour abstract conceptualization and reflective observation. As such, assimilators seek mainly to refine abstract theories rather than develop workable strategies and solutions. Lastly, Kolb defines the accommodator using active experimentation and concrete experience; these individuals have a clear preference for hands-on learning. The accommodator has been described as having a tendency for prompt action and a noted ability for adapting to diverse situations in any learning context (Kolb & Kolb, 2005).

Assertions that the styles outlined by Kolb will be associated with student performance have been borne out in a number of studies where, for example, Convergents perform better on conventional examinations involving concrete answers (Nzesei, 2015). Despite such support, studies examining the psychometric properties of LSI have raised concerns regarding its reliability and validity (Coffield, Moseley, Hall, & Ecclestone, 2014)

Kolb's emphasis on experiential learning and the developmental nature of learning suggests a potential for change in style (Nzesei, 2015). Studies that have examined stability and change using the LSI present a mixed picture. Low test-retest reliability statistics and changes in style classification (Nzesei, 2015) are countered by reports of exceptionally high-retest reliability of 0.99. Although, high test-retest reliability statistics, (Nzesei, 2015) is cautious about them, believing that inappropriate statistical techniques may be masking individual changes in style in favour of group effects. Let us now examine in details the learning style inventory of Kolb.

2.2.2.1 Kolb's Learning Style Inventory

David Kolb developed one of the most influential models of learning styles. Kolb (in Hawk & Shah 2017:3) defines a learning style as the generalised differences in learning orientation based on the degree to which people emphasise the four modes of the learning process. According to Kolb, a learning style is not a fixed trait but a

differential preference for learning which changes slightly from situation to situation and influence by availability of instructional materials (Azevedo & Akdere 2010:192; Bhatti & Bart 2013:2; JilardiDamavandi, Mahyuddin, Elias, Daud & Shabani 2011:187).

Kolb also views learning as a holistic set of continuous processes with less emphasis being placed on outcomes (Hawk & Shah 2007:3). In the early 1970s Kolb's theory of experiential learning and the instrument, which he devised to test the theory, the Learning Style Inventory (LSI), generated a very considerable body of research. Kolb was dissatisfied with the traditional methods of teaching students. This led him to experiment with experiential teaching methods. During this process he observed that some students had definite preferences for some activities (such as exercises), but not others (such as formal lectures). From these observations emerged the idea of an inventory that would identify preferences for learning by capturing individual learning differences (Coffield et al. 2014:60). Kolb designed and later refined the inventory into a self-report LSI which was used to assess learning styles derived from his experiential learning theory.

The LSI is one of the most widely distributed instruments used to assess learning styles and claims to provide a valuable framework for the design and management of learning activities. It is essentially used to describe the way an individual learns and deals with ideas and daily situations. The LSI is based on a bipolar view of two learning continuums namely *perception* and *programming*. The vertical axis looks at how the student takes in information through either concrete experimentation (CE) or abstract conceptualization (AC). The horizontal axis measures how students interact with information, which can be through active experimentation either (AE) or reflective observation (RO) (Duman 2010:2079; Pritchard 2014:55) (refer to Figure 2.1 below).

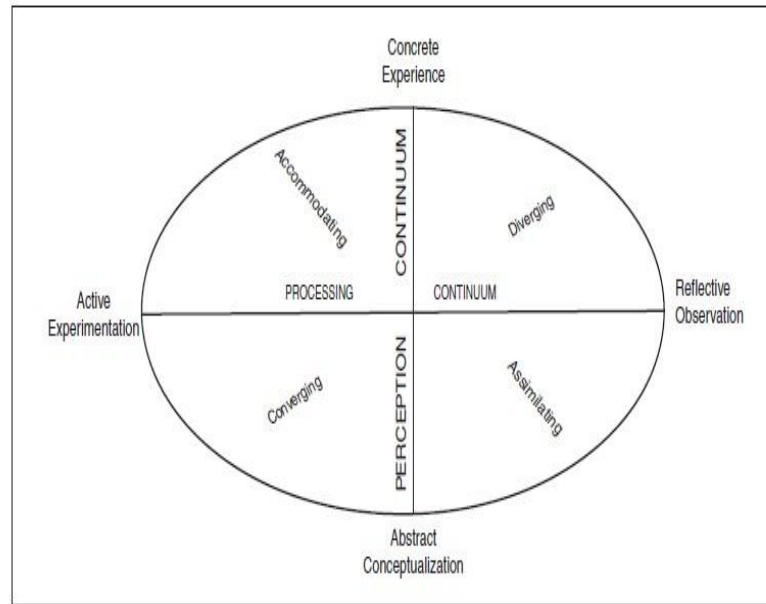


Figure 2.2: Kolb's learning styles model

Source: Azevedo & Akdere (2010:193)

The different learning modes identified in Figure 2.2 described by Barmeyer (2014:581) as follows:

- A high score on CE represents a receptive, experience-based approach to learning. These individuals rely heavily on feeling-based judgments. High CE individuals tend to be 'people oriented'. They learn best from specific examples in which they can become involved such as discussions.
- A high score on RO indicates a tentative and reflective approach to learning. Such individuals rely heavily on careful observation and prefer learning situations such as lectures.
- A high score on AC indicates an analytical and conceptual approach to learning. These individuals rely on logical thinking and rational evaluation. They tend to be more oriented towards things and symbols and less toward other people. They learn best from impersonal learning situations.
- A high score on AE indicates an active orientation that relies on experimentation. These individuals learn best from projects and dislike

passive learning situations.

A combination of these learning modes yields four types of learning styles namely Convergers, divergers, assimilators and accommodators (Bhatti & Bart 2013:1). The most effective and complete learning takes place when learning activities embrace all four modes. However, depending on the individual's preferences, learning may start at any one of the other modes in the cycle (Hawk & Shah, 2007:3; Dymoke, 2011: 55).

As stated earlier, the four types of learning styles, according to Kolb (1984), are Convergers, divergers, assimilators and accommodators. Each one of these will be explained below:

- **Convergers** are good at solving problems and making decisions. They like to make the abstract concrete. They are quite good at taking practical advantage of ideas and theories. Among their other strengths are skills of deductive reasoning and problem detecting. They prefer technical tasks to interpersonal issues (Bennett, 2013:146; Duman, 2010:2079; Yilmaz-Soylu & Akkoyunlu, 2009:45)
- **Divergers** are imaginative and enjoy coming up with new ideas. They are interested in people, values and feelings and are keen on viewing situations from many perspectives. They enjoy producing ideas through methods such as brainstorming. Individuals who have this learning style are able to see concrete situations from different perspectives. Their approach to events is limited to observing rather than acting. They have vast cultural knowledge and enjoy collecting information. Among the remarkable strengths of divergers are creativity, understanding others, being aware of problems and developing a significant perspective about an event by brainstorming (Duman 2010:2079; Dymoke 2011:55; Yilmaz-Soylu & Akkoyunlu, 2009:45).

- **Assimilators** are abstract conceptualizers. Individuals having this learning style can comprehend and transform comprehensive information into a meaningful whole. They prefer dealing with abstract concepts and topics rather than working with people. They generally attach more importance to logical validity of theories than to their practical value. They are good at planning, creating models, defining problems and developing theories. Such people can be used to organize information, create conceptual models, test theories and ideas, design experiments and carry out quantitative data analysis (Bennett, 2013:146; Dymoke, 2011:55; Duman, 2010:2080; Yilmaz-Soylu & Akkoyunlu, 2009:45).
- **Accommodators** prefer concrete examples. They take action readily, prefer acting based on their feelings rather than based on mental analyses and they acquire information through dialogues with people rather than through technical analyses. The most outstanding strengths of students with this type of learning style are practicality, leadership and courage to take risks (Bennett, 2013:146; Duman, 2010:2079; Yilmaz-Soylu & Akkoyunlu, 2009:45).

Figure 2.4 (see below) shows the characteristics, which have been highlighted above regarding Kolb's learning style model.

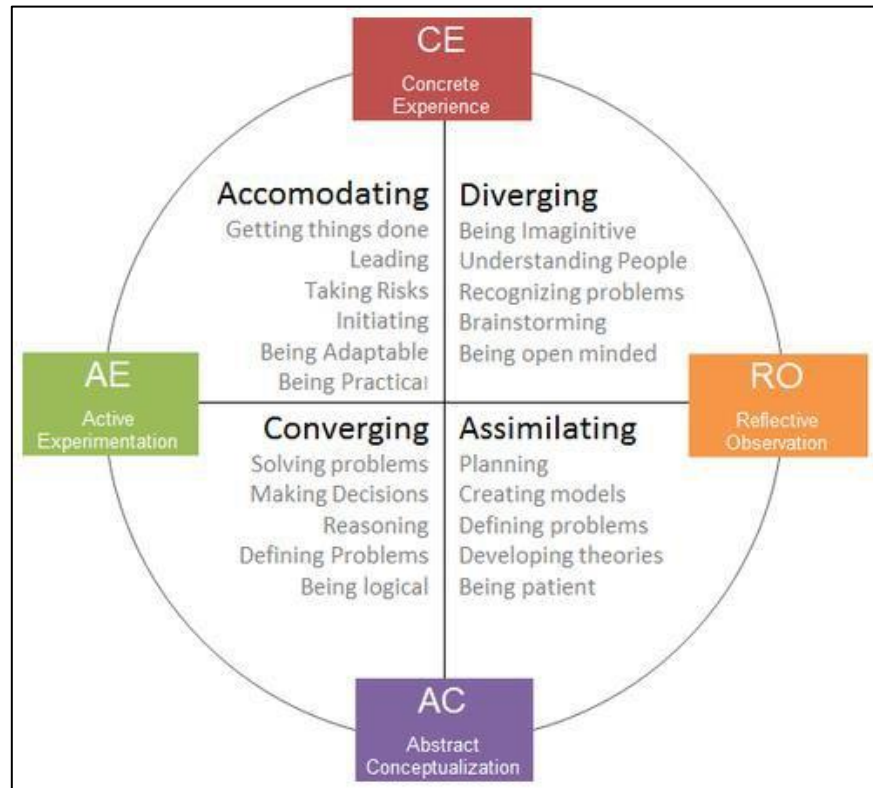


Figure 2.3. Characteristics of Kolb's learning styles model

Source: Barmeyer (2014:282)

Effective students can use each of the above four mentioned learning styles rather than only rely on their preferred style (Dymoke 2011:55; Platsidou & Metallidou, 2009:324). However, all students have a preferred learning style depending on the available instructional materials even though they can develop others with practice (Bennett, 2013:146; Yilmaz-Soylu & Akkoyunlu, 2009:44).

The Kolb model has many advantages. The questionnaire is relatively simple to administer, and score and it has demonstrated a high degree of reliability (JilardiDamavandi *et al.*, 2011:188). It is also the most researched, analysed and replicated of the myriad of LSIs (Aliakbari & Qasemi, 2012:275). However, Kolb's model has been criticised for being too complex (Brown *et al.*, 2013: 207).

2.3 CONCEPTUALIZATIONS OF LEARNING STYLES

Various scholars have defined learning Style mostly as a signal for individual differences. These differences may manifest itself in 'lifestyles' and even in personality types (Zhang & Sternberg, 2005). Honey and Mumford (2012) habitual and preferred ways of processing and transforming knowledge is described as learning style. According to Zhang and Sternberg (2005), psychological attributes, resulted from individual differences, determine the strategies a person chooses while learning. On the other hand, Keefe (2007) emphasizes learning styles, as the relative stable indicators of how learners respond, perceive and interact with learning environment in order to achieve desired learning outcome are traits of psychological, affective and cognitive domain. Moreover, Dunn and Dunn (2011) are of the view that new and difficult information stem from specific learning styles of individual's concentration are on mental process, retention and internalization of difficult information.

Learning style can also be described as a set of factors, behaviours and attitudes that facilitate learning for an individual in each situation. Styles influence how students learn, how teacher teach, and how the two interact during classroom activities. In my own view, the teacher and the students must be able to find desirable learning styles that can promote understanding of the subject matter and lead to desired outcome. Each person is born with certain tendencies toward particular styles, but these biological or inherited characteristics are influenced by culture, personal experiences, maturity level and development. Not only that, the background of the students can as well contribute to the style exhibits by the students. Style can be considered as 'Contextual' variable or construct because what the learner brings to the learning experiences is a part of the content as well as the important features of the learners experience itself. Each learner has distinct and consistent preferred ways of perceptions, organization and retention (Dunn & Dunn, 2011).

The researcher is of the believe that retention can be enhanced with appropriate learning styles. Students learn differently from each other and it has been determined that brain structure influences language structure acquisition. It has also been shown that different hemispheres of the brain contain different perceptions avenues. Some

researchers claim that several types of cells present in some brains are not present in others are responsible for different pattern of perception among individuals.

Some students are visual learners, while others are auditory or kinaesthetic learners. Visual learners learn variables by means of charts, graphs, and pictures. Auditory learners learn by listening to lectures and reading. Kinaesthetic learners learn by doing. Students can prefer one, two, or three learning styles. Because of these different learning styles, it is important for teachers to incorporate in their curriculum activities related to each of these learning styles so that all students can succeed in their classes. While we use all our senses to take in information, the learners do have preferences in how they learn best. In order to help all learners, learn, teacher needs to consider as many of these preferences as possible (Cuaresma, 2008). When we think about a typical classroom situation, it is rare to find all three of these approaches to learning incorporated into a class. While it may seem impossible to do this, it can be done through thoughtful planning and preparation. It does force us to conceptualize the class differently with a focus on the variety of ways in which students learn. The researcher believes that teacher should considering the adoption of more than one preference to promote performance. Teacher's style too should commensurate with learners' styles.

The various inventories on learning styles allow teachers to gain insight into which areas they can use further development in and which are already well developed (Cuaresma, 2008). One of the most significant advances in education has come from a considerable amount of research done in the area of learning styles, which recognizes that the students in classrooms have variety of different learning profiles. Some of the dimensions, which have been investigated in the area of learning style, are perceptual learning styles, field dependence/independence, analytic/global learning styles and reflective/ impulsive learning styles. Some of the benefits of increasing learners' awareness of their own learning styles: "higher interest and motivation in the learning process, increased student responsibility for their own learning, and greater classroom community.

For Felder and Henriques (2009), the criterion for classifying learners is their perceptual behaviour. They make two categories: sensing and intuitive learners. 'Sensing' learners are concrete and methodical; they are good at memorizing facts and doing hands-on work and are more comfortable with following rules and standard procedures. On the other hand, 'intuitive' learners tend to be abstract and imaginative; they like innovation and dislike repetition. As to the ways in which learners prefer input information to be presented, they can be either visual or verbal learners. Visual learners are those who prefer to receive in the form of pictures, diagrams, films and demonstrations while verbal learners prefer words as a medium for information transfer. However, the researcher is of the view that the visual learners are better than the verbal since the Chinese philosophers believe that what learners see, they remember than what they hear.

Moreover, with respect to the ways knowledge is processed, learners can be put into two categories, namely 'active' and 'reflective'. An active learner, as suggested by the name, is someone who prefers to be actively involved in examining and employing knowledge with others. He or she does so in group discussions and interactions with others. Reflective learners tend to employ their introspection. Active learners benefit the most from a dialogue, role-play, cooperative and teamwork learning activities while reflective learners are more inclined to ponder on perceived information. Learning styles were found to affect learners' learning behaviours. Learners having different learning style preferences would behave differently in the way they perceive, interact, and respond to the learning environment (Ma et al. 2013). Since learners differ in their preferences to certain learning styles, it will be important for teachers to examine the variations in their students on the features of their learning styles, because the information about learner's preference can help teachers become more sensitive to the differences students bring to the classroom (Felder & Spurlin, 2015). Adjustments can then be made to accommodate the students' varied needs.

In U.S. Shrestha and Heisler (2011), believed Mathematics serves as a gatekeeper to many academic endeavours of learners at different stages of academic progression. To them, Mathematics provides a channel of communication across cultures, genders and ethnics. It allows learners to solve their real-life problems. Therefore, learners' attitude is very important, and this really affect their learning styles. Learners whose

styles are compatible with the styles used by their teachers tend to retain and grasp better information longer and use it more effectively and have positive attitude towards Mathematics than their counterparts whose styles are not related to their teachers' styles of teaching. Therefore, learning style is very important to effective assimilation and performance.

The term learning style refers to the concept that individuals differ in regard to what mode of instruction, way of assimilating and receiving information in the class with how study is most effective for them (Pashler, Daniel, Rohrer, & Bork, 2008:105). According to Silver, Strong, and Perini (2010), the concept dates back to ancient Greek all the way to the Renaissance. They linked the learning style concept to Hippocrates "FOURNESS". When not in equilibrium cause PERSONSTO exhibit four types of personalities and William Blake's description of the four ZOAS of human existence: the body and its senses; the heart and its capacity for love; the head and its ability to reason; and the spirit and its potential for creative imagination seem similar to that of Hippocrates. Silver et al. (2010) believed that evidence of the learning style concept could also be found in the spiritual stories of Indians of the North American Plains. The four human personality traits are given as wisdom, clarity of perception, introspection, and understanding one's emotions. Murray (2013) reclassified human "FOURNESS" and advanced that humans use perception and judgement as cognitive functions to process information.

According to Murray (2013), perception is used to process information either through the senses or through intuition while judgement is demonstrated through logic of thinking or subjectivity of feeling. Jung's model of the way people process information seems to have motivated educational researchers to develop the many theories regarding the learning styles of students. In this regard, Murray (2013: 153) identified four types of learners. The mastery learner who operates under the sensing thinking realm and learns best from drill, demonstration, practice, hands on experience. The understanding learner who operates under the intuitive-thinking realm and learns best through lectures, reading logical discussion and debates, and projects of personal interest. The interpretative learner who operates under the sensing-feeling realm and

learns best from group experiences and projects, loving attention, personal expression and personal encounters, role-playing. The self-expressive learner who operates under the intuitive-feeling realm and learns best from creative and artistic activities, open ended discussions of personal and social values, activities that enlighten and enhance myths, human achievement, dramas.

Small (2011) opined that teaching should be student-centred, make use of appropriate technology and aim to develop communication skills via small group activities and projects to infuse positive experiences and confidence among students. While no specific learning style was implied by Small (2011). The suggested learning activities could be used to describe the three types of learners identified by Silver et al. (2010) for instance mastery, intuitive and interpretative. Further, Ng, Pinto, and Williams (2011) investigated the effects of learning styles on Mathematics performance of approximately forty students (40) in Cyprus. They used an interpretive and learner-centred approach as well as learning activities that emphasised the applicability of Mathematics to the real world. The study found that learning style was not a significant determinant of students' overall Mathematics scores for the entire group of students despite designing Mathematics to facilitate the diverse ways in which students processed information and emphasising deeper approaches to learning. However, learning styles were significantly related to the average obtained at examination for some subjects from the same sample used in the investigation discussed.

The findings of Ng et al. (2011) while specific to the Mathematics course investigated have implications for the performances demonstrated by year one students. The possible positive effect that accommodating the diverse ways in which students learn might have contributed to whatever increment in student achievement observed in the course. Few supports is given by the "meshing hypothesis" concept which posits that instruction is best provided in a manner that suits the learning style of students (Pashler et al., 2008).

Herington and Weaven (2008) utilizing an action research approach to explore methods of improving the learning styles and outcomes of first year university students within large class environments found that the employment of a student-centred teaching approaches did not enable students to employ deeper methods of self-regulating but served as a motivating tool. In South Africa, most of the classes in public schools are very large; therefore, what can improve learning styles and the teachers should consider outcome are very essential. They attributed the lack of development of a more sustained deeper learning style to the previously developed learning style of students, which may have to be unlearned before a new one is learnt. They further opined that enabling students to transcend surface learning might pose a significant problem for tutors since acquiring a deeper learning style might entail several interventions.

However, Riener and Willingham (2010) believe that the learning style theory is a myth. They agree that since differences among learners tend to affect their performance, teachers should consider them. They contend though those other factors such as learners' ability, background knowledge, and interest vary from person to person and when learning styles are emphasized these important elements are neglected in the analysis of their effect on learning. On the contrary, Murray (2013) believe that when mathematical backgrounds of ethnic groups are similar, but Mathematics achievement is different that the learning preference, among other variables, of these group should be investigated to determine what interventions could occur to improve performance. Clearly, any research into the factors that influence Mathematics performance should also take cognizance of the preferred way/style in which students learn since the diverse findings indicated the possibility of the variable influencing performance at the course and examination level.

In our ever-evolving society, it has become increasingly apparent that 'each student plays an integral role in his individual learning experience' (Weinstein & Hume, 2008: 6). While teachers prepare lessons and present information, ultimately the student interprets, understands, and retains such information in a way that permits simplistic retrieval and recall for application. In order to perform these tasks,

students employ different preferences for and habits of sense making. Learning style in this context is defined as the way in which a person 'begins to concentrate on, process, internalize, and remember new and difficult academic information' (Hall, 2008: 6). Learning styles therefore indicate how the student 'perceives, interacts with, and responds to the learning environment and what they are receiving in form of teacher in the classroom (Hall, 2008: 6).

Although the concept of learning styles appeared as late as the 1970s, there have been many ways to approach this concept. Nevertheless, it is reasonable to classify learning styles from two main perspectives. One pertains to individual processing of information (auditory, visual, and kinaesthetic) (Pashler et al., 2009); the other pertains to individual relationship with other learners (competitive and cooperative). Competitive and cooperative as learning styles are the focus of the present research.

Furthermore, in a classroom setting, most especially in South Africa and beyond, the competitive learner implements an individualistic personal learning plan and employs learning strategies that enable the learner to achieve learning goals (Ma & Ma, 2014). Competitive learners often see all students in the class as working towards the same goal of learning. However, the competitive learner wants not to only become the first in achieving that goal but also achieve that goal in a more outstanding manner than the peers (Ma & Ma, 2014). Consequently, competitive learners often see academic performance as a system of few winners and many losers. The chief benefit of the competitive learning style is the motivation that stimulates great learning effort (Burguillo, 2010). On the other hand, some educational psychologists have argued that competitive learning may not be desirable because it produces high stress, low self-concept (in the case of failure), cheating, and aggression in the classroom (Ma & Ma, 2014).

Ma and Ma (2014) argued that to promote academic success, educators need to understand how students differ in their approaches to learning tasks and use that understanding to create strategies for appropriate learning styles. Johnson et al.

(2012) examined eight cooperative learning methods and found that all of them indicate significantly positive effects on academic achievement. Specific to Mathematics education, Ma & Ma (2014) asserted that, to increase Mathematics performance, how students learn in Mathematics must be analysed. Hall (2008) also asserted that learning styles are a significant determinant of Mathematics performance. In general, review of educational research has indicated a positive relationship between learning styles and Mathematics achievement (Ma & Ma, 2014). Overall, it is important to investigate learning styles as a critical variable in explaining Mathematics performance.

People are not born to share a genetic predisposition in terms of the learning approach; instead, they learn how to conduct learning through a socialization process that is unique to each culture. Of course, some learning styles can be common to students around the world. For example, if tests require students mainly to reproduce knowledge, then memorization dominates their learning styles (Ma & Ma, 2014). However, other learning styles can be very culturally specific. They stated that every culture has unstated assumptions about people and how they learn, and these assumptions invisibly guide the educational process in that culture.

2.4 LEARNING STYLES AND MATHEMATICS PERFORMANCE

There have been many attempts made to enhance students' academic achievements. It has always been the main concern of many dedicated teachers and parents that their students and children be as much success as possible. In relation to this, many teachers are convinced that students need the positive attitude to succeed academically. Often, once learning style is identified to determine strengths for academic achievement. Dunn, Beaudry, and Klavas (2009) assert that through voluminous studies, it has been indicated that both low and average achievers earn higher scores on standardized achievement and aptitude tests when they are taught within the realm of their learning styles. Chuah Chong-Cheng (2008) discussed the importance of learning styles as being not only necessary, but also important for individuals in academic settings. Most students favour

learning in particular ways with each style of learning contributing to the success in retaining what they have learned. As such, studies carried out conclude that students retain 10% of what they read, 26% of what they hear, 30% of what they see, 50% of what they see and hear, 70% of what they say, and 90% of what they say as they do something (Chuah Chong-Cheng, 2008). The above findings are corroborated by Iyunade (2014), which says some students are visual learners, while others are auditory or kinesthetic learners. Visual learners learn visually by means of charts, graphs, and pictures. Auditory learners learn by listening to lectures and reading. Kinesthetic learners learn by doing. This is also in line with constructivist theory that says, "Learning occurs when learners are actively involved in the learning process as it leads to more understanding and knowledge acquisition" (Adu, 2018: 43).

These facts reveal that each learning style has its own strengths and weaknesses. Some students learn in many ways, while others might only favour one or two. Those students with multiple learning styles tend to gain more and obtain higher scores compared to those who rely solely on one style (Dunn, Beaudry & Klavas, 2009). Additionally, the differences in learning styles have also been reported between gifted and the underachievers; between the learning disabled and average achievers; among different types of special education students; and among secondary students in comprehensive schools and their counterparts in vocational education and industrial arts (Dunn & Dunn, 2011). Some special students favour kinesthetic instruction, such as experiential, active and hands-on, while many others are auditory and visually oriented. Researches have shown that combination of any of this will enhance Mathematics performance (Hermond, 2014).

Abidin et al. (2011) also believed that poor auditory memory is attributed to low achievers. Although they often want to do well in school, their inability to remember information through lecture, discussion, or reading causes their low achievement especially in a traditional classroom environment where teachers dominate, and students mostly listen or read. It is not only the low achievers learn differently from the high achievers; they also vary among themselves. Impulsive students for instance, when compared to reflective ones, show poor academic achievement (Hermond, 2014).

Other studies show that Field Independent students achieve more than Field Dependent ones (Hermond, 2014). Studies also reveal that matching teaching and learning styles can significantly enhance academic achievement at the primary and secondary school levels (Bosman & Schulze, 2018). According to Adler and Pillay (2015), students learn more when information is obtainable in a variety of approaches than when only a single approach is applied. The researchers strongly believe that approach is determined by the availability of instructional materials. Much experiential research indicates that learning styles can either hamper or increase academic performance in several aspects even though not much research has been conducted on the relationship between the instructional design of instructional materials and learning styles (Adler & Pillay, 2015). In general, a rich data has been obtained through studies on learning styles; however, the data have rarely been exploited by designers of instructional programs thereby a greater understanding of learners' approaches to learning can be obtained.

There have been several researches conducted to show the relationship between learning style and academic success or achievement. Matching teaching styles to learning styles can significantly enhance academic achievement of students at the primary and secondary level (Nzesei, 2015). Dedicated teachers have attempted to enhance their students' academic achievements (Abidin et al., 2011) in many ways. One of these ways according to Abidin et al. (2011) is to identify each student's learning style to determine strengths for academic achievement. In a study of Castro and Peck (2010) on learning styles and learning difficulties of foreign language students, they claimed that the preferred learning style of the student could be a help or a hindrance in the success of the student in the foreign language classroom. Abidin et al. (2011) implied that the students in their study possessed multiple learning styles or a combination of different learning styles, thus, they can learn effectively. They indicated that learning styles make an impact on the students' overall achievement. Nzesei (2015) argued that students who did better are those whose learning style matched the teaching methodologies than their counterparts whose learning styles are not compatible with teaching methodologies.

Academic achievement, creativity, attitude towards learning and thinking skills can increase as a result of student's learning style (Nzesei, 2015). Most researchers in the field of learning styles agree that enabling learners to reflect on how they learn best helps to develop their meta-cognition. Fostering meta-cognition is perhaps the most important advantage that can be claimed for applying learning style theory to teaching and learning, which in turn develop effective learners who can handle challenges in a learning context and excel in examinations. Learning style consideration in learning is therefore an approach that is directed at meta-learning, similar to setting goals, choosing appropriate strategies and monitoring progress which are more effective ways of improving learning outcomes and achievement than those which simply aim to engage learners at the level of presenting information or understanding and use (Nzesei, 2015).

2.5 LEARNING AND TEACHING STYLE MISMATCHES

Whenever there is mismatch between teaching and learning style there is always an associated problem as regards academic achievement and eventually lead to negative attitudes towards Mathematics. Teaching methods vary according to learning styles, a recap of learning styles types are as follows; some students learn by seeing and hearing; acting and reflecting, intuitive and logical reasoning, visualising and analysing are displayed by students. Whenever variety of these are happening, teachers need the skill of harmonising all these. If this does not happen, the learning process suffers and the natural differences in learning patterns displayed by the students can be interpreted by teachers as deficient (Naik, 2013:136). As a result, teaching and learning style dimensions should parallel one another. However, this does not often happen. It is difficult to determine each student's learning style and then teach to it exclusively or to put students into different classes based upon their learning style preferences. However, teachers can address the learning style of most of the students in a class or provide a variety of learning experiences that cater for different styles (Aliakbari & Qasemi, 2012:276, 282).

Research has shown that to have positive attitudes toward Mathematics and for effective and efficient teaching and learning of Mathematics, teaching style and learning style have to merge, this will enable students to retain information much longer and apply it to the activities given by the teachers in the classroom (Jilardi Damavandi et al., 2011:187). When teaching is arranged in accordance to learning preferences students' performances increase this is according, empirical evidences of many disciplines not only Mathematics. Bhatti and Bart (2013:1) point out that teachers and administrators can improve the quality of instruction in their schools when they are aware of the learning styles of their students. In other research conducted by Bas and Beyhan (2013:134), it was found that students' attitudes towards Mathematics and positive development of their academic achievement are directly linked to learning styles-based instruction.

Amran et al. (2011:326-327) also added that for any student to be empowered to perform better academically, their preferred learning styles must be considered. Learners' preferred learning styles will improve and enhance their understanding of what is being taught. Teachers are in a better position to develop appropriate curriculum content and to formulate teaching strategies that match the students' preferred learning styles. This enables the students to improve the quality of their learning and therefore empowers them to perform better academically.

Bhatti and Bart (2013:4) found that in many undergraduate courses the common instructional methods employed favoured and better fitted the converged learning style. As a result, many students with non-converged learning styles, such as the dominant assimilator learning style, may not perform as well as the converged learning style students. Since they believed this was unacceptable, they suggested that courses and programmes in the university should be designed to accommodate multiple student learning styles. This would therefore facilitate student learning. Ahanbor and Sadighi (2014:183) corroborate the above findings. According to them, the academic potential of students can be enhanced if teachers modify their instruction and offer a variety of opportunities for students to learn what is presented in class. Therefore, prior to

choosing any teaching materials, teachers should conduct a needs analysis in order to determine the learning styles of their students.

2.6 IMPLICATIONS OF LEARNING STYLES ON LEARNING AND TEACHING

With the shift from an instructional to a learning paradigm, there is growing acceptance that understanding the way students learn is the key to educational improvement. To achieve a desired learning outcome, one should provide teaching interventions that are compatible with the student's learning styles. Thus, learning style is a concept that is important not only in shaping teaching practices, but also in highlighting issues that help school administrators think more deeply about their roles in facilitating student learning.

When teaching takes place in or out of the classroom, students are expected to learn. Because teaching is intended to result in learning, high school teachers can benefit from understanding and applying certain principles of learning when designing and implementing their teaching initiatives. In addition, because neglect or misapplication of principles of learning could easily result in teaching that fails to achieve results, it is important that teachers become familiar with the underlying principles in learning. Previous studies have reported that students' learning performance could be improved if proper learning style dimensions could be taken into consideration when developing any learning or instructional process (Graf, Liu, & Kinshuk, 2010).

According to Nzesei (2015), learning may not take place if the teaching is not structured to facilitate learning even when the teaching mode is appropriate. Learning factors (principles) that will affect the learning of students and the success of teaching efforts are setting the stage provide clear instructions and modelling appropriate behaviour when emphasizing particularly skills or competencies, increasing learning during teaching. Also, providing active participation, increasing self-efficacy, matching teaching techniques to students' self-efficacy. Providing opportunities for inactive mastery, ensuring specific, timely, diagnostic, and practical feedback and providing opportunities for students to practice new behaviours and

maintaining basic knowledge in particular areas- developing learning points to assist in knowledge retention, setting specific goals, identifying appropriate reinforcers, teaching students how to reinforce their learning and teaching students how to take responsibility of their own learning.

The basis of learning research must be the individual learner because that is the learning unit. However, most teaching efforts today are made at the classroom level with a relatively large group of students. Thus, while the teaching approaches are at the class (macro) level, learning takes place at the individual student (micro) level, influenced by their individual learning style preferences (Nzesei, 2015). The challenge to the teachers is the attempt to bridge this gap.

Proponents of learning style assessment contend that optimal instruction requires diagnosing individuals learning style and tailoring instruction accordingly. Assessments of learning style typically ask people to evaluate what sort of information presentation they prefer (e.g. words versus pictures versus speech) and/or what kind of mental activity they find most engaging or congenial (e.g. analysis versus listening) although assessment instruments are extremely diverse. The most common-but not the only-hypothesis about the instructional relevance of learning style is the meshing hypothesis, according to which instruction is best provided in a format that matches the preferences of the learner (e.g. for a visual learner emphasizing visual presentation of information).

According to Dunn (2012) the chalk and talk method of teaching hypothetically ignores differences in students learning styles and the potential increase in student academic achievement associated with matching instructor's teaching methods with student-learning styles. It is ironic that the practitioners of the discipline devoted to the study of efficiency principles are implicitly accused of being inefficient in their approach to teaching that discipline. According to Nzesei, (2015), learning styles methodology is the optimal method of teaching that most closely matches student-learning styles. Learning styles are composed of multidimensional preference for elements within environmental, emotional, sociological and psychological strands.

According to Coffield, Moseley, Hall and Ecclestone (2016), comprehensive review of learning styles, an instructor wishing to utilize a learning style approach must decide which of the many different learning style theories or approaches is to be adopted. Hawk and Shah (2017:11) suggest that knowledge of the overall learning style profile of classes allow us to adjust our learning approaches as the profile changes from course and across semesters or school terms. Results of a study conducted by Terregross et al. (2009) indicated that the learning style characteristics of students appeared to have a significant relationship to the students' achievement. A reasonable reference from the findings was the way instructors convey knowledge to students. Particularly the congruence of that manner to the learning style of the students can be expected to systematically influence the performance of those students in learning the material.

In teaching, whether teachers are aware of it or not, an assumption underlying many of the current teaching practices is that students are empty vessels and teachers' role is to fill them with knowledge and academic content. However, increasingly, research on student learning suggests the metaphor of dialogue is more appropriate in that it emphasizes the interactive, cooperative, relational aspects of teaching and learning (Nzesei, 2015). Once faculty shifts from the empty vessel model to a dialogue and communal one, old habits in teaching begin to shift. A lecture class no longer entails simply a scripted delivery of information (no matter how well done), but it may also include a variety of active learning techniques that truly engage students in the collective dialogue. This is built on the fact that students' bodies are increasingly diverse, in terms of not only ethnicity and gender, but in terms of age, nationality, cultural background, etc. This diversity can affect classroom settings in many ways, including the diversity of learning styles. For example, older students who can draw from their life experience are more likely to be independent, self-directed learners (Nzesei, 2015). Despite the apparent tendencies, it is equally important not to pigeonhole students because of expected learning styles since a vast range of individual differences is evident with any demographic group (Knowles, 2008).

Any good teacher strives and passionately stays committed to his/her discipline/profession. Teachers are anxious to convey its significance and knowledge base to their students. Despite the good intentions, one may be so concerned with covering the subject matter that he/she loses track of how much of that material really is conveyed through their taken-for-granted teaching modes (Nzesei, 2015). For example, in a typical fifty-minute class, students retain 70% of what is conveyed in the first 10 minutes but only 20% from the last 10 minutes (Nzesei, 2015). If the teachers (therefore) want to get the message across, they need to orchestrate the content and material in a multi-faceted way across the range of student learning styles.

If teachers are not inclined to much self-reflection about their teaching methods and practices, they are likely to continue teaching their students the way they learn best, assuming that this way will work for all students (Nzesei, 2015). But given the increasing diversity of the student body, as well as the higher expectations for teaching performance among high school administrators, it's likely that many teachers feel the urgency in rethinking their teaching methods. The contention is that, by trying to consider students learning styles, teachers may be able to reap equal satisfaction from reinvigorating their teaching practices hence high academic achievement (Nzesei, 2015). Realistically, no teacher can expect to develop different ways of teaching for each individual student in their class, but they can provide variety of learning experiences such as that at one point or another each learning style is addressed.

2.7 LEARNING STYLES CRITIQUE

According to Reid (2015:80) and Sparks (2006:522) there have been some criticisms of the concept of learning styles. The criticisms rest on several key issues namely the lack of reliability and validity of some of the learning style instruments and the many competing perspectives on learning styles (in light of the fact that there are over 100 identification and assessment instruments) (Allcock & Hulme, 2010:67). According to Coffield et al. (2014:1), there are 71 models of learning styles and only

13 of these are considered major models. The remaining 58 consist of rather minor adaptations of one of the leading models and therefore lack any influence. Some models offer new labels for existing constructs as the basis for claiming to have developed a new model. Others have been used only on very small or homogeneous samples or have been briefly popular and then fallen into obscurity. It is important to note that the field of learning styles research is characterised by a very large number of small-scale applications of particular models to small samples of students in specific contexts. There have been very few robust studies, which offer, for example, reliable and valid evidence and clear implications for practice based on empirical findings (Coffield et al., 2004:1).

Another criticism directed at the concept of learning styles is that there are many competing ideas about the term 'learning'. This has led to a propagation of terms and concepts, many of which are used interchangeably in learning styles research. Examples of such terms are learning strategies, approaches to learning, cognitive styles, conative styles, cognitive structures, thinking styles, teaching styles, motivational styles, learning orientations and learning conditions. Sometimes these terms are used precisely in order to maintain distinctions between theories; at other times, they are used very loosely and interchangeably. Some theorists offer clear definitions of their key concepts at the outset but forget to maintain the limitations they have placed on their language in later papers (Coffield et al., 2004:2).

Other criticisms levelled at the concept of learning styles highlight the impracticality of addressing all the individual learning styles of all the students in a class. There is also much controversy on whether matching learning styles to teaching styles and teaching materials does produce more learning that is effective. The commercial element that accompanies a learning style perspective also needs to be highlighted. Teachers often must attend training workshops and purchase expensive materials in order to understand learning styles. As a result, the learning styles approach does not always have a sound image in educational psychology literature (Coffield et al., 2004:2; Reid, 2015:80).

Sparks (2006:521-522) concludes that numerous studies have shown that teaching according to students' learning styles without appropriate teaching styles would not improve achievements. Moreover, many of the learning style questionnaires are self-reporting so if the students do not understand how they learn, they might answer the questions incorrectly.

2.8 ENVIRONMENT AND SOCIAL SUPPORT ON LEARNING STYLES

a. Environment

The first discussion is on environment, which affects the ability of learner in the process of learning. The environment encourages the learner to either have a positive or negative self-perception of him/herself. This can be experienced in a classroom situation or home environment.

Larson (2009:156) defines environment as follows: -

Environment literally means surrounding and everything that affect an organism during its lifetime. In other words, environment is sum total of water, air and land interrelationships among themselves and with human being, other living organisms and property.

The environment with the learner also includes the place where the learner is studying. It is how conducive the place where one is studying. The classroom may have bright lights or natural light coming in. Some students may prefer a quiet place whereas others may enjoy studying with a background music in order words; environment has a lot of influence on learner's styles. In my own view, environment has a lot to do with instructional materials as well. For example, environment will determine the availability of technology and other sophisticated materials. Environment cannot be only confined in the classroom. Some other factors affect the learner in the community and family.

The child's environment is also his family, school and at times church. Sociologists regard these institutions as the fabric of the society. These play a vital role in the development of a child's ability to cope with the world. These are responsible for the cognitive, social, emotional, physical body, speech, and language abilities. The cognitive development is the one that is to be emphasized on since it is responsible for the learning styles and influenced by the environment in which a learner grows. The environment can influence the learner negatively resulting in low or high self-esteem (Metofe & Walker, 2014).

Taking high self-esteem individuals as it affects the learner in the process of learning. Persons with high self-esteem are often regarded to be better in setting and meeting their goals than low self-esteem. The people who are depressed and with low self-esteem suffer when they are rejected, and want to bring others to like them. Yet, on the other hand, they continue acting precisely the way that caused them to be repelled.

Metofe and Walker (2014: 24)

Among high self-esteem individuals, unstable self-esteem appears to reflect more fragile and vulnerable self-feelings and greater reactivity to both positive and negative self-relevant events. In contrast, among low self-esteem individuals, unstable self-esteem appears to reflect more resilient self-feelings, and less adverse reactions to negative self-relevant events.

It is also suggested that depressed people

- a. engage in self-serving downward comparisons
- b. solicit highly positive feedback from others and
- c. make self-serving attributions.

Example, they take special credit for success and deny responsibility for failure in area of their favourable self-evaluation.

Metofe and Walker (2014) asserted that low self-esteem plays an important role in emotional and dysfunctional behavioural problems. The authors list just a few of these following variables, for example, anxiety, depression, loneliness, jealousy, shyness, and the general unhappiness. It is also asserted that people with low self-esteem are less assertive, less likely to enjoy friendships, and more likely to drop out of school. Furthermore, they are more inclined to behave in ways that pose a danger to themselves

or to society. Low self-esteem is also associated with unsafe sex, teenage pregnancy, the aggression and criminal behaviour, the abuse of alcohol and other drug related activities. These individuals belong to deviant groups.

The deviant groups feel they are socially rejected. Leary, et al. (2005:6) use these following definitions to describe the social rejection:

- a. Sociometer – is first used as a model in the discussion. It is defined as a means of detecting rejection and acceptance of an individual socially.
- b. Dysphonic emotions – is a reaction of many kinds like depression, anxiety, loneliness, etc.
- c. Substance abuse, sexual behaviour, etc.

The exclusion and rejection of an individual is related to the maladjustment of people. These characteristics cited above are determinant factors of misbehavior among adolescents and a means of self-protection in misbehavior. The perception of the causes of low/high self-esteem is said to be related to extrinsic factors such as, socio-economic status, social fabric, dissonant religious context, broken family, birth order, etc. Socio-economic status refers to the social level, namely, the lower class, middle class, upper class, etc.

Social fabric, which is not very familiar to most people, is associated with family relationship in determining self. In addition, social integration may be viewed as a feature of society or as a characteristic of the individual. Feeling of attachment to groups, institutions or norms is a type of integration. The attachment is influenced by a person's level of self-esteem.

Divorce and death of one of the parents is regarded as broken family syndrome that leads to low self-esteem especially among the HIV/AIDS orphans. The orphans become victims of molestation by their relatives, which leads to guilty feelings, or the fear of reprisal if they come out and tell about their situation. This automatically leaves the victim with very low self-esteem and that no one to share the problem with.

Divorce has a negative influence on the child's self-esteem because parents end up using the child as an object of unleashing their anger and frustration. In some religions and beliefs, divorce is regarded as a social stigma. The persons involved in divorce are

forced to reconcile even if they are not compatible. Some stay in marriage though they know very well that they have problems but because of the stigma, they do not opt for divorce. This unhealthy relationship affects the children.

The above-mentioned characteristics and assertions lead to dysfunctional learning styles, which affect the academic performance of learners. They are unable to function in a classroom situation because their peers are not intelligent enough to learn regard them. Even the educators expect them to fail if they are given a task to perform because of their behaviour. Some educators label them as 'problem children'. Hence, it is advisable for the educators to identify them and guide them accordingly.

b. Social Support

The social support system as it relates to academic achievement and self-esteem overlaps with socio-economic status, parental support and teacher support. Society and self-values are assigned equal weight. Each quality may not be equally important to an individual. He/she may care a great deal about one and not care about the other quality of life. Values differ according to social learning, social roles and social groups (Davidavitch, 2017).

Students who participated in voluntary and formal organizations or extracurricular activities had high self-esteem. Participants who took part in leadership in any club and class showed high self-esteem. Low self-esteem students are less likely to join formal groups like friendship groups, cliques, gangs, crowds, potlucks, etc. The society in which the student lives in has an impact on the student's behaviour, learning styles, and academic achievement not only that the environment can also have a negative and positive influence on the student performance. Example, students living in the rural areas where poverty is prevalent tend to have low self-esteem because they are possessed by the inferiority complex as they interact with others. The society they come from has specific norms and values related to who they are (Constantiene & Wiebke, 2012).

Constantiene and Wiebke (2012) assert that, social psychologists who study the phenomena of socialization, meaning the process of being made fit or trained for a social environment, are interested in how the individual learns. The rules governing his/her behaviour toward other persons in his society, the groups of which he is a member and

individuals with whom he/she comes into contact. Attitudes have generally been regarded as learned predispositions that exert some consistent influence on responses toward objects, persons, or groups. Attitudes are usually seen as products of socialization and therefore as modifiable.

The behaviour of an individual is often consistent with his/her attitudes towards his environment. It was suggested that attitudes of a person about a group of people or the environment could often be changed by inducing the person to change his behaviour toward the group or environment. There is also the perception that a person infers unknown characteristics of another from other characteristics that he/she does know. The inferred characteristics can be positive or negative toward certain perspectives more specifically on educational achievement. These attitudes affect the individual's choice of remaining within the society or environment (Ahmar, 2013; Khumalo, 2013).

2.9 THE CONCEPT OF INSTRUCTIONAL MATERIALS: AVAILABILITY AND UTILIZATION

Different authors have defined instructional materials. Learning materials are concrete objects or physical objects that can provide visual, sound or both to the sense organs and these objects can be locally made or imported, but it is certain that they will provide good performance. According to Abdullahi (2014), these materials will help the teacher to make a lesson much clearer to the learner. Instructional materials are also described as concrete or physical objects, which provide sound, visual, or both to the sense organs during teaching (Agina-obu, 2016).

Adu et al. (2016) explained instructional materials as resources or teaching materials, which a teacher utilizes in the course of presenting a lesson in order to make the content of the lesson understandable to the learner. They explained that one of the principles of Mathematics education is that the instructional materials to be used in training the learners should be a replica of what is obtained in the learners' environment. Abimbola and Udonsoro (2012) posited that instructional materials are two or three-dimensional aids used by a teacher in order to save students from wondering in imagination and to help their understanding. According to Agbulu and Wever (2011), instructional materials

are important because they are used for the transference of information from one individual to another, help the teacher in extending his learner's horizon of experience, stimulate learners' interest and help both teachers and students to overcome physical limitations during the presentation of subject matter, among others. In fact, Mathematics as a discipline cannot be taught in isolation. Having instructional materials is not more important than using them appropriately for dissemination of information during classroom activities (Adu et al. 2016).

In Kenya, Instructional materials can be improvised, (SMASE Project, 2010). Improvisation depends on teachers' adventure, creativity perseverance and curiosity. These skills need to be possessed by the teachers in order to facilitate pedagogical content knowledge. Such skills are only realized through well-planned training program on improvisation, improvised instructional materials involve the fact of producing and using alternative resources aimed at facilitating instruction. It involves deployment and selection of relevant instructional materials when there is shortage for meaningful classroom interaction.

Teaching at any level requires that students' exposure to some form of simulation. Ikerionwu (2012) refers to instructional materials as objects or devises that help the teacher to make learning meaningful to the learners. Instructional materials, which are educational inputs, are of vital importance to the teaching of any subject in the school curriculum. Adu et al. (2018) opined that the use of instructional materials would make new facts given by the teacher to stick to the memory of the learners. A teacher who makes use of appropriate instructional materials as a method of teaching and aids to supplement his teaching will help enhance student's innovative and creative thinking as well as help them become enthusiastic.

Instructional materials refer to objects or devises which help the teacher to make learning meaningful and interesting to the learners, as a researcher I fully agree with the assertion since Mathematics involves daily occurrence in life. Life itself is a calculation, it involves addition and subtraction, you part away with many things and absorb many things (Adu et al., 2018). Instructional materials can be classified into

two as learning styles have its own classification. There are two categories of instructional materials; visual materials made up of reading and non-reading materials, and audio-visual materials comprising electrically operated and none electrically operated materials.

According to Aduwa et al. (2016), these materials and resources include, audio tapes recorders, video tape recorders, slide projectors, still pictures, programmed instructional filmstrips, maps, chart, graphs and many more; offer a variety of learning experience individually or in combination to meet different teaching and learning experiences. Adu (2018) talk of teaching and learning materials as those that are accessed in the school environment. The authors emphasized the role of environment in promoting the use and availability of instructional materials. Schools in a remote arears are vulnerable with having electronic gadgets. Even schools in the City without adequate security are also vulnerable. The type of environment will determine the use of ICT equipment in schools. Some schools in Pretoria and Johannesburg in South Africa are enjoying modern ICT facilities while other areas are not (Adom & Adu, 2018).

Instructional materials can be improvised (SMASE Project, 2010). Mntunjani (2016) noted that improvisation demands adventure, creativity, curiosity and perseverance on the part of teachers. Such skills are only realized through well-planned training program on improvisation. The researcher believes that there are some instructional materials that the teacher can provide within the learning environment for teaching Mathematics such as bottle-tops, counters, matches sticks, charts etc. Mntunjani (2016) asserts that improvised instructional materials may be used as practice devices with which the students build accuracy, understanding and efficiency. According to Dada (2016), improvised instructional materials involve the fact of producing and using alternative resources aimed at facilitating instruction. Again, Ikwuas and Onwiodiket (2013) state that improvised materials involve selection and deployment of relevant instructional elements of teaching and learning processes in absence or shortage of standard teaching and learning materials, for meaningful realization of specified educational goals and objectives. Mntunjani (2016) had earlier noted that the approach

of using improvised materials in Mathematics classroom assist in proper introduction of new skills, develop understanding as well as show the appropriate way of doing things.

Instructional strategies need to be identified where the use of manipulative is often suggested as some of the effective approaches to improve student Mathematics achievement (Gurbuz, 2010; Sherman & Bisanz, 2009). Mathematics manipulative-based instructional techniques are approaches that include opportunities for students to physically interact with the objects to learn target information (Charbonneau & Marley, 2012). For example, at the elementary level, teachers use play money to help students learn basic arithmetic functions. The use of manipulative in Mathematics instruction has been cited as a strategy to allow students draw on their practical knowledge (Mntunjani, 2016). Concrete objects that resemble everyday items should assist students in making connections between abstract mathematical concepts and the real world (Brown, Neil, & Glernberg, 2009).

Brudett and Smith (2014), in their study based on 57 schools in England and Wales concluded that those learning institutions with abundant learning and teaching resources, favourable student-teacher ratio, commendable workload and good reward and incentives for teachers perform better than the institutions that do not provide the same. However, in a clear departure from the above views, Orji (2012) and Ekpe (2010) in their independent studies agreed that instructional materials are not necessarily important if the learners are intelligent and the teacher has good mastery of the subject matter. Egbu (2012) argued that involving learners in classroom activities is what matters most as it makes teaching learner centred. The researcher concurs to this sentiment of Egbu because in South Africa, whenever a teacher possesses the mastery of the subject matter with the use of learner-centred method, such is very lively, and learners' level of retention is very high.

Eke (2010) carried out a survey study on the various roles of using instructional materials in teaching Mathematics in primary schools in the Isukwata local government. The finding showed that instructional materials make abstract ideas concrete and

easier to understand. Similarly, Mntunjani's (2016) study on the usage of instructional materials by Mathematics teachers in junior secondary schools in Oredo local government area of Edo state. In this study, female teachers were found to use instructional materials more than the male teachers did. The finding equally showed that female teachers are more predisposed than the male teachers in terms of improvisation of instructional materials are. Williams (2015) conducted a study on the extent of utilization of instructional facilities in secondary schools in the Gboko Education zone of Benue state, which found that instructional facilities appear to be inadequate. Nwafor (2012) carried out a study on the availability and utilization of Mathematics Instructional materials in secondary schools in Onueke Education zone of Ebony, State. According to this study, instructional materials were available but underutilized. Ifeaka (2005) studied the influence on the production and utilization of instructional materials on students' attitude to Mathematics and Chemistry in Anambra state. The results revealed that both Mathematics and Chemistry teachers tend to show a poor attitude towards the production of instructional materials.

In Tanzania, visual resources such as pictures, diagram buildings, projectors, teacher themselves, charts, real objects, books, newspapers, magazines, pamphlets, handouts, clock face, simple abacus, coloured objects, puppets, models and chalkboard likewise audio resources such tape recording cassette, radio, CD and dramatization are instrumental to the development of child mental and cognitive ability. These resources are essential to enhance performance. Similarly, audio-visual resources like television, video recording, motion pictures with soundtracks, slides, films and multimedia, computer and DVD played pivotal roles in learners learning styles and performance generally.

In Uganda, instructional resources play a significant role in the teaching and learning process particularly with students who have dyscalculia. Characteristic of them is the working memory deficit and may be mediated by factors such as intelligence quotient (IQ) or processing speed (Hulme & Snowling, 2009). They assert that many schools do not have visual aids and other equipment necessary in teaching maths calculation. They also added that some schools' ratio of sharing is (1:6) one textbook to six students. Students may not understand complex mathematical concepts like such as multiplication,

division and some abstract ones that require implication. Similarly, they do not remember to build on the existing knowledge to help them master what they do not know yet.

2.10 INSTRUCTIONAL MATERIALS IN RELATION TO THE TEACHING OF MATHEMATICS

Savoury (2014) submitted that it is most disheartening to note that most public primary schools in various local government areas in Nigeria do not know the scope and content of educational technology and proper management strategies of any available instructional materials to enhance better teaching and learning. Little wonder then their negative attitude to the resources available. Some teachers see technological advancements as a competitive threat that will invade the teacher's authority in the classroom and so they avoid using them.

Another problem facing or infringing on the academic performance of the learners in public primary schools. Ogundiran (2015) includes non-use of instructional materials, lack of funds to acquire some of the materials that cannot be improvised, lack of adequate room facilities for storage and security facilities, inadequate regular electricity supply to sustain specific audio-visual resources that require specific room temperature. Erratic supply of electricity has a damaging effect on some of these teaching facilities. Added to this problem, includes inadequate specialists in the discipline. Ogundiran (2015) stressed some other factors that infringe on the appropriate use of instructional resources such as unavailability of useful materials; inadequate room facilities and budgets, poor planning, poor communication, unfamiliarity with audio visual materials and methods of teaching. Some of these problems are happening in South Africa except irregular supply of electricity.

Ogundiran (2015) further stressed that many teachers do not pay much attention to understanding the immediate problem affecting the learners in the subject they teach. Likewise, they do not monitor and assess the level of their understanding or performance even as the instructional resources during teaching/learning process thereby hampering the efficacy of the media resources, which in turn affect the academic performance of the public primary learners. For instance, teacher who comes into the

classroom to teach “countable and uncountable nouns” and fails to introduce the instructional material at the beginning of the lesson makes the whole lesson boredom and uninteresting for the learners. In addition, teachers handling Mathematics in the primary schools, dealing on the topic like multiplication signs for primary one and six learners, must come to the class with visual aids. The teacher needs to show each of the multiplication signs to drive his lessons home. Where the teacher fails to use these instructional materials, the learners will find it very difficult to understand the lesson because they cannot see or reason abstractly.

To ensure that the goals of primary education were met, the policy document recommended that primary education should be tuition free, universal and compulsory. It also recommended that teaching and learning must be practical, exploratory and experimental and should be handled by teachers the document also recommended the provision of educational resources centres to boost the availability of teaching materials (Ogundiran, 2015).

According to Orhun (2013), the use of instructional materials at primary level has become an accepted fact in the world over. However, what has not been accepted is the “Modus Operandi” of using and management of instructional materials within the classroom. This implies that teachers differ in their mode of implementation and management of instructional materials in our primary schools has been suggested as one of the problems of teaching and learning. Ideally, no effective education programme can exist without equipment, facilities, and materials. They are indispensable to good teaching and learning. Teachers handling Mathematics and other science subjects complain of lack of equipment and materials to carry out practical exercise with learners. Due of this, some teachers ignore or avoid the practical aspect of science while concentrating their attention on the theoretical aspects. Some try to verbalize their teaching on theoretical aspect. Moreover, by so doing render the lesson vague and abstract. The use of instructional materials in teaching and learning will enable the learner to develop problem solving skills, and positive attitude, acquire and develop functional knowledge and manipulative skills.

The availability and use of mathematical resources should be matched by a good understanding of how and when these resources should be used, as different resources serve different functions at different times, topics, subject, and in different grades (Mtetwa, 2011:255). For example, flash cards are sometimes used for calculation when their primary purpose is to support the learning of place value (CAPS, 2011:247). Another example is that of number lines and number tracks. It has been found that most teachers use number tracks and not number lines in Foundation Phase classrooms (Iannone, 2012:10).

Iannone (2012:10) finds this problematic and argues that the use of number tracks alone limits learners' understanding of numbers and portrays a number system as made up only of cardinal numbers, leaving no space for fractions and irrational numbers. Number lines, on the other hand, broaden learners' understanding of the number system as they support the learning of different types of numbers. Thus, it is essential for each Foundation Phase class to have and use number lines so that learners can have a better understanding of numbers from an early age. The researcher concurs with this assertion not only for Foundation Phase but also for Intermediate Phase (IP). IP is the bedrock of General Education and Training (GET) in South Africa, hence, the researcher uses Grade 6 learners.

The persistence of poor Mathematics results at the school at which the researcher was teaching led her to question of how resources were being utilised to support the learning of number concepts. The researcher looked at resource related challenges that IP teachers experienced when teaching number concept, IP teachers' perceptions pertaining to the importance of using resources when teaching number concept and how they use resources when teaching number concept. The researcher was interested to find out how the basis for Mathematics learning was laid in the IP. Of interest was to find out how number concepts were taught in this phase, as it is the basis for all other concepts. Number concepts (which include computation) are an important part of Mathematics, and proficiency in this area has long been one of the main objectives of

teaching and learning Mathematics in both school and university (Engelbrecht, Bergsten & Kågesten, 2009:928). The next section will deal with the type of resources being used in Mathematics classroom.

2.11 RESOURCES IN A MATHEMATICS CLASSROOM

The term 'resources' goes beyond material objects (Adu et al., 2016) and includes human, cultural time-related resources and material resources. 'Mathematical resource' refers to any form of mathematical apparatus (structured or unstructured), game, tool, paper, or everyday material made, information and communications technology (ICT), which could be used to teach a mathematical lesson or serve as a learning aid (Drews, 2012).

2.11.1 Human resources in a Mathematics classroom

Human resources in a Mathematics classroom include teachers, parents and learners, but of these Mathematics teachers play the most crucial role (Adu et al., 2016). Mathematics teachers are trained and entrusted to facilitate teaching and learning in the classroom. Their qualifications and skills comprise an important resource in educating learners. The number of learners in their classrooms and parental involvement influences the teachers' ability to be resourceful (Adu et al., 2016).

Intrigued by the extent to which Chinese students outperformed American students in international comparisons of Mathematics competency, Ma (2011) conducted a study, which revealed that the more knowledgeable other plays a vital role in the success of learners. In the case of Ma's study, the more knowledgeable others were the teachers and it was evident in Ma's study that their teaching approaches influenced and determined the learners' success in Mathematics. Makgato and Mji (2016) agree that among many other reasons, South Africa's poor results in Mathematics can be ascribed to underqualified Mathematics teachers, their use of outdated teaching methods, their lack of basic content knowledge, inadequate resources, and their having

to teach in overcrowded classrooms.

A significant percentage of a teacher's effectiveness lies in the ability to design and implement teaching that promotes learning (Adu et al., 2016). A lesson plan, which is a detailed blueprint of the goals and activities for a specific class, is a central part of this process. Drawing up a lesson plan entails considering how to organise material in order to achieve the goals and objectives recommended for the course (Adu et al., 2016). In this regard, Makgato and Mji (2016:42) advise that a teacher should:

- Be flexible and not adhere to the lesson plan rigidly because a lesson plan is simply a guide. Valuable learning opportunities will be missed if teachers fail to adjust based on how the class is learning.
- Have alternative plans. The lesson might not go, as planned and necessary adjustments will need to be made. When planning, leave room for one or two possible scenarios and be prepared with alternative plans.
- Find a lesson plan format that is comfortable for oneself because teachers are all different.

Teachers should provide experiences through which learners will be able to develop and build connections (Van De Walle, Karp & Bay-Williams, 2010: 26). In the present context, this means, "teachers should actively introduce mathematical concepts, methods and language through a variety of appropriate experiences and research-based teaching strategies" (NCTM, 2013:1). Mtetwa (2011:255) asserts that improvement of the quality of teaching is the responsibility of teachers. Teachers need to understand what they are currently doing in their classrooms through deliberate and serious observation of and reflection on their own current practice, as there is always more to learn about the content and methods of teaching Mathematics. Van De Walle et al. (2010:23) concur that: The ability to examine oneself for areas that need improvement or to reflect successes and challenges is crucial for growth and development. Best teachers try to improve their practice through reading latest articles, newest books, attending conferences and reading conference proceedings.

Schoenfeld and Kilpatrick (2008:1) argue that in order to improve Mathematics teaching, one must first find out and understand what the dimensions of proficient teaching are. Furthermore, one needs to find a workable theory of proficiency in teaching Mathematics that could be used to guide the selection and use of tools for Mathematics teacher education. Proficient teachers possess knowledge of school Mathematics that is both broad and deep (Schoenfeld & Kilpatrick, 2008:1). Teachers should have both subject matter content knowledge and pedagogical content knowledge (Schoenfeld & Kilpatrick, 2008:4). They maintain that teachers with broad knowledge have various ways of conceptualising the current grade-level content, can represent it in a variety of ways, understand the key aspects of each content area, and see connections with other content areas at the same level (Schoenfeld & Kilpatrick, 2008:4). Their knowledge is deep in that they know the origins of the curriculum and the direction of its content.

2.11.2 Material resources in a Mathematics classroom

There is a wide range of material resources in mathematical classrooms, and these can be grouped into three types (Adu et al., 2016). There are (i) school Mathematics materials, (ii) mathematical objects and (iii) everyday objects. School Mathematics materials are materials made specifically for school Mathematics like chalkboards, computers and textbooks. Mathematical objects refer to resources that arise in the context of the discipline, like a number line and Dienes blocks. Everyday objects include money and bottle tops, which are not related to the Mathematics classroom.

The use of material resources for teaching and learning has been a standard practice for many years among primary school teachers, especially in the Foundation Phase (Drews, 2017:19). Allied to material resources are teaching and learning resources, like textbooks, videos, software, and other tools that teachers use to support learners to meet the learning outcomes recommended by the curriculum. Lesser and Pearl (2008:2) claim that “teaching and learning resources are fun materials used to teach”. While neuropsychologists believe that humans are born with “number sense, or an

innate ability to perceive, process, and manipulate numbers”, this ability needs to be fostered through the extensive use of visual resources (Abramovitz, 2012:2).

Teaching and learning resources in Mathematics classroom are not just concrete materials but can range from concrete to semi-concrete to abstract materials. It is through the activity of manipulating these resources and the resultant experiences that learners are given opportunities to make connections (Drews, 2017:19). Boggan, Harper and Whitmire (2010:2) agree, “It is important for children to have a variety of materials to manipulate and the opportunity to sort, classify, weigh, stack and explore if they are to construct mathematical knowledge”. Martin, Lukong and Reaves (2007:1) refer to concrete materials as “manipulatives”. They define manipulatives as “hands-on objects” that help learners to learn Mathematics better. In sociocultural theory, resources are often referred to as “mediational means or cultural tools” (Furberg & Arnseth, 2009:157). Bornman and Rose (2010:82) add that mathematical resources are visual tools that help learners understand what is being taught or asked. They further explain that visual tools can be real objects, pictures or drawings that are used by teachers to help learners solve mathematical problems (Bornman & Rose, 2010:82). Crafter (2012:34) says, “Resource is a concept that refers to the way in which the individual is simultaneously a seeker and provider of meaning. The classical definition of a resource suggests that it is any object which one resorts to for aid or support”.

The primary purpose of resources is to assist children to make abstract concepts concrete (Nishida, 2007:1). Drews (2017:19) agrees that resources assist in the storage of mental pictures. In the early stages, children are merely memorising numbers and matching their representation as numerals to their spoken names (Anghileri, 2007). In order for learners to be able to compute using the four basic operations, they must first have established basic concepts including more, less, many, one-to-one correspondence with real objects, the concept of sets and basic number sense (Abramovitz, 2012). Mathematics by its very nature is abstract and additional effort is essential to enable learners to understand its concepts, principles and applications (Ojimba, 2013:47). Furthermore, “many principles and concepts in

Mathematics are not simply explained with common sense deduction”, which makes it even more difficult for learners to understand Mathematics (Ojimba, 2013:47).

The value of practical resources lies in their enabling learners to create and store pictures in their minds. This means that engagement with any resource needs to be internalised through mental imaging so that learners can use images even in absence of resources to solve future mathematical problems (Drews, 2017:20). Boggan et al. (2010:2) add that mathematical tools can be used at any grade to introduce, practice, or even remediate a Mathematics concept. It is important for learners to see the calculations and Mathematics they perform and part of their daily life. Providing opportunities to apply basic concepts and operations in daily activities reinforces learners’ skills and motivates them to progress in Mathematics (Abramovitz, 2012).

The use of pictures in Mathematics texts has become an important educational tool and part of a growing interest in notational systems used to present or represent ideas for learners and teachers. Textbooks and workbooks such as the blue books (Department of Basic Education) are being used for visualisation to achieve clarity and focus (Yerushalmy, 2015:217). Yerushalmy (2015:217) explains that visual language in Mathematics can become a resource for activities that promote new ideas and thinking. Visual language refers to the use of words and pictures within the defined shapes and structures, communicating through visual elements. Visual language can be used to simplify challenging ideas, demonstrate deeper meaning or support collaborative thinking. The ability to extract only the important information from a visual tool is necessary for further reasoning about the mathematical object in question. This is a valuable skill for Mathematics.

This is because “the mathematical structure of the problem situation is not sufficiently apparent to the learners” (Yerushalmy, 2015:217). Ma (2010:5) warns about the shortcomings of Drews and Anghileri’s enthusiasm, pointing out that “using mathematical resources does not guarantee the right destination”—the intended

outcome.

Drews (2017:22) advises that learners should be encouraged to use a variety of the same type of resource so that they do not form misconceptions based on experience with limited resources. Learners' ability to use mathematical resources in various ways can stimulate more opportunities for "investigational and collaborative work: such activities are more likely to encourage purposeful mathematical discussion and development of logic and reasoning" (Drews, 2017:22).

The fundamental concern is whether or not teachers understand the value of using mathematical resources to teach number concepts and the rationale behind the use of such resources, as "effective Mathematics teaching entails understanding what learners know, what they need to learn and then challenging and supporting them to learn it well" (NCTM, 2012:16).

2.11.3 Cultural resources in a Mathematics classroom

Language is a cultural and social resource for communication in the classroom (Adu et al., 2016). It includes learners' home languages and their relation to the language of instruction. South Africa has many languages, and it is of the belief that the use of home language to teach Mathematics makes learners to grasp the content of the subject matter. There are some concepts that the teacher needs to explain in learner's home language in order to get the understanding (Adu, 2018).

Language provides a framework for using external speech and internal speech to make meaning of situations (Hines, 2008:4). This statement implies that language is necessary for making meaning. Siyepu and Ralarala (2014:327) agree that proficiency in the language of instruction or Language of Learning and Teaching (LOLT) is a prerequisite for understanding and making sense of the language of Mathematics. However, most learners in South Africa are taught Mathematics in a language that

is not their mother tongue (Siyepu & Ralarala, 2014:327). With English being the dominant language and the language of opportunities, parents who can and want to, enrol their children at schools where English is the LOLT, irrespective of whether they can speak and understand the language. This makes it difficult for learners to access the language of Mathematics too, and make sense of the signs, symbols, rules and formulae used (Siyepu & Ralarala, 2014).

Barbu (2010:13-14) also acknowledges that language is important for learning, suggesting that the difficulty experienced by learners in solving mathematical problems might lie in the complexity of the language in which mathematical problems are given. He conducted research hoping to prove that language and the complexity thereof plays a huge role in learners' Mathematics achievement. The researcher in her findings during her master's degree discovered that most of the teachers sampled are of the opinion that the language use to write Mathematics textbooks are too hard and without clarity (Adu, 2018). He gave English learners sets of the same mathematical problems but simplified to verify that the complexity of language does indeed play a role in the successful solving of mathematical problems. He found that the learners performed better in the problems that were not linguistically and mathematically challenging (Barbu, 2010:13-14). Therefore, language is important as it promotes understanding. Most learners in the Foundation Phase can compute when given context-free computations but find it challenging to do the same computations in context.

Killen (2013:25) adds that Mathematics has its own special language and learners need to learn and master that language in order to understand the subject. English second language (ESL) learners thus have the double burden of having to learn the LOLT as well as the language of Mathematics. Lack of clarity or misunderstanding of symbols inhibits learners from finding the relationship between their existing mathematical knowledge and the new knowledge to be learnt, and this tends to have negative repercussions on their success in Mathematics (Siyepu & Ralarala, 2014:328).

In their study, Siyepu and Ralarala (2014: 327) write about their concern for English second language university students struggling and failing to understand Mathematics. This problem is exacerbated by the fact that some ESL student teachers and teachers (especially Foundation Phase trained) are not proficient in the language of instruction (English) but were taught Mathematics in English. If ESL student teachers struggle to understand Mathematics at university level, how much more will they struggle to teach it? “Learning the language of a new discipline is a part of learning the new discipline; the language and learning cannot be separated” (Schleppegrell, 2007:140). Learners start schooling with an understanding of their home language that they use to construct their knowledge of the world. Teachers should therefore use and build on that language and knowledge, moving learners towards new and more scientific and technical understandings by being aware of the linguistic challenges that accompany the conceptual challenges of learning (Schleppegrell, 2007:140).

It is also important for teachers not to assume that by using a word frequently learners will understand it (Killen, 2011:25). Teachers should not even assume that because learners use words, they understand and know them. Schleppegrell (2007:143) agrees that just knowing mathematical words such as more, less, and as many as, is not enough. She says that learners also need to learn the language patterns associated with these words and how they construct concepts in Mathematics. Mathematical language is not something that learners will learn automatically, it has to be taught (Killen, 2011:25). Furthermore, the ability to work with language alone is not enough in Mathematics. “Mathematics draws on multiple semiotic (meaning creating) systems to construct knowledge: symbols, oral language, written language, and visual representations”—such as concrete, semi- concrete and abstract materials (Schleppegrell, 2007:141). Teachers should therefore use resources together with language to teach learners the language of Mathematics, as this is the basis for everything, they will need to learn to solve mathematical problems.

2.11.4 Time as a resource in a mathematics classroom

Time may be regarded as one of the most valuable resources in a mathematical classroom (Adu et al., 2018:5). They observe, “It is the resource that we often pay the least attention to and end up abusing (wasting) more than any other”. Time functions in schools through timetables, the length of periods and possibilities for homework (Adu, 2018). Time structures school Mathematics lessons to create pacing, sequencing and time-bound tasks. It structures teachers’ work. They point out that teachers have a certain number of days in which to teach their learners and cover the curriculum. They concede that there are worthwhile activities such as sports that may use up some of that time, as well as minor time wasters that add up, such as “morning announcements, classroom business, learners being summoned to the office, assembly and other classroom interruptions”.

Johnson (2014) argues that the most important aspect of time for teachers is the amount learners spend actively engaged in the learning process, not just the amount they spend on school grounds. He further explains that learners should spend less time listening to teachers and more time being engaged in activities using resources that will help them understand and retain the information. “Knowledge or comprehension-level information and skills are pushed into long-term memory by practice, memorisation, or participation in varied higher-order thinking activities” (Johnson, 2014:7). Teaching is a complex task. Teachers tend to feel that there is a lot to do, and only a limited amount of time in which to do it (Francis, 2013). How teachers and schools spend, their time is the critical issue in establishing urgency.

2.12 INEFFECTIVE USE OF MATHEMATICS RESOURCES

The selection and effective use of appropriate mathematical resources requires careful consideration and planning on the part of the teacher (Drews, 2017:21). The mere use of manipulatives does not mean that desired outcomes such as promoting understanding and enhancing knowledge of mathematical concepts will be achieved. Mathematics is not just about completing sets of exercises or following processes

that the teacher explains, but rather generating strategies for solving problems, applying those strategies to help solve problems and checking to see whether the answers make sense. As Van de Walle et al. (2014:12) assert, “Mathematics in the classroom should closely model how Mathematics is done and used in the real world”.

Many classrooms employ mathematical resources such as number charts, number lines and counters. These mathematical resources are designed to represent mathematical concepts. However, it is not always easy for young children to connect concrete objects such as blocks, beans, and sticks with mathematical concepts (Paek, 2012:2). Imagine that there are white blocks, each of them having a length of one unit, and orange blocks, each having a length of ten units, on the same scale, and that the addition problem, $6+7$, is given to a child to solve with these blocks. The child must collect six white blocks, and again seven white blocks. Once the blocks are collected, they can be put together. When the length of the collected white blocks equals that of an orange block, the ten white blocks are replaced by one orange block. The teacher’s intention with this activity is to teach the concepts of addition and place value using concrete materials. However, for young learners, the activity might be a simple colouring exercise, replacing blocks according to their colour. Young learners might not be aware why they are exchanging the ten white blocks for the single orange block, while still following the directions correctly step-by-step. In this situation, the activity becomes simply procedural, which is a commonly perceived problem with manipulatives (Paek, 2012:2).

Mathematics resources such as those mentioned above have been shown to be effective in supporting the learning of number concepts such as addition, subtraction, multiplication, division, and problem solving in various contexts. However, as already suggested, the use of these resources does not necessarily mean that constructive learning is taking place, as resources may not be used optimally (Van de Walle et al., 2010:29). The ineffective use of resources often happens when teachers “tell learners exactly what to do and how to use the resources” (Van de Walle et al., 2010:29). This teaching style does not promote understanding so much as rote learning.

Van de Walle et al. (2010:29) thus caution against “the natural temptation by teachers to take out the materials and showing children exactly how to use them”. Although learners need the direction of teachers in using resources, too much directing from teachers can be harmful. Too much direction on the use of resources or models can lead to learners depending on them and using them as “answer-getting devices rather than tools to explore a concept” (Van de Walle et al., 2010:29). Teachers do this in such a way that it may even look as if the learners understand, “but they could be just mindlessly following what they see” (Van de Walle et al., 2010:29). This suggests that there is a fine line between telling and guiding learners. Ma (2010:5) argues that children will not learn how to use resources on their own. Therefore, the direction that learners take with resources still depends largely on the teacher. The emphasis should be on concept development rather than process or rote memorisation (Abramovitz, 2012). Concept development will ensure understanding, the ability to apply knowledge and know when to use different resources in various situations.

2.13 CONCRETE MATERIALS AND MATHEMATICS PERFORMANCE

Concepts are constructed from a series of experience. Piaget's Stages of intellectual development are useful guides to the teaching in which he emphasizes concrete operational materials that facilitate internalization of concepts presented to them. There is therefore a need to determine the adequacy of teaching and learning resources for Mathematics as this would affect achievement in the subject.

Onasanya (2012) gave various kinds of models used in educational instructional materials namely; mental models, theoretical models etc. These types of models are of special pedagogic significance in Mathematics instruction due to the nature of knowledge and knowledge getting process in the discipline. Concrete models are material objects which are likenesses of natural or synthetic structures or systems and which are intended to highlight and explain or describe structures, functional processes and relationships in the original. Concrete models constructed in the effort to understand the behaviour of the physical world and the causes of such behaviour

(Onasanya & Adegbija, 2007). Huang and Chang (2012) mentioned that assessment of student's mathematical understanding should not be solely based on their writing of the problems but also on their demonstration and oral interpretation.

Concrete manipulative are concrete objects used as tools that allow students to experiment and explore mathematical concepts (Burns & Hamm, 2011). Boggan, Harper, and Whitmire (2010) state manipulative have been used for many years and from several different civilizations to solve mathematical problems that they have encountered every day. When students employ concrete manipulative in long-term use during early elementary level, they have greater mathematical achievement than students who have not used concrete manipulative (Burns & Hamm, 2011). Concrete materials that resemble everyday day items should assist students in making connecting between abstract mathematical concepts and real world.

Hunt, Nipper, and Nash (2011) in their study found many perceived benefits on the use of concrete manipulative. The benefits included trial and error, view mathematic information visually, kinaesthetically break down mathematical concepts, and actively engage in the math lesson (Hunt et al., 2011). "A good manipulative bridges the gap between informal Mathematics and formal Mathematics" (Boggan et al., 2010: 2). Over the past few decades, researchers have studied the use of manipulative in several different grade levels and in several countries (Boggan, Harper & Whitmire, 2010, Castro, 2006; Kelly, 2006). Manipulative can also be referred to as virtual or concrete (hands on) materials.

The majority of the studies indicate that Mathematics achievement increases when manipulative is put to good use. Teachers need to know when, why and how to use manipulative effectively in the classroom as well as opportunities to observe, this will also generate desired learning styles, first-hand impact of allowing learning through exploration with concrete objects. Students who use manipulative during Mathematics instruction outperform students who do not (Adu et al., 2016). Mathematics

manipulative can both be commercial and teacher- made. The ultimate goal of using manipulative is to help children to handle abstract concepts and symbols that are used to represent these concepts. Adu (2018) claims that since all Mathematics come from the real world, the real situation must be translated into symbolism of Mathematics for calculating. In order to help students to construct geometric ideas, concrete educational materials such as geometric rods, geo board, among others are to be utilized. This utilization also provides an opportunity for the teacher to assess and meet the needs of primary school students as they construct personal mathematical knowledge.

2.14 MATHEMATICS PERFORMANCE

Mathematics is one of the formal disciplines that help man to lay a solid foundation for future survival. Scientific and technological developments are dependent on Mathematics. Adu et al. (2016) define Mathematics as a fundamental human activity-a way of making sense of the world. They see Mathematics as an essential tool in the formation of the educated man. Because of its importance, Kenya has made Mathematics compulsory in both primary and secondary School curriculum (Adu et al., 2016) in order to give a sound basis for scientific and reflective thinking and prepare students for the next level of education. Its application in other disciplines, mostly in sciences, is appreciative and without it, knowledge of the sciences remains superficial. However, a considerable number of students have an inadequate understanding of Mathematics and mathematical concepts and skills. According to data released by the Ministry of Education Science and Technology on December 31st, 2014 of the 839,759 of standard eight learners took the 2013 KCPE, which serves as the form one entrance examination, 467,353 scored below the average, receiving scores 250 out of possible 500 marks. Uwezo Kenya's report findings of 2012 showed little progress on student's learning capabilities (Adu et al., 2016).

Mathematics is used as a basic entry requirement into any of the prestigious courses such as medicine, architecture, and engineering among other degree programs. Despite the important role that Mathematics plays in the society, there has been poor performance in Mathematics in Kenyan national examinations (Aduda, 2003). Similarly,

in South Africa too, performance in Mathematics has not been encouraging (Adu, 2018). Several factors have been attributed to poor performance in Mathematics among which are poor methods of teaching and lack of textbooks (Adu, 2018), poor interest in Mathematics (Badimus, 2002; Bodo, 2004). Lack of appropriate instructional materials for teaching Mathematics at all levels of education (Gambari, 2010; Adu, 2018).

TIMSS report of 2011 on Mathematics result analysis showed that Mathematics achievement is improving over the years in some member Countries, Kenya and South Africa are not one though. The percentage of high level and low-level students increased in both 4th and 8th grades. The governments of many countries are struggling in considering how to provide best Mathematics education for their students for example, there are many intervention strategies put in place by South Africa government to assist Grade 12 learners during their matric examination. Subjects like Mathematics and Physical science are of priority. According to the report, students' ability in Mathematics is deteriorating over their school years, as a student grows older, Mathematics competencies decrease. This cut across other developed nations. Therefore, it is imperative for study to be carried out on other hidden causes of Mathematics failure.

Research has shown that Identifying difficulties at an early age can prevent children from developing inappropriate strategies and misconceptions that can become long-term obstacles to the learning of Mathematics (Williams, 2008). Early intervention can also combat the development of anxiety in Mathematics, which can become a significant factor among older students (Dowker, 2009). It can be assumed in most cases that if intervention start early and specific weaknesses are concentrated upon, they might not need to be very long or intensive (Dowker, 2009). Zan and Maartino (2007) reported in TIMSS that 4th Grade students have much more positive attitude towards Mathematics and this plays a crucial role in learning the subject, hence high achievement.

Gathier et al. (2014) in their report assert that junior years are an important time of transition and growth in student's mathematical thinking. According to the report, during this time, the expectations, abstraction, sophistication and expectations of student proficiency are displayed. There is also move to abstract reasoning. Junior students begin to investigate increasingly complex ideas, building on their capacity to deal with concepts that are more formal.

2.15 FACTORS THAT CONTRIBUTE TO LEARNERS' POOR PERFORMANCE IN MATHEMATICS, SOUTH AFRICA

Many factors may be contributing to the continually poor Mathematics results in South Africa. One certain fact emerging from the ANA results is that the problem does not start in the higher grades (Adu et al., 2016). It starts in the Foundation Phase. Thereafter, learners' performance deteriorates as they progress from lower grades to higher grades. The decline from grade to grade in the Foundation Phase. Posthuma (2015) agrees that there is a need for intervention in the Foundation Phase. This is confirmed by the poor performance of Grade 3 learners in the ANA in 2010, achieving an average mark of 28%; in 2011, only 17% achieved 50% and in 2012, 37% achieved 50% (Posthuma, 2015). Spaull (2013:3) suggests that inequality plays a huge role in the performance of learners in Mathematics. He points out that:

The analysis of every South African database of educational achievement shows that there are two different public-school systems in South Africa. The smaller, better performing system accommodates the wealthiest 20-25 % of learners who achieve much higher scores than the larger system, which caters for the poorest 75-80 % of learners. These two systems can be seen when splitting learners by wealth, socio-economic status, geographic location and language (Spaull, 2013:3).

Ndlovu (2011:419) agrees that even findings by the Centre for Development and Enterprise (CDE) suggest that South Africa relies on just more than 400 of its top

schools for half of its Mathematics passes at the 50% level and 350 schools for half of its science passes at the 50% level, out of 5903 schools nationally. The great majority of South African learners struggle to read, write and calculate at correct grade level, with many being functionally illiterate and innumerate. The wealthy minority are an exception (Spaull, 2013:3). According to Mbugua, Kibet, Muthaa and Nkonke (2012: 90), poor academic achievement may also be the result of low socio-economic status. It is believed that “low socio-academic status is associated with limited resources thus lower academic achievement” (Mbugua, et al., 2012:90). This shows that even though South Africa is a democratic country, education is still not equal. Learners are not given the same quality of education throughout the country.

Spaull (2013:4) argues that for disadvantaged learners, there are increasing gaps between what they should know and what they do know. Mbugua et al. (2012: 90) argue that the educational background of learners’ parents and guardians can make an important contribution to minimising such gaps and to the learners’ success in school. They found that most learners’ parents do not have education beyond secondary level. These low levels of education make it difficult for parents to help their children in school activities such as homework, assignments and projects (Mbugua et al., 2012). These factors contribute to gaps becoming bigger as time passes, leaving learners further behind in the curriculum and making it difficult for them to cope in secondary school. Similarly, in South Africa the education background of parents has a lot of influence on their children performance; nevertheless, single parent in which such parent is busy with his or her career raises most of the children. In addition, as Ndlovu (2011:420) argues, very little is being done to find out what underpins the high pass rates in well-resourced or top-performing schools.

Another complication may lie in the way in which the education system measures the functionality of a school (Ndlovu, 2011:420). Mbugua et al. (2012: 87) conducted a study in Kenya to determine factors that might be affecting learners’ performance in Mathematics in secondary schools. They found that looking at learners’ entry marks

to secondary schools from primary schools revealed no reason for their poor performance in Mathematics, as these marks were between 200 and 400 out of a maximum of 500. Measuring a school's functionality according to percentage passes in Mathematics and science as opposed to the quality of education being provided can cause more complications (Ndlovu, 2011:420). This is in line with South Africa where the performance that learners brought from foundation level to intermediate are very encouraging, one is wondering while the performance diminish when the learners are about to finish Grade 6, the last grade of intermediate. Adu et al. (2016) found out that non-availability and utilisation of instructional materials is one of the factors responsible for the decline in learner's performance. Ndlovu (2011:420) suggests that this type of measurement has created tension and discouraged many learners from studying Mathematics at advanced levels. Other factors that lead to poor performance is teachers' workload which also affect quality of teaching

Mbugua et al. (2012: 87) found that the workload of Mathematics teachers might also affect the quality of teaching. They found that some of the teachers used the "lecture method" to teach as this method is not time consuming and covers greater content. Nevertheless, the lecture method is not effective because it does not encourage learners to participate actively in the process of learning (Mbugua et al., 2012:87). The use of outdated teaching methods and lack of content knowledge have also contributed largely to the poor Mathematics results (Makgato & Mji, 2014:254).

Posthuma (2015) adds that teachers themselves often make the same mistakes as learners, which shows that they urgently need in-service training and development to become more competent in their jobs. Thence, the researcher supports the view of many scholars like (Xaso, Galloway, & Adu, 2017) that continuing professional teacher development CPTD should be made compulsory periodically for educators. There are no specific knowledge or practice standards that are defined as guidelines for the development CPTD for preparation of teachers in all phases and subjects in South Africa. South African universities that offer Foundation Phase teacher training develop their own curriculum for the preparation of Foundation Phase teachers in

Mathematics (Posthuma, 2015). Posthuma (2015) finds this problematic because the quality of teachers' training might not be the same and they might not all be equally well prepared.

We cannot have overemphasized the use of resources to teach number concepts and many other topics in Mathematics, which play an important role in determining the quality of education and better performance of learners (Ndlovu, 2011). The focus is on the Intermediate Phase as the basis of the entire schooling system since it is the last grade in this phase and the place where gaps in Mathematics knowledge start to develop. It is of paramount importance for the "learners' future schooling to have developed a solid foundation of basic understanding and skills across the core subject areas by the early grades" (Mullis, 2011:13). Learners performing below the required standard may be at risk for future success in their educational careers and may fall further and further behind their peers as they continue in school (Mullis, 2011:13). This suggests that the earlier the problems are addressed, the better are the chances for future success for learners.

The Cyprus Turkish educational system has recently been updated; they found out that absence of technology integration could affect the performance of the learners (Eyyam & Yaratan, 2014). However, no experimental study has yet been conducted to provide local evidence that educational technology enriches learning experiences and student success in Cyprus. Although the basics of the new formal educational system seem clear, understandable, and appropriate on paper, it is unfortunate that most of the proposed procedures have not been completely accepted by schools and that the implementation of technology in schools is very limited. This could have resulted from the fact that the Ministry forced this program to be implemented without either preparing additional infrastructure or providing necessary in-service training to teachers who are the actual users of the technology; or it may have resulted from a lack of necessary aids, equipment, and resources. Above all, within this context there is no primary evidence that educational technology does, in fact, enhance achievement and have a positive effect on attitudes among students (Eyyam & Yaratan, 2014).

2.16 ACADEMIC ACHIEVEMENT AND LEARNING

When determine an individual success in school, academic achievement is very important and this can affect the life, health and income of an individual (Briley, Harden & Tucker-Drob, 2014:2614). Quality of education is needed for any academic achievement; therefore, all education stakeholders and policy makers' hands should be on the decks to find out what are the causes of low-quality education to increase more spending on education. What is most detrimental to economic and social life even of a country is attributed to poor education. The social and economic development of any country cannot be divulged from quality education. Therefore, to have acceptable quality education that does not limit the articulation of students there is need for every needed work force and resources to be in place.

Adu, et al. (2016) are of the view that individual productivity and future income will be hampered if quality education is not in place or provided for. Students with low achievement due to poor quality education will experience unemployment, delinquency as adults and substance use. They will later become liabilities for their families, societies and countries at large. In South Africa, these set of people increase the social welfare grant of the nation. Government must cater for them because at zero income, consumption must take place. They will become burden to their retired parents and grandparents (Adu, 2018).

Ahmad et al. (2011:266) succinctly described the level of academic achievement or success as being measured with the using of assignments, test and examination results whereas the standard of education is low. They define academic achievement of a student as measure of success. Academic performance or achievement is related to the skills and knowledge developed by a student in various subjects (Adu, 2016).

When student prepare for their final exams throughout the year, there is tendency that they injected many efforts before they wrote final examinations, they study at regular time, they take notes in class, ask questions in class, undertake group discussion, review their notes etc. all these aquiline tasks should perhaps lead to commensurate

achievement. When all these do not lead to high performance, there is need for us to examine other factors that militate against academic achievement. When a student follows class instructions, submit assignment as and when due, contributing in class, pay attention in class, looking for teachers after class, all these must produce desired results. When facing low marks, they ask teachers questions, they have group discussion, they utilise reading materials and subject content in order to get marks. Their opinions are extensive and include 'analysis in progress' while speaking. They sit at the front of the classroom, engage in conversations regarding the topic being studied, ask questions regarding concepts they do not fully understand and ask for feedback regarding assignments, they will have the confidence that they are getting marks they deserve (Adu, 2016; Cerna & Pavliushchenko, 2015:49-50).

A key of keeping and getting students actively involved in their class activities lie in their learning style preference. The performance of such students will be improved. Their attitude will be enhanced because such learning style preferences has the capacity to positively influence not only their performance but increasing their thinking skills, creativity and eventually improved academic achievement, students are actively immersed in the learning process (as the ones described above) will be more likely to achieve success. Once students are actively involved in their own learning processes, they have sense of fulfilment and belonging, they get more confidence and they start to feel empowered and their personal achievement and self-direction levels rise. Instructional strategies with appropriate students' learning styles will improve their ability to concentrate and learn (Tuan, 2011:286).

Students cannot succeed academically because they did not exist in a vacuum without support of other extraneous factors like families, environment, schools and neighbourhoods. These and more factors will be discussed further. Researchers and teachers are very concerned with various ways of maximising the potentials of the students. Students' academic achievement has really captured their attention. Hence, they have originated intervention programmes. In South Africa, government of the day put in place many intervention programmes for matric students, especially in science

related area. (Evans, Richardson & Waring, 2013: 211), A student's academic success is the product of many factors, both individual and contextual. (Chase *et al.*, 2014:884-885; Ghaedi & Jam, 2014:1232).

2.16.1 Factors Which Influence Learning and Academic Achievement in Mathematics

Academic achievement can be influenced by many factors. Let us examine some of these factors on three major headings: the family, school and student themselves. These factors are very important because it has direct effect on the students' academic performance.

2.16.1.1 The family

Learners' family has a lot of influence on academic achievements and their studies. Family background, parental education qualification, environment, siblings, etc. all these are directly linked to the success of any learner. Let us discuss some of these under the following headings.

Parents

Several researches have been done on the influence of parental involvement on the academic performance of their children. Parents need to help their children shaping their academic destiny by assisting in different ways such as with their homework, procuring textbooks, transportation, attending all meetings called by the schools, regular visit to their children class teachers and so on. Research has shown that parents who assist the children with schoolwork make the children record success in their academic (Adu, 2018).

Parent should know the development that take place in their children growth. When a child grows into adolescent's stage, he or she begins to display some potentials, his or her cognitive development will increase, his or her relationship with the other members of the family will also change. He or she will start to develop some boldness and self-confidence. At this stage, he or she needs the parental guidance in making academic

decisions on his or her academic achievement. Failure of parents to monitor at this stage is very problematic and it can affect the academic achievement of the students. Low monitoring will affect the child because, the child will begin to exhibit juvenile delinquency with associated problem like teenage pregnancy, drug abuse and this will eventually lead to lower grade and poor academic performance (Toren, 2013).

The family socio-economic status can also affect the academic achievement of the student, research has shown that parent with high socio-economic status tend to provide for the needs of their children and this can lead to greater academic success (Toren, 2013). Another fundamental role of parent is to be optimistic and positive in dealing with their children. Words of encouragement should be used rather than being pessimistic and comparing their children with others. A child from pessimistic parents will achieve less in academic endeavours. Whereas who have positive expectation from their children will promote in their child self-concept and such child will build a good relationship with his or her teacher. He or she will start spending additional time with his or her reading and teacher and have success in return. It therefore follows that on average basis, parents who have higher expectations for their children have higher achievement (Adu et al., 2016).

The circumstance of the family

Income is one of the issues faced by the family. The high-income family enjoys more privilege than their counterparts with low-income do and their children achieve more than the low-income family. A wide academic gap is recorded between low and high-income parent. This is what led South Africa to consider low-income parents by giving their children free education to bridge the gap (Morrissey, Hutchison & Winsler, 2014). The breadwinners in low-income family may have to do extra job and not available to support the children with their school works. Children of low-income family at times are reluctant to go to school regularly. They go to school reluctantly; they get to school late. In other words, they record high absenteeism, and this could lead to low academic achievement. In South Africa, researcher observes that there is low level of absenteeism rate in primary schools because of the mechanism put in place to curb this are not functional. Parents often receive phone calls or SMSs when their children miss

school.

Absenteeism of students has become global phenomenon, students who absent regularly from school due to one reason or the other may not benefit from teacher's instructions. Peer interactions and other classroom activities will elude them. When this is repeated constantly, it will lead to poor performance and other negative consequences (Morrissey *et al.*, 2014). In addition to this, missing a class many times cannot leave the students the same, even using catch up programme or any assistance may not work because the contents of curriculum is loaded and has stipulated period to cover it. The consequences may be softening in a school with many instructional materials where the learners can be assisted, and they can think independently (Adu *et al.*, 2016).

Their neighbourhoods affect low-income families. Low-income families obviously reside in low cost house that they can afford, they are surrounded by neighbours who perhaps could afford to send their children to good schools, the low-income neighbourhoods are characterised with violence and social vices and this can affect the students in pursuance of their academic career. Academic achievement of students living in the low-quality neighbourhoods will be affected because these neighbourhoods is bedevilled with stress, violence, drug activity, gangs or drug activity. Students living there cannot be motivated; there is negative peer influence and low morale. It is obvious that their school attendance will be affected, high rate of absenteeism will be recorded. They may not be encouraged to go to school regularly and therefore their academic achievement will be low (Adu, 2018).

In addition to the above, schools in low quality environment will lack some resources that can enable the teacher to go extra miles (intervene) in assisting the students with catch up programme. In fact, low-income household children will attend low quality schools than their high-income counterparts. They do have poor attendance records and often get late to class (Morrissey *et al.*, 2014:742).

2.16.1.2 The school

Another factor, which can affect students' academic achievements, is the school environment. In this regard, the school climate, the peer culture, the discipline in the school and the teachers are all important role players. Each of these influences is discussed below.

School and classroom climate

The school climate plays a key role in the performance of students and therefore in their academic achievement. The term 'school climate' refers to the interpersonal relationships which are developed at school and whose quality and stability affects the cognitive, social and psychological development of the child. The term also refers to the atmosphere, which characterises either the school or the classroom. A positive school climate can be created by constructive relationships between the teachers and the students. Teachers who encourage their students to perform, emphasise commitment to learning, provide a relaxed learning environment (dominated by positive feedback and discovery learning), create feelings of security and attract the students' attention are providing the conditions necessary for a supportive, pleasant and serene school climate. Such an atmosphere improves the overall quality and effectiveness of the school and thus enhances the academic achievements of the students (Awang *et al.* 2013:24-25; Babalis, Tsoli, Artakis, Mylonakou-Keke & Xanthakou, 2013:55-56; Fiksl & Abersek, 2014:30). On the other hand, an undesirable school climate is defined by perceptions of unfairness, hostility and victimisation and is negatively related to school engagement and academic achievement (Lynch, Lerner & Leventhal, 2013:8).

Another factor that can affect academic achievement within the ambit of the school climate is the level of respect and self-respect of the students. Njoroge and Nyabuto (2014:291) stress the fact that if self-respect prevails in the school situation, students will learn self-discipline. If there is self-discipline, there is more chance that students will achieve academically.

Apart from school climates, there is also the need for school facilities. If schools have good facilities and the needs of the students are well catered for in the form of sufficient resources, clear codes of conduct, conducive learning spaces and efficient teachers, there should be high-quality academic achievement of the students (Njoroge & Nyabuto, 2014:291-292). Efficient teachers exhibit relevant teaching styles, competent guidance and counselling, positive modelling, teaching efficacy, and the effective use of rewards and punishments. In essence, one of the keys to meaningful learning is therefore trying to make school more enjoyable (Bostrom, 2012:13). Where school becomes home away from home.

Within every school, there are many classrooms. Fiksl and Abersek (2014:28) state that the classroom's function is primarily to cultivate learning. A positive classroom climate promotes students' motivation to work, develops their internal motivation and reduces fear. Students should sense the classroom's academic atmosphere from the moment they enter it. Every item in the classroom needs to emphasise learning in some fashion. Once teachers organise their classes to promote learning, they establish a climate of respect and safety. When students feel they are in a safe and respectful environment, they will express themselves freely. Students also create the classroom climate that is specific to their personalities. Students' personalities are also integral to creating a classroom climate that is conducive to learning (Fiksl & Abersek, 2014:28, 35).

2.16.1.3 Teachers

One of the most important factors that can affect student academic performance is the teacher. Research from Turkey has shown that students with teachers who have more than 10 years teaching experience usually have higher achievement scores than the students of teachers with less experience. However, it should be kept in mind that experienced teachers usually have more say than less experienced ones at schools and thus they may be assigned more successful classes who will probably

achieve top academic results (Bostrom, 2012: 12-13; Jebson & Moses, 2012: 90-91).

Apart from experience, the teachers' subject knowledge is also important. Jebson and Moses (2012:90-91) noted the importance of teachers who majored in their subject areas. Many teachers do teach more than one subjects, which make them not to have deeper knowledge of the content. It was also found that when teachers feel satisfied with their profession, confidently teaching their subjects and have participated in continuing professional teaching development activities (CPTD), the academic achievement of their students is significantly higher than students being taught by dissatisfied teachers. The career satisfaction of teachers, pleasant working conditions and the use of appropriate teaching methods which match the students' learning styles were considered important factors which may have positive effects on the instruction process and therefore on student performance (Wichadee, 2013:104; Yetisir, 2014:13, 15).

Continuing Professional Teacher Development (CPTD) obligations are common to most professions including teaching. CPTD should be a structured approach to learning that helps to ensure competence to practice of the lecturers, acquiring information, taking in knowledge, skills and application of practical experience. CPTD can involve any relevant learning activity, whether formal and structured or informal and self-directed. In today's world, the teaching profession has been relegated with many factors contributing to job dissatisfaction of teachers, which did not allow them to be fulfilled as a professional. To them CPTD is a fiction rather than veracity. They show little or no concern (Xaso, Galloway & Adu, 2017).

South African teachers need to be appropriately equipped to meet the evolving challenges and needs of the country (Adu & Ngibe, 2014). In other words, this implies that there have been many curriculum changes in the country since 1994. Educational change has been stimulated by the major political changes which occurred in the country during the 1990s and which brought about the abolition of apartheid and the introduction of a democratic South Africa. The vision for education that emerged was

to integrate education and training into a system of lifelong learning. South Africa is embarking on radical education reform (Adu & Ngibe, 2014). This is justified by continuous change in curriculum policy systems since 1997, when the first one was introduced in South Africa. Curriculum 2005 (C2005) was introduced in 1997, Revised National Curriculum Statement (RNCS) in 2002, National Curriculum Statement (NCS) in 2007 and currently Curriculum and Assessment Policy Statements (CAPS) which was introduced in 2012. This means that Education policy is revisited repeatedly. Outcomes Based Education (OBE) was therefore adopted as the approach that would enable articulation between education and training, recognition of prior learning and thus increase mobility for learners.

Other factors, which can also affect academic achievement, are positive teacher-student relationships, a satisfactory rapport between key role players and a positive school environment and ethos. These factors are more influential than class size, teacher experience or availability of instructional materials, parental background, indiscipline of students etc. If teachers can meet the students' needs for a social connection and can develop positive relationships and trust, students will be more engaged and motivated. They are then more likely to attend school, co-operate, socialise and engage in learning and will thus be more likely to achieve academically. Teachers, who play a pastoral role, who show sensitivity to individual differences among students, include students in the decision-making and acknowledge students' needs often produce greater motivation in their students thus resulting in better academic performance. On the other hand, students who are in conflict with their teachers often have behavioural problems and consequently achieve poor marks at school (Awang et al., 2013:24-25; Buka, 2013:323-324; Vitaro, et al., 2014:34).

Another key factor that can affect learning and therefore academic achievement is the pedagogy/teaching methods of the teacher. Methods of teaching have a lot to do with achievement of desired learning outcome. Some teachers adopt a content-focused/transmission- oriented approach, whilst others implement a more learning-focused/student-focused approach to teaching. Previous findings have indicated that

surface learning is more commonly reported in learning environments that are characterised by heavy workloads, little student autonomy and high teacher control. Such environments are generally characteristic of content-focused/transmission-oriented teaching approaches. In these situations, teachers exert a high level of control over their students' learning processes. They also use elements of direct instruction in their teaching practice such as asking many quick questions during the class in order to check if students understand the material. In a learning-focused teaching approach, teachers help students to take control of their learning (Donche, et al., 2013:242-243).

Students are attracted to teachers who are adept at organising fun activities in class and teachers who use teaching aids. Instructional materials do not only strengthen the students' understanding of related concepts, but also provide for effective and fun learning. If teachers do not use teaching aids during the teaching process, the interest of students in the subject is reduced and consequently the students assume that the content of the subject is uninteresting. This may ultimately affect negatively on the academic achievement of such students (Awang et al., 2013:24-25). The teachers' tasks are therefore to make the learning process visible to the student by asking the students reflective questions about what they learn and how they learn. It is important that teachers build on students' interests and on their own initiatives (Bostrom, 2012:12-13).

In addition to the above, teachers can play a crucial role in the academic achievement of their students through encouraging self-efficacy. This can be achieved if teachers individualise and tailor classroom instruction to the academic abilities of the students. Students are then encouraged to estimate their progress according to their own internal standards. Another way teacher can build learning styles in students is to help those set goals and monitor their learning progress. Self-regulatory habits that are developed early persevere and are relatively resistant to change. Thus, teachers face the challenge of facilitating the growth of positive self-efficacy beliefs and self-regulatory strategies in their students so that these become automatic and habitual

as early as possible. This approach enhances academic achievement (Caprara et al., 2011:92).

2.17 INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTS) AND EFFECTIVE TEACHING AND LEARNING MATHEMATICS

The effectiveness of the use of Information and communication technologies (ICTs) in teaching and learning Mathematics in primary schools is germane in the recent educational innovations in Africa. Both the teachers and learners are finding it difficult to adapt with the new trend. The use of ICTs is tremendously in most times having positive effects in the behaviour and entire lives of the users. It also believed that it improves the activeness of some values that relates to moral, social, ethical and economic on learners. Ojo and Adu (2018) saw information communication technology as a tool for changing learners' learning behaviour in schools and they revealed that the major potential of information communication technology is the manner of changing learners and their learning outcomes.

The introduction of ICTs in the educational curriculum is to enhance the effectiveness of teaching and learning in not only primary schools but also universities. Adu and Galloway (2015) revealed that advanced countries have attested to the fact that ICT is a central focus of educational policies through their implementation for its usage and integration in the Mathematics curriculum of the school. Moreover, according to Hennessy, Harrison and Wamakote (2010), they observed in their study that the use ICTs in primary and secondary schools is to enhance the quality of teaching and learning interaction in the classroom. The study, which was titled "the influence of internal factors on teachers' use and lack of use of information communication technology in the classroom" shows clearly that the use of ICTs improves learning and has greater record of success.

Ojo and Adu (2018) revealed that teachers are thirsty of the desire to improve on their teaching pedagogies using ICTs facilities especially the teaching of Mathematics. They are aware of the existing potential in the field of education; hence, the constraints of accessibility and lack of adequate knowledge of its handling post a barrier to the effectiveness of the new development

Adu and Galloway (2015) stated that the effectiveness of ICT in teaching and learning in primary school today could assist in reducing the Mathematics teachers' workloads on the preparation of lesson plan and the lesson presentation as well as the evaluation of learning outcomes. In a related study, Ojo and Adu (2018) further supported the fact that teachers in primary school will become facilitator of learning, collaborator, coach, mentor, knowledge navigator and co- learner and not a mere dispenser of knowledge.

Additionally, it is believed that when technology is used appropriately in Mathematics classroom instruction, it has a very positive impact on learner achievement or success. Moreover, using technology in education or teaching helps teachers provide immediate feedback to learners and motivates active learning, collaboration, and cooperation. It also helps teachers provide individualized learning opportunities and flexibility for their learners.

In this regard, Ramadan and Hüseyin (2016:4) stated that to live, learn and work successfully in an increasingly complex and information-rich society, students and teachers must use technology effectively. Within a sound educational setting, technology can enable learners to become:

- Capable information technology users
- Information seekers, analyzers, and evaluators
- Problem solvers and decision makers
- Creative and effective users of productivity tools
- Communicators, collaborators, publishers, and producers
- Informed, responsible, and contributing citizens.

Ramadan and Hüseyin (2016:12) also asserted, "Technology presents new opportunities for learners and teachers that can be organizational, instructional, individual, procedural, and cultural..." The authors continued by stating that ICT has an impact if learners understand and experience the main purpose of technology. They also pointed out that one of the main points that has to be taken into consideration by schools

is the necessity to prepare learners for the changing world in which technology plays an enormous part.

2.18 TREND OF THE DEVELOPMENT OF ICTS FOR TEACHING AND LEARNING IN SOUTH AFRICA

The population of South Africa is currently estimated to 55 million people, the number of those who engaged themselves in the use of internet grew to four million in 2002. In 2009, the records show that 10 out of every 75 South Africans had access to internet while 10 out of 100 of them had fixed landlines accessibility (Kritzinger & Padayachee, 2010). Based on the findings of the Department of Education (DoE) in a paper submitted titled “White Paper on e-Education”, the use of ICTs for teaching and learning in Africa increased by 20 per cent in 2007. Although the record shows that, the increase was not evenly distributed because the percentage of usage in the countries with higher gross domestic product (GDP) per capita was much than other countries (Department of Basic Education (DBE).2013). This indicates that as at 2007, 6.4 per cent of South Africans had access to and used the internet, as compared with 72,7 per cent of Americans, this revealed that South Africa needs to improve on the effectiveness of ICT especially in teaching and learning. DoE (2013) highlighted some of the steps taken by the government of South Africa as follows:

- a. The establishment of the Presidential National Commission on Information Society and Development (PNC on ISAD) in 2001 was to advise the government appropriately on the development of ICT in South Africa to be at the same level or higher above other developed countries as regards the use of ICTs in teaching and learning. The commission comprises of members from both public and private sector.
- b. The establishment of Electronic and Communications Trans- action Act, No. 25 of 2002 by the Department of Communications (DoC) was to lead and direct all ICT initiatives in South Africa and to ensure the development of national e-strategy for citizenship empowerment especially in the education sector for a five years’ development plan.

- c. The support of ICT in teaching and learning through integration of various initiatives led to the formulations of policy for the effectiveness of ICT (Ojo & Adu, 2018:7).

Furthermore, between 19th and 20th of April 2012, the government of South Africa, through the DoC, organized a National ICT Policy Colloquium held at Gallagher Estate. The purpose of the colloquium was to implement a process of reviewing all the government policies on ICT that have been in existence since 1994. Another colloquium tagged ICT Indaba was held at Cape Town in June 2012. This gathering had in attendance various stakeholders in business, labour, academia and civil society across Africa and beyond.

According to the White Paper report of 2003 by DoE White, the provinces within South Africa totalling nine have recorded various degree of progress as regards ICT implementation. Western Cape, Northern Cape and Gauteng had made significant development as at that moment; meanwhile, the remaining provinces were still trying to meet up to the standard. Although, the government in their effort to improve on ICTs engaged the services in partnership with some non-governmental organisations (NGOs), this has responded to bridging the digital divide by initiating various projects, which include the following:

- (a) INTEL 'Teach to the Future' teacher development programme provides insights for teachers on ICT integration into teaching and learning.
- (b) SCOPE, which is a Finnish development support programme, has, in collaboration with SchoolNet SA and the South African Institute for Distance Education (SAIDE), developed 11 teacher development modules for introduction into schools.
- (c) SchoolNet SA provides online, mentor-based programmes that provide in-service training to teachers on how to integrate ICT into the curriculum and its management.

Moreover, the DBE, through its Education Management Information System and information received from provinces presents the reflection of ICT profile of South African schools.

2.19 GENDER AND MATHEMATICS EDUCATION

The factors identified in contributing to the gender problem in Mathematics Education in the developed countries remain valid for Africa. Some other factors are prominent when we are discussing Mathematics Education generally. These include among other; negative socio-cultural attitudes, household tasks at home, gender biased curriculum, poor didactic materials, lack of school facilities (dormitories), lack of sponsorship, unmotivated and unqualified mathematics teachers, lack of moral and financial parental support, lack of self confidence among the girls, poor performance in exams, etc.

According to the UNESCO Institute for Statistics report published in September 2010, the lowest literacy rates were observed in sub-Saharan Africa, where the adult literacy rate for males is 71.6 and 53.6 % for females and in Northern Africa, it is respectively 76.7 and 58.1 %. It should be highlighted that more than half of the adult population is still illiterate in the ten following countries: Gambia (55 %), Senegal (58 %), Benin (59 %), Sierra Leone (60 %), Guinea (62 %), Ethiopia (64 %), Chad (67 %), Burkina Faso (71 %), Niger (71 %), and Mali (74 %). The net enrolment ratio in the primary school age population in sub-Saharan Africa countries is around 52.3 % girls (and 60.7 % boys), except in a very few countries where almost all girls of primary school age are enrolled at schools. Nevertheless, there is a substantial drop out among girls at the secondary school level; it is due to socio-cultural (early marriage), financial reasons, institutional barriers and poor performance of girls.

The Trends in Mathematics and Science Study (TIMSS) 2007 reported that between 68 and 90% of African students in Grade 8 failed to reach the low benchmark in Mathematics (Nouzha, 2015). Moreover, unfortunately no significant progress was registered in TIMSS 2007. It is a pity that Africa was so poorly represented in such an important international assessment of the mathematics and science knowledge of fourth and eighth grade students

As at the elementary school level and in higher education, no specific gender differences have been found in different studies concerning Mathematics grades and the gender inequality in access to higher education (Gaisman, 2015). The largest university in Mexico reported in 2009 (Saavedra, 2010) that the percentage of female students was larger than that of male students and that graduation percentages favored women (56 % of women graduated against 50 % of men). However, there is still a severe under-representation of women in mathematics. Only 38 % of women enroll in mathematics programs, and 43 % of all students who graduate from these programs are women. The gender gap is greater when considering access to post-graduate education. In 2008, only 30 % of students in postgraduate programs were women, although in programs related to Mathematics Education female students comprised 45 %.

In a study by Espinosa (2007), it was found that they considered male students more proficient in mathematics than females. They expressed the same beliefs as those found among teachers in elementary school about women being successful in mathematics because of their effort and discipline. Observation of classes detected a more passive attitude of female students and a tendency of male students to be more participative. Although results show that, in general, female students are more perseverant in their studies, it seems that they still consider mathematics as a male domain, too competitive for women and that professors' beliefs tend to reinforce this conception.

2.20 CHAPTER SUMMARY

In this chapter, the research study was placed within the context of recent literature on the learning styles, availability, and utilization of instructional materials as correlates of Grade 6 learners' mathematics performance in Buffalo City, the challenges inherent in the using of instructional materials to teach Mathematics and the type of learning styles exhibited by the learners are discussed. The theoretical framework that underpins this study, which is constructivist learning theory and Kolb's experiential learning theory, was extensively linked to the study and discussed.

The researcher also reviewed some existing literature that are relevant and related to learning styles, availability, and utilization of instructional materials on Grade 6 learners'

Mathematics performance. Conceptualization of learning styles, learning styles and Mathematics performance, different types of learning styles, learning and teaching style mismatches, implications of learning styles on learning and teaching, instructional materials and Mathematics performance, the concept of Mathematics and Information Communication and Technologies and effective teaching and learning of Mathematics were also reviewed.

The next chapter explains the research methodology of how the research paradigm, approach and design were carried out in order to collect the data. Implementation of the research design and the methodology applied to determine the samples. The instruments for data collection, validity and reliability of the instruments were not left behind in order to unpack how learning styles, availability, and utilization of instructional materials correlates Grade 6 learners' Mathematics performance in Buffalo City.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

In the last chapter, the research study was placed within the context of recent literature on the learning styles, availability, and utilization of instructional materials as correlates of Grade 6 learners' Mathematics performance in Buffalo City, the challenges inherent in the using of instructional materials to teach Mathematics and the type of learning styles exhibited by the learners are discussed. The theoretical framework that underpins this study, which is constructivist learning theory and Kolb's experiential learning theory were extensively discussed. The researcher also reviewed some existing literature that are relevant and related to learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance. Conceptualization of learning styles, learning styles and Mathematics performance, different types of learning styles, learning and teaching style mismatches, implications of learning styles on learning and teaching, instructional materials and Mathematics performance, the concept of Mathematics and Information Communication and Technologies and effective teaching and learning of Mathematics were also reviewed.

This chapter dealt with the methodology used in the course of this research, which includes the research paradigm, which is positivism apart from explaining other paradigm like Interpretivists and pragmatism. Research approach, which is quantitative apart from qualitative and mixed method, were articulated. The chapter also discussed many research designs before narrowing it to the one used for this study, which is, correlational survey. Population, sample and sampling techniques, instruments, validity and reliability of the test instruments, a general procedure for data collection, and data analysis extensively enunciated.

Olubela (2015) identified the Research Methodologies by using a hierarchical taxonomy with three levels and eighteen categories as shown in table 3.1 indicating whether they typically conform to the positivist or Interpretivists paradigms. Before introducing the paradigm used in this research, let me summarize the key features of the key

methodologies in the table, identifying their respective strengths and weaknesses. In the following sections, the researcher justifies the choice of methodologies and explain how they both operate and inter operate in this research.

Table 3.1: Taxonomy of Research Methodologies

Scientific/ Positivist	Interpretivists/ Anti-positivist
Laboratory Experiments	Subjective/Argumentative
Field Experiments	Review
Surveys	Action Research
Case Study	Case Studies
Theorem Proof	Descriptive/Interpretive
Forecasting	Future Research
Simulation	Role/Game Playing

Source: (Creswell, 2014)

Laboratory experiments permit the researcher to identify precise relationships between small numbers of variables that are studied intensively via a designed laboratory situation using quantitative analytical techniques with a view to make generalizable statements applicable to real-life situations. The key weakness of laboratory experiments is the "limited extent to which identified relationships exist in the real world due to oversimplification of the experimental situation and the isolation of such situations from most of the variables that are found in the real world" (Olubela, 2015:85).

Field experiments extend laboratory experiments into real organizations and their real-life situations, thereby achieving greater realism and diminishing the extent to which situations can be criticized as contrived. In practice, it is difficult to identify organizations that are prepared to be experimented on and still more difficult to achieve sufficient control to make replication viable.

Surveys enable the researcher to obtain data about practices, situations or views at one point in time through questionnaires or interviews. Quantitative analytical techniques are then used to draw inferences from this data regarding existing relationships. The use of surveys permits a researcher to study more variables at one time than is typically possible in laboratory or field experiments, whilst data can be collected about real world environments. A key weakness is that it is very difficult to realize insights relating to the causes of or processes involved in the phenomena measured. There are, in addition, several sources of bias such as the possibly self-selecting nature of respondents, the point in time when the survey is conducted and in the researcher him/herself through the design of the survey itself (Olubela, 2015).

Case studies involve an attempt to describe relationships that exist, very often in a single organization. Case studies are typically restricted to a single organization and it is difficult to generalize findings since it is hard to find a statistically meaningful way to analyze the data gotten from it and therefore it is considered weak. Case studies may be positivist or Interpretivists in nature, depending on the approach of the researcher, the data collected, and the analytical techniques employed. Reality can be captured in detail by an observer-researcher, with the analysis of more variables than is typically possible in experimental and survey research. Furthermore, different researchers may have different interpretations of the same data, thus adding research bias into the equation (Olubela, 2015).

A research philosophy is a belief about the way in which data about a phenomenon should be gathered, analyzed and used. The term epistemology (what is known to be true) as opposed to doxology (what is believed to be true) encompasses the various philosophies of research approach. The purpose of science, then, is the process of transforming things believed into things known: doxa to episteme. Two major research philosophies have been identified in the Western tradition of science, namely positivist (sometimes called scientific) and Interpretivists (also known as anti-positivist) (Olubela, 2015).

3.2 RESEARCH PARADIGM

Taylor and Medina (2013) explained that a paradigm is a comprehensive belief system, worldviews or framework that guides research and practice in a field. There are three dimensions of a paradigm; it entails a set of beliefs, values, and methods, which influences what should be studied, how it should be studied, and how to interpret the results (Creswell, 2014). In the words of Babbie (2012), a paradigm is essentially a frame of reference with which to understand the world.

Lincoln, Lynham and Guba, (2011), Creswell, (2014), and Babbie, (2012) posit that a paradigm is essentially a frame of reference with which to observe and understand the world. This research study adopted the positivism paradigm. Positivists believe that reality is stable and can be observed and described from an objective viewpoint (Creswell, 2014), i.e. without interfering with the phenomena being studied. They contend that phenomena should be isolated and that observations should be repeatable. This often involves manipulation of reality with variations in only a single independent variable to identify regularities in, and to form relationships between, some of the constituent elements of the social world.

Predictions can be made based on the previously observed and explained realities and their inter-relationships. "Positivism has a long and rich historical tradition. It is so embedded in our society that knowledge claims not grounded in positivist thought are simply dismissed as a scientific and therefore invalid. Creswell (2014) who, in a review of some research articles; found that all the empirical studies were positivist in approach indirectly support this view. Positivism has also had a particularly successful association with the physical and natural sciences.

There has, however, been much debate on the issue of whether or not this positivist paradigm is entirely suitable for the social sciences (Creswell, 2014), This led to the calling for a more pluralistic attitude towards research methodologies. It is germane to our study since it is also the case that Information Systems, dealing as it does with the interaction of people and technology, is considered to be of the social sciences rather than the physical sciences (Creswell, 2014). Indeed, some of the difficulties experienced

in research, such as the apparent inconsistency of results, may be attributed to the inappropriateness of the positivist paradigm for the domain. Likewise, some variables or constituent parts of reality might have been previously thought unmeasurable under the positivist paradigm - and hence went unsearched

Table 3.2 below presents a summary of the three major paradigms showing their respective ontological, epistemological, axiological, and methodological philosophical assumptions.

Table 3.2: Major research paradigms and their philosophical assumptions

Descriptive	Positivism	Post-Positivism	Interpretivist	Critical Theory	Pragmatism
Synonym	Verify	Predict	Understand / Interpret	Emancipate	Dialectic
Ontology What is real?	Objectivist, findings are the whole truth, which is realism	Modified objectivist, findings are probably true, and there is transcendental realism	Local, relative, co-constructed realities. There is subjective, objectivity and realism	Historical/virtual realism shaped by outside forces, material subjectivity	Constructed based on the world we live in and explanations that produce the best desired outcomes
Epistemology What is true?	The only knowledge is scientific knowledge- which is truth, reality is apprehensible	Findings approximate truth, reality is never fully apprehended	Co-created multiple realities and truths	Findings are based on values and local examples of truth	Objective and subjective points of view
Axiology What is the role of values?	Value- free, propositional	propositional knowing about the	Value-laden, and biased.	Propositional, transactional knowing is	Multiple stances, e.g. researchers

	knowing about the world is an end in itself, is Intrinsically valuable.	world is an end in itself, is Intrinsically valuable.	Propositional knowing is Instrumentally valuable as a	instrumentally valuable as a means to social emancipation,	include both biased and unbiased Perspectives.
Methodology How do I examine what is real?	Quantitative - Primarily Experimental, Quasi-Experimental	Usually Quantitative - Experimental with threats to validity. Qual- a case study	Means to social emancipation. Often Qualitative and/or Quantitative	Which is an end in itself, is intrinsically valuable. Usually Qualitative, but also Quantitative	Quantitative & Qualitative Together (Mixed Methods Approach)

Source: (Creswell, 2014: 80)

At this point, it will be important to give a detailed explanation of each of the philosophical assumptions that inform a research paradigm.

Ontology

Ontology refers to the claims and assumptions that people make about the nature of social reality, claims about what exists, what it looks like, what units make it up, and how these units interact with each other (Adams, 2014). In other words, ontology refers to people's understandings of the entities they encounter, including the meanings of those entities (Cameron, 2011). This means ontology is all about the nature of the world around us. As a philosophical assumption, ontology addresses the question: What constitutes reality and how can we understand its existence? Within pragmatism, a particular ontological position was chosen, and this is realism. This view holds that the world comprises objectively given objects and structures independent of the researcher (Ormston, Spencer, Barnard & Snape, 2014).

Epistemology

Epistemology is defined as responding to the question of what is (or should be) regarded as acceptable knowledge in a discipline (Bryman & Bell, 2011) and is also concerned with how knowledge can be created, acquired and communicated to other human beings (Cohen, Manion & Morrison, 2011). In other words, epistemology is all about, what it means to know. It should be noted that the kind of epistemological assumptions a researcher makes or holds about knowledge profoundly affect how they will go about uncovering knowledge of social behaviour (Al-Saadi, 2014).

Axiology

Axiology refers to the analysis of values to better understand their meanings, physiognomies, origin, acceptance as true, as well as their influence on people's daily experiences (Creswell, 2014). It is a branch of philosophy that studies judgment about value. In other words, it is all about the role of values in research. Researchers demonstrate axiological skill by being able to articulate their values as a basis for making judgments about what research they are conducting and how they go about doing it (Aliyu et al., 2014). The seminal axiological question is: 'What is the ultimate purpose of the inquiry?'

Methodology

Methodology is concerned with plan or strategy of action, which lies behind the choice, and use of methods. It addresses the why, what, from how, when and where data is collected and analyzed (Scotland, 2012). The important question of a methodology is: 'How can a researcher discover whatever he/she believes can be known?'

The following section gives a brief outline of two major research paradigms, describing their principles and explaining the ontological, epistemological, axiological, and methodological positions of each.

3.2.1 Interpretivism

It is a widely held belief among interpretive researchers that reality comprises of people's subjective experiences of the outside world; therefore, they may adopt an inter-subjective epistemology and the ontological belief that reality is socially constructed. According to Carson et al. (2012), the Interpretivists use simple structural frameworks and flexible research structures compared to positivist researchers that adopt the rigid, structural frameworks that are approachable to capturing meanings in human interaction (Creswell, 2014) and making sense of what is perceived as reality (Carson et al., 2012). They believe the researcher and his/her informants are interdependent and mutually interactive. According to Vos et al. (2011), despite prior knowledge available to the Interpretivists researcher about the context of the research, the researcher strongly believes that it is not enough to have a fixed research design because of the complexity and unpredictable nature of what is seen as reality. The researcher does not foreclose the emergence of new discoveries throughout the study through the help of informants. The use of such an up-and-coming and collaborative approach is consistent with the Interpretivists belief that humans could adapt, and that no one can gain prior knowledge of time and context bound social realities. Therefore, the goal of Interpretivists research is to understand and interpret the meanings of human behaviour rather than to generalize and predict causes and effects.

The core principle of Interpretivism is that observation through direct experience of the people from within is the only way that research can be objectively and accurately observed. The study of hermeneutics and phenomenology had a significant influence on the Interpretivists paradigm. Hermeneutics is the study of meaning and interpretation in historical texts, and this meaning-making cyclical process is the basis on which the Interpretivists paradigm was established (Mack, 2010). Therefore, the ontological assumptions of Interpretivism are that multiple people, who interpret events differently, leaving multiple perspectives of an incident, see social reality.

Therefore, the role of the scientist in the Interpretivists paradigm is to understand, explain and interpret social reality through the eyes of different participants (Cohen et al., 2007). Further, the Interpretivists paradigm seeks to understand rather than explain the real situation from different perspectives. This paradigm proposes that it is vital for a researcher to understand motives, meanings, reasons and subjective experiences, which are time and context bound.

The Interpretivists approach differs from that of the positivist in that while the positivist makes use of research hypotheses, the Interpretivists uses open-ended research questions (Phothongsunan, 2010). The focus of this class of researcher is gathering qualitative data from which meanings will be interpreted; this they achieve by making use of a small sample size unlike the quantitative researcher that has a large number as sample in a study. One method of carrying out interpretive research is the use of grounded theory. In applying this paradigm, ideas are generated from the data collected, i.e. Interpretivists generate theory from the data they generate, while the reverse is the case with the positivism approach where the theory is tested with the data generated.

The quantitative researcher uses questionnaires to gather information from the subjects, while Interpretivists use interviews which may be structured, semi-structured or unstructured to gather information from the respondents (Flick, 2015; Phothongsunan, 2010). Sometimes questionnaires are used for data collection in qualitative research. According to Phothongsunan (2010), the interpretivism paradigm derives its strength from its naturalistic approach by relying on the natural forms of human communication. It involves the deep participation of the researcher and gives room for change over a period without using generalizations like positivist research that uses variables to deduce relationships. Despite the aforementioned strengths of interpretivism, the following are the shortcomings of the approach.

3.2.1.1 Limitations of Interpretivism

Interpretivism is limited because it discards the scientific processes of verification and therefore results cannot be generalized to other situations. Secondly, interpretivism ontological assumption is subjective rather than objective. Every researcher is subjective in the sense that once a researcher decides on the paradigm or approach to use for a study, subjectivity or bias has already set in. The major argument against interpretivism is failure to acknowledge the political and ideological influences on knowledge and social reality (Wyk, 2010).

Based on the criticisms of the Interpretivists paradigm, this research study therefore adopted the positivist paradigm because it uses scientific methods of natural science to study human activity using objective enquiry and striving to investigate and confirm the pattern of behaviour in testing theories and hypotheses (Creswell, 2014). The positivism paradigm mostly involves quantitative methodology (Vos, Strydom, Fouche, & Delport, 2011) and aims to seek generalizations and quantitative data (Wellington, 2015). It is in line with this argument that this paradigm is found relevant to employ in finding out how learning styles, availability, and utilization of instructional materials affect grade 6 learners' mathematics performance in buffalo City

3.2.2 Pragmatism Paradigm

In etymological terms, pragmatism is identified as an action-oriented paradigm to finding solutions for existing problems and issues (Kalolo, 2015). The definition implies that pragmatism signifies practicality, compromise, prudence and a clear goal orientation in dealing with problems. From another perspective, pragmatism is believed to be a broad research paradigm covering many different areas, which include knowledge, language and ethics (Goldkuhl, 2012). These authors believed pragmatism is associated with action, intervention and constructive knowledge, drawing heavily on the inductive and deductive reasoning (Ihuah & Eaton, 2013). As a paradigm, it is characterized by its ability to accept all well-constructed paradigms of scientific inquiry as valid when they are appropriate (Kalolo, 2015). The paradigm, therefore, provides for the use of both qualitative and quantitative research methodologies to collect information and make

inquiry into complex phenomenon of social and natural contexts (Creswell, 2009; Teddlie & Tashakkori, 2010).

Regardless of any paradigmatic or philosophical assumptions, what works and what is useful according to pragmatists should be used (Zandvavian & Daryapoor, 2013) and can be described as a better process to answering “what”, “why” and “how” research questions (Saunders, Lewis & Thornhill, 2009). It is acknowledged that pragmatism offers an alternative worldview to that of positivism and interpretivism and focuses on the problem to be researched and the consequences of the research (Creswell & Plano-Clark, 2011). These authors go on to argue that pragmatism allows the researcher to be free of mental and practical constraints imposed by the “forced choice dichotomy between positivism and constructivism, and researchers do not have to be prisoners of a particular approach or technique (Creswell & Plano Clark, 2011:27).

The pragmatic research philosophy provides for the adoption of mixed methods as the data collection method, which opens the opportunity to be objective and subjective in analyzing the points of view of the participants (Creswell, 2009; Saunders et al., 2009). It focuses on the problem and tries to find practical solutions using mixed methods (Ihuah & Eaton, 2013). By doing so, pragmatic approach allows areas to be studied that are of interest, embracing methods that are appropriate and using findings in a positive manner in harmony with a recognized value system (Creswell, 2009). It therefore, follows that pragmatic research is multi-purpose in nature, making it a good approach that will allow questions to be addressed that do not fit comfortably within a quantitative or qualitative approach, research design and methodology (Ihuah & Eaton, 2013).

Morgan (2010) indicates, rather than assessing any new approach strictly on its own merits, the implications of that approach should be pondered within the realms of an ongoing research context in which researchers have established commitments to other sets of beliefs and practices or research paradigms. Thus, established qualitative and quantitative research paradigms and the paradigmatic arguments for mixing them for this research are now contemplated. Researchers’ beliefs about the research questions to ask and usage of methods to address these questions are generally based on their stances about what can be known and how to go about achieving such knowledge. These stances are important components of researchers’ ideas about reality and the

nature of knowledge as reflected in their worldviews (Morgan, 2010). Quantitative research is associated with view of a social world that is external, independent, fixed or objectively real, whereas qualitative research is linked to ideas of a world that is constructed, subjectively experienced and the product of human thought as expressed through language (Creswell, 2014). Each of vantages on the social world drive epistemological assumptions about which knowledge is deemed valid, which in turn impacts the type of knowledge or research evidence that is sought (Cohen, Manion & Morrison, 2007)

According to Creswell (2014), quantitative research has traditionally been linked to the so-called “scientific method”, also identified as positivist or post-positivist research, empirical science and post-positivism. As its name suggests, post-positivism specifically refers to the thinking that followed positivism, which challenged the notion of an absolute truth-awaiting discovery and recognized that there cannot be absolute certainty about knowledge claims when studying human behaviour and actions. Nonetheless, post-positivism does reflect a deterministic philosophy in which causes do probably determine outcomes, a stance, which is often reflected in the design of the research associated with this paradigm. Research data, evidence and rational considerations shape knowledge, and, researchers were collected information on instruments based on measures completed by participants or researcher recorded observations. The goal is to develop relevant, true statements, which can explain the situation of concern or which describe causal relationships of interest (Creswell, 2014). Pragmatism, in its many forms, originated from the work of Pierce, James, Mead and Dewey (Creswell, 2014), and as an epistemological stance for this research ensconces these ideas and those introduced in the sub-section above most appropriately. Knowledge claims are thought to arise from actions, situations and consequences rather than from backgrounds, as in the case of post-positivism. The concern is with applications and solutions to problem situations, and, the problem is more important than the actual methods chosen (Creswell, 2014).

Pragmatism is further based on the idea that a false dichotomy exists between quantitative and qualitative research and that researchers should make the most efficient use of both research paradigms to understand educational and social phenomena

(Onwuegbuzie & Leech, 2006). Pragmatism is not committed to any one philosophical system of reality and knowledge (Creswell, 2014). Knowledge from the pragmatic viewpoint are both constructed and based on the reality of the world we experience and live in (Johnson & Onwuegbuzie, 2007). Creswell (2014) identify the following rationales for mixing qualitative and quantitative approaches: participant enrichment, instrument fidelity, treatment integrity, and significance enhancement.

Participant enrichment refers to increasing the number of participants in the research. Onwuegbuzie and Leech (2006) contend that the larger the sample, the more reliable and valid the research findings was. In terms of this rationale, the sample used for this study was limited to primary schools' learners of Grade 6 with Mathematics as the focus in Buffalo City Education District, respondents from each school completed the questionnaire.

Instrument fidelity refers to maximizing the appropriateness and/or utility of the instruments used in the study. For this study, three self-developed research instruments were validated and used for data collection, these are:

1. Students' Learning Style Scale (SLSS)
2. Availability and Utilization of Instructional Materials Inventory (AUIMI)
3. Mathematics Achievement Test (MAT) (**See appendix A**)

3.2.3 Paradigm of this study-Positivism

The origin of the term positivism is traceable to Auguste Isidore Comte (1798-1857), the French philosopher and sociologist with his '*Cours de Philosophie Positive* (1832-1842). His opinion is that reality can be observed which coincide with the ideas of J.S. Mills author of *A System of Logic* written in 1843 (Wellington, 2015). According to him, "Comte's position has led to a general doctrine of positivism which held that all genuine knowledge is based on sense experience and can only be advanced through observation and experiment" (Wellington, 2015:164).

Positivism is also connected with realism and scientific methods (Flick, 2015; Ormston, et al., 2014, Cameron, 2011), therefore it upholds the view that the scientist is merely an observer of objective reality, hence, the only way to establish truth. Positivist paradigm is deeply rooted in the positivist philosophy, which upholds rigid rules of logic and measurement, truth, absolute principles, and prediction (Adams, 2014; Al-Saadi, 2014). They hold that true knowledge only comes from research based in Mathematics with methods, techniques and procedures that offer the best framework for investigating the social world (Scotland, 2012).

The positivist paradigm, also referred to as the scientific paradigm, seeks to prove or disprove a hypothesis (null or alternate). Also, to test the reliability and validity of instruments, and used specific data to measure and draw conclusions (Wyk, 2010). Other characteristics of positivist research include scientific method, statistical analysis, generalizability of findings and ability to replicate the result (Wellington, 2015), and findings with large samples (Mack, 2010).

The ontological position of the positivist paradigm is that there exists an objective reality out there in the world, and research findings through collection of numerical data are the whole truth and reality (Milman, 2012). This truth and reality is free and independent of the viewer and observer so that it can be investigated. A positivist investigator, therefore, holds the idea that the universe or world conforms to permanent and unchanging laws and rules of causation (Aliyu, Muhammad, Rozilah & David, 2014). These authors submit that the ontological stance in positivism is also held by the belief that there exists an intricacy and complexity in the universe, and it can be overcome by reductionism. This is done with an intention of asserting an importance and emphasis on impartiality, measurement, objectivity and repeatability.

Positivism holds the epistemological stance that the only knowledge is scientific knowledge, and that truth and reality is inapprehensible (Milman, 2012). The paradigm emphasizes that genuine, real and factual happenings can be studied and observed. scientifically and empirically, it can be elucidated by way of lucid and rational investigation and analysis (Aliyu et al., 2014). In doing all this, the philosophical perspective expects the researcher to take an objective position, where the inquirer

adopts a distant, non-interactive posture to his/her object of inquiry (Dieronitou, 2014). This suggests that there must be a 'subject-object' relationship to the phenomenon under study. Considering this epistemological stance, some researchers believe that an objective researcher has to have the right data gathering tools to be able to come up with absolute truth for a given inquiry (Aliyu et al., 2014; Creswell, 2014). It is also believed that positivist knowledge is generalizable since it is time and context free.

Positivism upholds an axiological stance that research should be value-free for it to be objective. It further argues that propositional knowing about the world is an end in itself and it is intrinsically valuable (Aliyu et al., 2014). This position expects researchers to employ scientific methods of gathering data, which are objective, and to produce results, which are value-free.

From a methodological point of view, positivism is inclined to the side of experimentation, coupled with confirmatory analysis and quantitative analysis (Aliyu, et al., 2014). A positivist research is meant to be deductive in nature and to test a prior hypothesis or theory. However, a contrasting view argues that positivism entails elements of both deductive and inductive approaches (Brown, 2014). It is argued that the paradigm imposes a top-down approach to research, where ontology is placed at the top of the hierarchy and methodology at the bottom (Dieronitou, 2014). The same author goes on to argue that the cause-effect ontological position of positivism constrains research, at the methodological level, to the use of empirical tests under carefully controlled conditions.

According to Flick (2015), the underlying assumptions of positivism are as follows:

- Only phenomena confirmed by the senses can be regarded as knowledge.
- Hypotheses emanate from theories that can be tested and explained through deductive reasoning.
- Knowledge can be generated through the collection of facts that produces a basis for induction.

- Science must be carried out in such a way that it is objective and value free (Wellington, 2015: 210).
- There is a demarcation between scientific and normative statements.

The point of divergence is when modern scientists are viewed as positivists; this is nothing but a fallacy. The argument here is that modern science cannot always clearly identify and control its variables today as it was before (Wellington, 2015).

For instance, the issue of climate change and genetically modified (GM) foods has dislodged to some extent the cause-effect relationship, that is, X agents cause Y phenomenon to occur; this to some reasonable extent no longer stands. On the other hand, the Interpretivists accepts that the observer makes a difference to the observed and that reality is a human construct (Creswell, 2012). Thus, the Interpretivists paradigm, also known as the “anti-positivist” paradigm, was a product of the reaction to positivism. It is sometimes referred to as constructivism because it emphasizes the individual’s ability to create meaning. The positivist research paradigm operates best when used with the quantitative approach (when compared with quantification of data). Cohen et al., (2011) stated that the quantitative research approach is an investigation that is rooted in the assumption that features of the social environment constitute an objective reality that is relatively constant across time and settings

They further point out that the dominant methodology used in this kind of inquiry is to describe and explain features of this reality by collecting numerical data and subjecting such data to statistical analysis. This kind of methodology also involves the testing of hypotheses and, since this is done statistically, the results thereof are believed to be objective.

In corroborating the above, Cohen et al. (2011:14-15) described the quantitative research paradigm in- depth as follows:

- It is an inquiry that assumes an objective social reality;
- It assumes that the social reality is relatively constant across time and settings;

- It views casual relationships among social phenomena from a robotic direction;
- It studies populations or samples that represent populations;
- It takes an objective, detached stance toward research participants and their settings;
- It studies behaviour and other observable phenomena;
- It studies human behaviour in natural or artificial settings;
- It analyzes social reality into variables;
- It uses preconceived concepts and theories to determine what kind of data will be collected;
- It generates numerical data to represent the social environment;
- It uses statistical methods to analyze data;
- It uses statistical inference procedures to generalize findings from a sample to a defined population;
- It prepares impersonal, objective reports of research findings;
- Its procedures are highly formalized;
- It is more explicitly controlled;
- It uses a deductive form of reasoning through data collection for the assessment of preconceived models, hypotheses and theories;
- It tests hypotheses that the researcher triggers off his/her study with;
- When using quantitative research paradigm, observations are systematically undertaken in a standardized manner;
- Its concepts are in the form of distinct variables;
- Data are presented by means of exact figures elicited from precise measurement;
- The researcher's role is that of an objective observer;

- The research is standardized based on fixed procedure and can therefore be replicated;
- Studies are focused on specific questions or hypotheses that remain constant throughout the investigation;
- Data collection procedures and types of measurement are constructed in advance and applied in a standardized manner; and
- Measurements are focused on specific variables that are quantified through rating scales, frequency counts and other means.

3.2.3.1 Justification for the positivism paradigm in the current study

Since the current study is aligned to the positivism paradigm, it then follows that numerical data will be gathered, collated and analyzed in order to develop knowledge about the effects of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance in Buffalo City Education District.

It is a widely held belief by positivists that only observable phenomena that are agreeable to the senses can be validly classified as knowledge (Flick, 2015); hence, phenomena that are not subjected to observation through experience or use of instruments cannot be regarded as knowledge (Wellington, 2015). Central to positivism are mathematical and statistical techniques, which follow a specific research structure to unveil single and objective reality (Cohen et al., 2011). Positivist researchers aim at time and context free generalizations. This is believed to be possible since human actions can be classified as cause and effect that precedes researchers' behaviour and their subjects who act independently without been influenced.

According to Kura (2012), scientific laws and facts are based on falsifiability, logical consistency, relative explanatory power and survival, which are logically connected to positivism. Positivism is rooted in atomism, quantification and operationalization. It implies that there is an occurrence existing as a separate entity from the whole world as distinct from discrete elements. Quantification refers to the variables that can be expressed in terms of numbers and frequencies, which uses mathematical tools to reveal

the significance for drawing conclusions. Operationalization seeks to define social phenomena as simple behaviours and life experience (Kura, 2012). This suggests that the epistemological perspective of any research defines its instruments of data collection and analysis.

Positivists aver that scientific theories provide backdrop to experimental research because hypotheses derived from these theories are subjected to empirical testing, meaning that science allows for deductive reasoning by seeking to extract specific propositions from generalizations (Vos et al., 2011). In line with this argument, the hypotheses raised in this research work will be subjected to empirical testing through the questionnaires generated to elicit information from the respondents from which generalizations will then be made.

Although the positivist paradigm continued to exert its influence on educational research for a long time, in the latter half of the 20th century critics challenged it from two alternative traditions – the Interpretivists and post-modernist – because it is not subjective in interpreting social reality (Kumur, 2011). According to them, there is need to replace objectivity with subjectivity in the process of scientific inquiry. They express skepticism that knowledge can be derived through observation (Flick, 2015) and about the testing of hypotheses and theories with the aim of gaining secure knowledge.

In the words of Babbie (2012), a paradigm is essentially a frame of reference (view) with which to understand the world. Positivists follow the natural science approach by testing theories and hypotheses (Kura, 2012), therefore the research paradigm suitable for this study is the positivist paradigm. The positivist paradigm, in which the current study is located, is discussed in detail, giving a justification of its choice as well as highlighting the strengths and limitations of the paradigm.

This research adopted the Positivist Paradigm because it uses the scientific method of natural science to study human activity using objective enquiry and it strives to confirm and investigate the pattern of behavior in testing theories and hypotheses. The positivism paradigm mostly involves quantitative methodology, it is in line with this argument that, this paradigm is found relevant by the researcher to employ in finding out how learning

style, availability, and utilization of instructional materials affect grade 6 learners' Mathematics performance.

3.3 RESEARCH APPROACH

Research approaches are grounded in the philosophical assumptions underpinning existing research (Adu et al., 2016). Traditionally, objective and subjective theories have been conventionally distinguished, as purely quantitative approaches and purely qualitative approaches respectively (Adu et al., 2016). However, a growing number of mixed method researchers suggest that research need not be restricted to exclusive paradigms and limited methodological practices (Creswell, 2013; Adu et al., 2016). In comparison to the above distinction, they state that one should choose a combination of methods that provides sufficient evidence for answering the research question (Creswell, 2014). The mixed method approach combines a distinct set of ideas and practices, which separates it from the traditional qualitative-quantitative. Leading mixed methodologists such as John Creswell, Jennifer Greene, Burke Johnson, David Morgan, Anthony Onwuegbuzie, Abbas Tashakkori, Charles and Teddlie offer defining characteristics of the mixed method approach. Descombe (2013) adequately summarizes these characteristics to involve the use of:

- *Quantitative and qualitative methods within the same research project;*
- *A research design that clearly specifies the sequencing and priority that is given to the quantitative and qualitative elements of data collection and analysis;*
- *An explicit account of the manner in which the quantitative and qualitative aspects of the research relate to each other, with heightened emphasis on the manner in which triangulation is used; and*
- *Pragmatism as the philosophical underpinning for the research (Descombe, 2013: 272).*

He argues that many research questions generally cross-paradigmatic boundaries and cannot be adequately addressed using the positivist or Interpretivists philosophies exclusively. In fields such as sociological and educational research, where evaluation and achievement scores are as important as the contributing factors, mixed methods research is increasingly used as a legitimate alternative to conventional mono-methods

(Creswell, 2014). Let me briefly discuss the three major types of approaches in research before justifying the approach I used for my study.

Table 3.3: Characteristics of qualitative and quantitative research

Point of comparison	Qualitative research	Quantitative research
Focus of research	Quality (nature and essence).	Quantity (how much, how many).
Philosophical roots	Phenomenology, symbolic interactionism, constructivism.	Positivism, logical empiricism, realism.
Associated phrases	Fieldwork, ethnographic, naturalistic, grounded, constructivism.	Experimental, empirical, statistical.
Goal of investigation	Understanding, description, discovery, meaning, hypothesis generating.	Prediction, control, description, confirmation, hypothesis testing.
Design characteristics	Flexible, evolving, emergent.	Predetermined, structured.
Sample	Small, non-random, purposeful, theoretical.	Large, random, representative.
Data collection	Research as primary instrument, interviews, observations, documents	Inanimate instruments: scales, tests, survey, questionnaires, computers.
Primary mode of analysis	Inductive, constant comparative method.	Deductive, numerical.
Findings	Comprehensive, holistic, expansive, richly descriptive.	Precise, numerical.

Source: Merriam (2009: 18)

Saunders, Lewis and Thornhill (2009) depict the step to follow in research by the research onion (see Figure 3). The entire research process as illustrated by the research onion, suggest that the outer layer of the onion is the philosophical underpinning of the research and that decision-making in research is driven by the philosophy or paradigm on which the study is premised. The outer layer of the research onion is the most important in any scholarly endeavours because it determines the data collection techniques and analysis procedures.

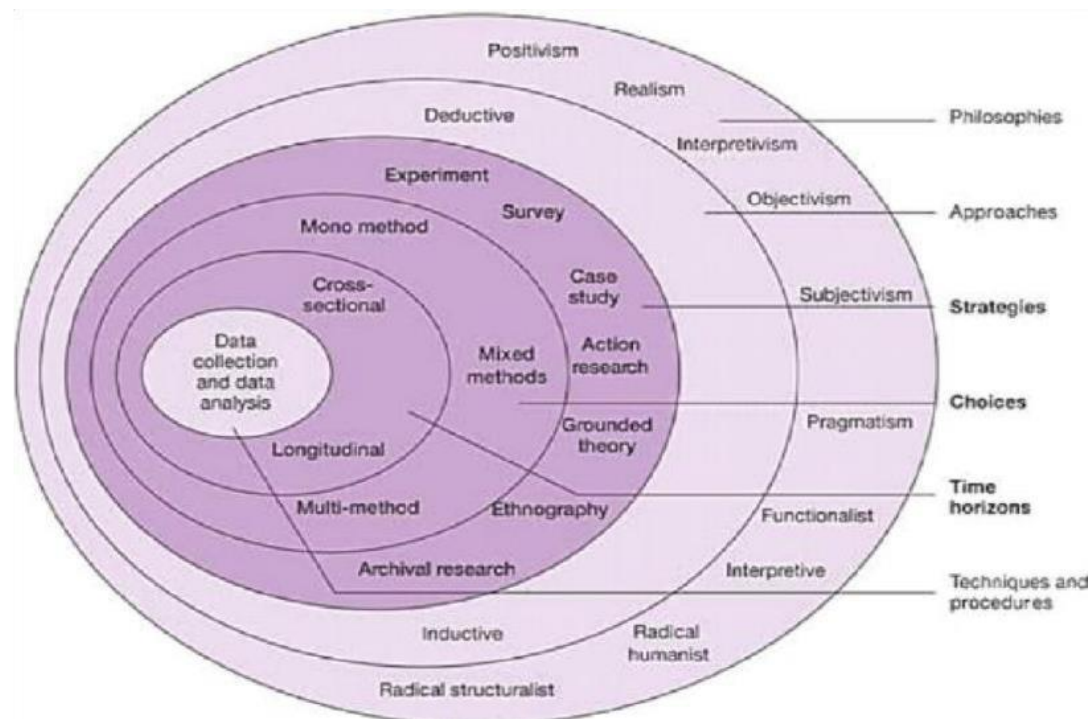


Figure 3.1: Research Onion (Source: Saunders, Lewis and Thornhill, 2009)

3.3.1 Quantitative Approach

Rubin and Babbie (2015) aver that the quantitative approach used in research attempts to produce findings that are precise and generalizable. Using specific definitions and carefully operationalizing what particular concepts and variables mean is the focus of this approach (Tewksbury, 2009). Due to its nature, quantitative approach is found to have significant advantages. The approach is believed to be helpful in testing and validating theories, testing hypotheses, and replication of findings (Everset, 2014). It is useful when carrying out a large-scale need assessment or baseline survey by allowing the collection

of large quantities of data. Quantitative approach works well in measuring trends, producing results which are numerical (quantifiable), and hence considered more “objective”. Above all, the quantifiable data is likely to provide a clear, quantitative measure that can be used for grants and proposals especially for companies and organizations (Ramona, 2011). Data analysis in quantitative approach is believed to be relatively less time consuming, for it can be done using statistical software. Despite the highlighted merits of the quantitative approach, it should be noted that its major weakness is that of ignoring a very important human element (that is, depth of an issue) in research.

3.3.2 Mixed method research

The mixed methods approach combines and integrates the philosophical assumptions and approaches of both quantitative and qualitative forms in a study (Creswell, 2014:3) using distinct designs that may involve philosophical assumptions and theoretical frameworks; it is a form of approach that involves collecting and analysing data for both quantitative and qualitative to increase the overall strength of the study. This combined strength makes the mixed method approach to be greater than either quantitative or qualitative research (Samuel, 2012) and will help in delivering a more complete understanding of a research problem than either approach only. Researchers who have the time mostly adopt the approach and resources; also enjoy the combination of the structure of quantitative research with the flexibility of qualitative inquiry. However, a notable challenge when applying a mixed method design centers on how the researcher was able to adopt an impartial position of distance and neutrality (positivism) from the process and the participants, while promoting a subjective level of nearness and exchange when trying to understand of the participant’s common realities (Interpretivists) (Patton, 2010). Therefore, it is imperative that the researcher maintains and accepts the truth of their positions and that information claims cannot be mixed between what was resulting from quantitative data, with that derived from qualitative data (Creswell, 2014). Additionally, researchers are advised to use different research methods in such a way that the consequential combination has complementary powers and not overlying weaknesses (Johnson & Turner, 2013).

3.3.3 Qualitative Approach

According to Everset, (2014) qualitative approach focuses on the meanings, traits and defining characteristics of events, people, interactions, setting or cultures, and experiences. This approach is useful when researchers need to explore people's feelings or ask participants to reflect on their experiences and when it is done well, qualitative approach does provide valuable insights and advances to knowledge (Bryman, 2015). It also emphasizes the importance of direct contact with social reality as the springboard for any investigation thus, fashioning an understanding of the social world through that contact (Bryman, 2015). Qualitative approach is responsive to local situations, conditions and stakeholders' needs and apart from that, it is also useful for describing complex phenomena. However, qualitative approach findings are difficult to generalize to other people or other settings, since the findings may be unique to the people included in the research study (Rubin & Babbie, 2015) due to the limited number of respondents involved in the qualitative data that are gathered. Another weakness of qualitative approach is that it usually takes more time to collect data compared to quantitative approach, and qualitative data analysis tends to be cumbersome and often time consuming (Wellington, 2015).

The objective of qualitative research is to promote better self-understanding and increase insight into the human condition. Unlike quantitative research, which has, as its objective, collecting facts about human behaviour that were led to verification and extension of theories, qualitative research emphasizes the improved understanding of human behaviour and experience. Qualitative methods include direct observation, document analysis and overview, participant observation, and open-ended unstructured interviewing. These methods are designed to help researchers to understand the meanings people assign to social phenomena and to elucidate the mental processes underlying behaviors. Adu (2018) characterize qualitative inquiry as research approach that is generally conducted in natural settings, utilizing the researcher as the chief tool in both data gathering and analysis. The benefits of qualitative inquiry are embedded in its emphasis on thick description, i.e. obtaining real, rich, deep data, which illuminates

everyday patterns of action and meaning from the perspective of those being studied (Wellington, 2015).

This view emphasizes the importance of the voice of the researched and gaining first-hand information regarding the lived experiences of the researched on a subject. It tends to focus on social processes, where the established relationship between the researcher and the respondents is valued, rather than primarily or exclusively on outcomes. Qualitative inquiry uses an inductive approach to data analysis, extracting its concepts from the mass of certain detail, which constitutes the database; it also involves employing multiple data gathering methods, especially participant interviews. The strength of qualitative approaches, according to Weinreich (2009), is that, they generate rich, detailed data that consent the participants' perspective intact and provide a context for the phenomena being studied. A disadvantage of data collection in the qualitative approach is that it may be labour intensive and time consuming.

3.3.4 Approach for this study and justification

This study is a quantitative approach of a descriptive survey research. The quantitative approach as a traditional mode of research involves a highly systematic procedure with carefully worked out rules guiding it (Kura, 2012). It includes cross-sectional and longitudinal studies using questionnaires or structured interviews for data collection with the intent of generalizing from a sample to a population (Kura, 2012). It is more relevant when factors that influence an outcome are to be identified or to predict an outcome (Lincoln, Lynham, & Guba, 2011), but if a concept needs to be explored as a result of an earlier research carried out on it, the best option is to apply a qualitative approach (Creswell, 2012).

According to Creswell (2014), the quantitative method is predetermined based on the use of instruments, performance (achievement) data, attitude data, observational data, statistical analysis and interpretation, while the qualitative method uses open-ended questions, interview data, observation data, document data and audio visual. Others include text and images analysis, themes, sub-themes and patterns interpretation

(Creswell, 2014). Quantitative research is an empirical research in which data gathered are in numerical forms using the syntax of mathematical operations and represents data in numerical values (Kura, 2012).

It employs statistical tools in the collection and interpretation of data. Quantitative methodologists are of the opinion that research can only be executed using statistics and statistical methods; hence, quantitative research is seen as been more representative and reliable than qualitative research. Its emphasis on systematic statistical analysis helps to ensure that findings and interpretations are robust (Devine, 2002). Quantitative research is deeply rooted in positivism and epistemological orientation; hence, the researcher adopted this approach. Descriptive survey research shows the associations among two or more variables in a study without any attempt to influence them. It investigates the possibility of relationships between two variables and these variables cannot be manipulated (Sanni, 2011). Further, it describes the phenomena being studied, data collection and analysis using descriptive statistics (Lomax & Li, 2013).

This study adopted the quantitative approach. The purpose of using this approach for this particular study is because it can predict human behavior or predict likely outcomes (identify relationships among variables) which particularly this study is all about, to show how learning style, availability, and utilization of instructional materials affect Grade 6 learners' Mathematics performance. Creswell (2014) explains that a correlational research is useful in determining to what degrees two variables are related and not to prove a relationship; rather it indicates an association between two or more variables.

Quantitative research, according to Lomax and Li (2013), is a research approach aimed at testing theories, determining facts, demonstrating relationships between variables, and predicting outcomes. Quantitative research uses methods from the natural sciences that are designed to ensure objectivity, generalizability and reliability (Weinreich, 2009). The techniques used in quantitative research include random selection of research participants from the study population in an unbiased manner, the standardized questionnaire or intervention they receive, and statistical methods used to test predetermined hypotheses regarding the relationship between specific variables. The researcher in quantitative research, unlike in the qualitative paradigm where the researcher is regarded as a great research instrument due to active participation in the

research process, is considered as being external to the actual research, and results are expected to be replicable, no matter who conducts the research.

The primary reason for employing the quantitative approach in this current study was to provide answers to questions raised on how learning style, availability, and utilization of instructional materials affect Grade 6 learners' Mathematics performance. The researcher is of the opinion that the effects of learning style, availability, and utilization of instructional materials on learners' Mathematics performance can be obtained using questionnaires and achievement tests to gather data to be analyzed using descriptive survey research design, thereby enhancing the validity of inferences drawn using step-wise regression analysis and t-test.

The quantitative approach is employed in the current study since; it is helpful in testing and validating theories, testing hypotheses, and replication of findings (Everset, 2014). It is useful when carrying out a large-scale need assessment or baseline survey by allowing the collection of large quantities of data. Quantitative approach works well in measuring trends, producing results which are numerical (quantifiable), and hence considered more "objective".

Another reason for the quantitative approach is based on the assertion of Ramona, (2011) that data analysis in quantitative approach is believed to be relatively less time consuming, for it can be done using statistical software such as the Statistical Package for Social Sciences (SPSS) in comparison to hazardous task of transcribing information collected using the qualitative approach.

3.4 RESEARCH DESIGN

Research design is the plan for connecting the theoretical research problems to the relevant empirical research. In other words, what methods that are going to be used to collect data, analyze data and how all the research questions will be answered are articulated by research design (Wyk, 2010).

According to Kumur (2011), research design is a routine plan for answering research questions in a valid, accurate and economical way. A research design in its simplest term is a systematic and well laid out route-map to answering research questions. The 'glue' holds all the elements in a research project together and is referred to as the structure of a research. In the same vein, Cameron (2014), defined research design as a systematic and justified route-map to answering research questions. The pivotal role of a research design is to minimize the chance of drawing inappropriate causal inferences from data obtained.

Definitions cited above reveals that researchers need to be guided and directed by a research design to ensure that evidence collected enables them to adequately address the demands of research questions or to test theories as unambiguously as possible. In every design, there are elements. These elements are observations symbolized by 'O' in design notation, treatments or programs symbolized with an 'X' in design notations, and the third element is group which symbolizes the number of elements contained therein (Cameron, 2014). This study is a descriptive survey that adopts correlational design, which is a scientific method that involves observing, and describing the behaviour of a subject in which information will be collected without changing the environment (i.e. nothing is manipulated).

3.4.1 Correlational Research Design

Correlational research design is a form of quantitative design that is non-experimental. The researcher described and measured the degree of association uses statistical data derived from correlational studies or relationship that exists between two variables or set of scores (Creswell, 2012). According to Waters (2005), correlational design is a quantitative method in which there are two or more quantitative variables from the same groups and the researcher tries to determine if a co-variation exists between the two variables. In theory, any two variables can be associated as far as scores are obtained from the same respondents.

Lomax (2013) maintained that the main reason for correlational research design is to show the relationship that exists between two or more variables by gathering data from multiple variables and various correlational statistics, which are then applied, to the data. It investigates many factors, which include the characteristics of the association between two or more variables and the likely theoretical model that may be developed and tested to explain the resultant correlation. The methodology and data collection should be done in the most effective manner in producing answers to the research question, taking into cognizance the practical constraints of the study. It reflects the purpose of the enquiry be it exploratory, historical, descriptive, explanatory, predictive or evaluative.

Therefore, the correlational design is the most useful and appropriate research design for this thesis due to the high levels of uncertainty and ignorance about the subject, because of the paucity of existing research and literature on the research topic. This type of research is usually flexible without a formal structure. Descriptive research is aimed at identifying limitations in the environment in which the problems, opportunities or situations of interest are likely to reside and to identify the relevant factors or variables that might be found to be of significance to the research.

The motive behind descriptive research is to provide an accurate and valid representation that summarizes the factors or variables that pertain or are relevant to the research question. Such research is more structured than exploratory research. Explanatory research, sometimes referred to as analytical study, aims at identifying any causal links between the factors or variables that pertain to the research problem. This type of research design is not truly experimental but shows the association between two or more worlds, hence, it was useful in this study to determine the correlation between learning style, availability, and utilization of instructional materials and learners' academic performance in Mathematics.

According to Kumur (2011), research design is a procedural plan for answering research questions validly, accurately and economically. A research design in its simplest term is a systematic and well laid out route-map to answering research questions. This study is correlational survey research design, which is a scientific method that involves observing, and describing the behavior of a subject in which information will be collected without

changing the environment (i.e. nothing is manipulated). This is in line with the constructivists that suggest that learning is more effective when a student is engaged in the learning process with learner-centered methods rather than receiving knowledge passively. When learners are allowed to use and construct their personal understanding based on the skills acquired, allow them to learn best. This type of research design is not truly experimental but shows the association between two or more worlds, hence will be useful in this study to determine how learning style, availability, and utilization of instructional materials affect grade 6 learners' Mathematics performance.

3.5 POPULATION

Population in the view of Creswell (2014) is that group which the researcher is interested in gaining information and drawing conclusions. A population is the larger group about which a generalization is made and is a group of individuals who have the same characteristic (Creswell, 2013). Johnson and Christensen (2012) assert that a population is a large group to which a researcher wants to generalize the sample results. It can be concluded that a population is the total group that the researcher is interested in learning more about (Johnson & Christensen, 2012). They view a population as a group of individuals with common elements, objects, or events that conform to specific criteria and to which researchers intend to generalize the results of the research. Best and Heugh, (2015) defined a population as any group of individuals that has one or more characteristics in common and that are of interest to the researcher. The target population for this study are Grade 6 learners in Buffalo City education district.

3.6 SAMPLE AND SAMPLING TECHNIQUES

A sample is a representation of the target population being researched, and findings from the population are usually used to draw conclusions about the population (Adu et al., 2016). It is a process of selecting units from a population of interest so that by studying the sample the results can be generalized back to the population from which they were chosen. Sampling is classified majorly into probability and non- probability sampling

methods. According to Sanni (2011), a research sample helps to inform the quality of inferences made by the researcher that stem from the underlying findings.

Probability sampling techniques refer to the possibility that each object in the target population can be selected, and in most cases the chances of selecting one is equal to the possibility of selecting any other object (Sanni, 2011).

According to Bamberger (2012), sampling is that part of statistical practice, which has the purposes of making predictions based on statistical inference. It is concerned with the selection of a sub-set of individuals from within a population to yield some knowledge about the whole, it is a sub-set of the population selected for a given research enquiry which helps to inform the quality of inferences made by the researcher that stem from underlying findings (Tashakkori & Teddlie, 2010).

There are various types of probability sampling techniques such as simple random, systematic sampling, cluster sampling, multi-stage sampling, quota sampling and stratified sampling. Each of these sampling techniques shall be briefly explained for proper understanding of their use in social sciences and educational research.

3.6.1 Random Sampling

This sampling method is based on the principle, which ensures that each individual in the population has an equal opportunity of being selected for the study (Fowler, 2009). In using this sampling technique, the exact size of the population must be known. The first step in random sampling is to construct a list of all the individual sample units (i.e. the sample frame) in the population being sampled (Bamberger, 2012). In systematic random sampling, the researcher chooses a random start on a list and selects every Y numbered people on the list. This Y number is based on a fraction determined by the number of people on the list and the number that are to be selected on the list (For instance 1 out of every 20th person). It is a fair way to select a sample and reasonable for the purpose of generalization of results from the sample back to the population (Creswell, 2014).

3.6.2 Systematic Sampling

In the systematic technique, each element in the population is allotted a number (Sanni, 2011). The researcher may select every 10th, 20th or nth element of a population until the desired sample size is selected. Since the first is chosen at random, all the items have the same prospect of being selected for the sample. According to Hammed and Popoola (2016), the strategy of determining items for inclusion in the sample can be obtained by dividing the size of the population by the same sample size. It is of a higher value when compared with the simple random sampling because it is more convenient (Vos et al., 2011).

3.6.3 Cluster Sampling

This sampling technique is mostly ideal when it is impracticable to compile a list of the elements that make up the population. In using this method, the total population is divided into a number of relatively small subdivisions that are themselves clusters of smaller units (Hammed & Popoola, 2016). These subdivisions are randomly selected for inclusion in the overall sample. It is used when a sampling frame such as a list of names is not available (Vos et al., 2011). The problem with this sampling technique is that to cover a very large population that is not found in the same place, there will be a need to cover a lot of ground geographically to get to each of the units sampled. In cluster sampling, the following steps will be followed:

- Divide the population into clusters especially along geographic boundaries;
- Randomly sample clusters; and
- Measure all units within sampled clusters.

3.6.4 Multi-Stage Sampling

When a population is highly heterogeneous and difficult to develop the sample frame of individual elements, it is advisable to select random samples in stages (Vos et al., 2011). The combination of simple, stratified, systematic and cluster sampling is known as the multi-stage sampling technique. By combining different sampling methods, a variety of

probabilistic sampling methods are achieved that can be used in a wide range of social research contexts.

As the name suggests, this sampling technique is done in stages until all the samples in the study are represented. For example, a researcher might randomly select some villages within a state as the first stage; in the second stage, he/she can randomly select some schools within the selected villages and in the third stage, he/she randomly selects some students within the selected schools.

3.6.5 Quota Sampling

This is a type of sampling in which deliberate control factor is used to draw samples from a study population on the assumption that the chosen samples have similar characteristics with the sampling population (Hammed & Popoola, 2016). It is a subjective method of selecting samples from a given population. In quota sampling, it is impossible to estimate population parameters and sampling errors with statistical procedures developed based on random sampling. There are two types of quota sampling: proportional and non-proportional. In proportional quota sampling, major characteristics of the population are sampled through a proportion. Non-proportional quota sampling is a little bit less restrictive. The minimum number of samples to be used in this method must be specified. This argument disparages not in any way the quota sampling technique, rather it is useful in research where the population size is indeterminate, the sampling frame is not available, and to compile one is difficult. Here quota sampling becomes relevant in order to reduce the cost of sampling, save time and energy reduction in using the probability sampling technique.

Having briefly explained some of the probability sampling techniques, the focus will be on the stratified sampling technique adopted by the researcher for the purpose of this study because it allowed the researcher to draw his sample from a heterogeneous population.

3.6.6 Stratified Sampling

Stratification implies that specific characteristics of individuals such as being male or female is represented in the sample which reflects the true proportion in the population of individuals with certain characteristics (Fowler, 2009). When randomly selecting people from a population, these characteristics may or may not be present in the sample in the same proportions as in the population, hence stratification ensures their equal representation.

Sanni (2011) identified the characteristics used in stratifying the population (e.g. gender, income levels, and education). Within each stratum there is need to identify whether the sample contains individuals with the characteristic in the same proportion as the characteristic appears in the entire population.

When a population is heterogeneous, it might be necessary first to stratify by dividing it into a set of mutually exclusive subpopulations or strata, which could be based on race, sex and religion. Random samples are then selected from each stratum.

Stratified sampling is a process of dividing the sample frame into a stratum to obtain a relatively homogenous subgroup (Sanni, 2011). It is suitable for heterogeneous population so that the small subgroups in terms of percentage will be guaranteed to be included in the sample frame (Vos et al., 2011). The use of stratified sampling ensures that there will be adequate representation of not only the overall population but also key subgroups of the population, especially small minority groups. In addition, stratified sampling will generally have more statistical precision than the simple random sampling technique. This research is carried out in South Africa, and being a heterogeneous society, it is therefore stratified into nine provinces; out of these, one province, which is Eastern Cape, was selected. Eastern Cape comprises of many circuits and districts (Buffalo City Education District) is randomly selected so as to cater for the homogeneity of the respondents, such as gender, home language, level of education, and age. This is to ensure that the different groups of the population are well represented in the sample (Vos et al., 2011). Details of the samples and sampling strategies for this study will be explained latter.

Burns and Bush (2010) stated that the size of a sample influences how the sample findings accurately represent the population of a given study. The larger the sample is the more likely that the generalizations are an accurate reflection of the population (Saunders, Lewis, & Thornhill, 2009), Stratified sampling was used to select participants. Stratified sampling is a process of dividing the sample frame into strata to obtain relatively homogenous subgroups (Sanni, 2011). East London district consists of twelve (12) circuits, out of these; seven (7) circuits were randomly selected. Disproportionate stratified sampling technique was used to select five (5) schools from each of the circuit. This gave 35 schools selected across all the circuits in the district. From each selected school, one arm of Grade 6 was also randomly selected and total enumeration was used to involve all the learners in the selected class. Averagely, 35 learners are expected in each class, this gave us 1225 Grade 6 learners selected across 35 schools in Buffalo City as the sample of the study. This sample is representative according to the table below.

Table 3.3 is a sample guideline designed by Stoker (1985) to assist researchers on the size of the sample that will be representative of a population in any quantitative study.

Table 3.3: Stoker's sample guideline (Stoker, 1985 cited by Adu et al., 2014:15)

Population	Percentage suggested	Number of respondents
20	100%	20
30	80%	24
50	64%	32
100	45%	45
200	32%	64
500	20%	100
1 000	14%	140
10 000	4,5%	450

100 000	2%	2 000
200 000	1%	2 000

3.7 VARIABLES OF THE STUDY

A variable can simply be referred to as an attribute possessed by an individual or an organization that is measurable and observable with variations among the people or organization being considered. This variance means that scores in each situation fall into at least two equally exclusive groups (Thompson, 2006). Variables often measured include gender (male or female), age, socio-economic status (SES), or attitudes or behaviours such as racism, social control, political power, or leadership (Creswell, 2014).

3.7.1 *Types of Variables*

Independent variables, also referred to as treatment, manipulated, antecedent, or predictor variables, cause and/ or influence effect outcomes of a study. For the purpose of this study, the independent variables are learning style, availability, and utilization of instructional materials.

Dependent variables, as the name implies, are variables that depend on the independent variables; they are the outcomes of the influence of the independent variables. Dependent variables can also be referred to as criterion, outcome, effect and response variables. For this study the dependent variable grade six learners' Mathematics performance.

Intervening or mediating variables stand between the independent and dependent variables and mediate the effects of the independent variable on the dependent variable. For example, if students perform well in a research methods test, which is a dependent variable, the outcomes may be due to (a) their study preparation (independent variable), or (b) their organization of study ideas into a framework (intervening variable) that influenced their performance on the test. The mediating

variable, the organization of study, stands between the independent and dependent variables in the probable causal link.

Moderating variables are regarded as variables that affect the direction and/or the strength of the relationship between independent and dependent variables or moderate the influence of the independent variable on the dependent variables (Thompson, 2006). These moderating variables are new variables constructed by a researcher by taking one variable and multiplying it by another to determine the joint impact of both on the dependent variable (e.g. age, and gender) and moderating variables instead of major independent variables which are typically found in experiments (Creswell, 2014).

3.8 VALIDITY AND RELIABILITY

Sanni (2011) refers to validity as the extent to which a test measures what it was designed to measure. The instrument for this study will be validated by giving a draft copy to my supervisor and other experts in the field of research studies for their perusal and necessary corrections. Pilot testing the research instruments was used to ensure the content validity. After validation, the instrument was subjected to Kuder Richardson 20 and Cronbach alpha to establish its reliability. Hence, reliability according to Babbie (2012) is the degree of consistency exhibited by an instrument when used repeatedly and yielding the same result each time.

3.8.1 Validity

Validity measures the extent to which findings and data are presented accurately on the account of the events they claim to be describing. According to Sanni (2011), “validity is generally acknowledged to be a *key* issue in research design”. Validity stands out as a critical component in answering questions like: *How were readers know that the conclusions are valid. Why should they believe the results? What if the researcher is wrong?* Therefore, validity is the degree to which a choice of a research method investigates what it is intended to investigate. Validity, in other words refers to the truthfulness and trustworthiness of findings. Validity is a key concept in any form of

enquiry (Ralenala, 2013). Validity, furthermore, is concerned with whether the researcher is observing and measuring what the researcher thinks and one way to assess how valid an instrument is, is by comparing its results with other sources of data (Du Plooy, 2010:124). Ralenala (2013) asserted, "Individuals must be interviewed in sufficient detail for the results to be taken as true, correct, complete and believable" in order to establish validity. Validity, in this study, is achieved through the use of multiple methods of data collection, namely the use of the quantitative and qualitative approaches and a comprehensive document analysis to support the findings of the study.

3.8.1.1 Internal validity: is crucial to experimental research designs; and it may be obtained by using at least two groups that are equal in respect of both the dependent variable and all nuisance variables. Cozby (2011) believed that the internal validity of a research study is the extent to which its design allows the researcher to draw accurate conclusions about cause-and-effect relationships. To ensure the internal validity of research, the researcher needs to attempt to eliminate any other possible explanations for the results observed (Cozby, 2011).

3.8.1.2 External validity: if a study lacks external validity, then one is not confident that the findings can be applied beyond the narrow confines of the study. One especially common threat to external validity is the lack of random selection. When the sample does not reasonably represent the population, external validity is lacking (Creswell, 2013). Cohen et al. (2011) suggested four areas of doubt concerning the ability to generalize findings:

- The researcher's inability to conceptualize performance indicators, so that other researchers can replicate the experiment;
- The researcher's inability to ensure that the experimental and control groups are representative of larger populations;
- The researcher's inability to be confident that the operationalized variables in the experimental setting can be replicated in real-life situations; and

- The researcher's inability to be certain that internal validity variables such as history, maturation, pre-test sensation, test reliability and selection were not detrimentally affected external validity.

3.8.1.3 Measurement validities: Neuman (2011:25) described measurement validity “as how well an empirical indicator and the conceptual definition of the construct that the indicator is supposed to measure fit together”. Although there are many types of validity, authors agree that there are a few common techniques used to assess the validity of a measuring instrument. Regarding content validity, (Kumur, 2011) distinguishes three types of content validity, namely face validity, sample validity and factorial validity. Face validity, according to Lankford and Volkmann, (2009) refers to the relationship (similarities/correlation) between the researcher's description of concepts and description of the categories measured. In the light of the purpose of the current research, face validity determines if a questionnaire after a superficial (on the surface/on the face of it) assessment, looks valid at first glance (the face of it) for a respondent (person) who has to complete the questionnaire. That face validity does not refer to what items of a questionnaire really measure. It rather what the researcher wants it to measure at first glance. In other words, each question or item on the measurement instrument should have a logical link with an objective. Broadly, the establishment of the referred to link is called face validity (Kumur, 2011).

Sample validity (logical) of measuring instrument as for instance a questionnaire on the other hand, is grounded on a representative sample of the content subjacent to the concept about which information is obtained from. In this regard Lankford and Volkmann, (2009) alleged, “Content validity is the degree to which the total variance of the sample (the actual questionnaire) is related to the variance in the total possible population of tasks or items”. Lastly, the factorial validity of a measuring instrument (questionnaire) refers to the loading of the questionnaire with a general factor – in other words, the relation (correlation) which exists between the questionnaire and a common factor, as measured by means of the questionnaire (Kumur, 2011). Lankford and Volkmann (2009), implicitly purport, that there is a relation (correlation) between the questionnaire and a common factor, which is measured by means of the questionnaire.

Two other forms of validity are construct validity and criterion validity. It has been the purpose to determine the perceptions of respondents on the importance of sport management abilities in developing a sport management programme for educator training, which would enable sport managers to manage school sport in accordance with the diverse needs of South African schools. Concept validity accepts relation to expectations supported by concept relevant to the theory. In an endeavor to ensure construct validity for the current study, the questionnaire items were developed in position with the theoretical foundations concerning school sport management. Face validity was optimized by the conduct of a pilot test to verify the relevance and representativeness of the various items to the intended setting (Kumur, 2011). Criterion validity seen as the ability of a measure to link with other standard measures of similar constructs or established measures. Given the fact that no other standard measure of similar constructs or established criteria available, criterion validity is not established. Subsequently, it is in line with the research design adopted for this research (Kumur, 2011). Internal validity was ensured by means of a substantial theoretical framework, initial qualitative data and an adapted existing questionnaire.

3.8.2 Reliability

Reliability refers to the degree of consistency between two sets of data or observations obtained with the same instrument or equivalent forms of the instrument (Sanni, 2011; Akinsola & Ogunleye, 2012). Reliability happens when an instrument measures the same thing repeatedly and produces the same outcome (Wellington, 2015; Sanni, 2011; Vos et al., 2011).

Reliability implies the ability of an instrument to yield consistent results each time it is applied and not subject to fluctuations except where there are variations in the variable being measured. Reliability refers to the regularity, constancy and repeatability of results (Adefioye, 2015), i.e. the result of a researcher is considered reliable if the same results are arrived at in similar situations but under different circumstances. Hence, reliability

is the degree of consistency exhibited by an instrument when used repeatedly and yielding the same result each time (Babbie, 2012).

Furthermore, it is an expression of precision and accuracy of results obtained from measuring an instrument. When an instrument measures what it supposed to measure under the same condition and produces the same result, such instrument is deemed reliable. According to Adu et al. (2016), an instrument is reliable when it is error free in measurement. In order to increase the reliability of instruments, the following procedures are suggested by Vos et al. (2011):

- i) The number of items or observations must be increased;
- ii) Remove ambiguous items;
- iii) Increase the level of instruments or measurement;
- iv) Use standard conditions for the test;
- v) Maintain a moderate difficulty level for the instrument;
- vi) Reduce external influence;
- vii) Instructions must be standard;
- viii) Consistent scoring techniques must be followed;
- ix) Pilot test the instrument (Vos et al., 2011:177).

3.8.2.1 Test - Retest Reliability

This method requires that an instrument be administered twice to the same groups at different times within some time interval. The time interval could be as short as one day and as long as two weeks depending on the researcher (Cohen et al., 2011). Test-retest reliability is estimated when the same test is administered to the same sample on two different occasions (Trochim, 2006). The assumption of this approach is that there is no substantial change in the construct being measured between the two occasions. If the interval given for test retest is short, respondents may be able to recollect responses given in the first test. If too long extraneous variables are set it will affect the reliability of the instrument. It should be noted that the time lapse between the time the first and the second test is conducted on the same observation would show the level of correlation.

The correlation of scores in both tests administered will give a measure of how reliable the instrument is.

3.8.2.2 Equivalence form or Parallel Form Reliability

This is known as the alternate or parallel form. In using this form of reliability, two equivalent instruments are administered to the same subjects at almost the same time but with one following the other (Cohen et al., 2011). The two instruments are not the same, but they measure the same thing, that is, they are based on the same content.

For instance, the equivalence or parallel form of reliability is the fulcrum for pretest and posttest in an experiment, being alternate forms of instrument to measure the same issues. This type of reliability might also be demonstrated if the equivalent forms of a test or other instrument yield constant results if applied simultaneously to the matched samples (for example a control and experimental group or two random stratified samples in a survey). Here reliability can be measured through a t-test, through the demonstration of a high correlation coefficient, and through the demonstration of similar means and standard deviations between two groups.

3.8.2.3 Split-Half Reliability

In the split-half methods, results are divided into halves (subsets) and juxtaposed to see if the results are the same either on the basis that one subset contains all even number items and other subset odd number items (Sanni, 2011; Akinsola & Ogunleye, 2012).

The first half of the items can be taken as one subset and the second half another subset depending on the researcher. For instance, if an instrument contains 40 items, items 1-20 are taken as the first subset, while items 21-40 will be the second equivalent subset. Each of the halved subset is scored separately. The reason for this is to produce two equal halves from one instrument, which are separately scored and then the results correlated to obtain an index of its reliability.

3.8.2.4 Inter-item Consistency

In this method, the relationship between each item and the whole instrument is determined. This is done in order to determine the relationship between the items. Instruments used to determine this include the Kuder-Richardson formula (KR 20-21), Cronbach coefficient alpha, Spearman rho, etc.

(a) **Kuder-Richardson method:** This method makes use of psychometric data obtained from one test administration. It is assumed that items in the instrument are homogeneous and so possess inter-item consistency. In order to apply KR20, the items must be scored dichotomously (right or wrong) followed by the preparation of person-by-item matrix. This matrix indicates how each member of the sample answered each item in the test either rightly or wrongly.

(b) **Cronbach coefficient alpha method:** The Cronbach coefficient alpha is a generalized form of K- R20 except that $\sum si^2$ replaces the value $\sum pq$. The basic assumption is that items requiring responses such as “strongly agree”, “agree”, “disagree” and “strongly disagree” do not correspond with the usual right or wrong format and this may make coding difficult. For example, for all positively worded items, the “strongly agree” response may attract 4 points, 3 points for “agree”, while 2 and 1 respectively will be scores for “disagree and “strongly disagree”.

The scoring order is reversed for all negatively worded items (Cohen et al., 2011). Instruments with such negatively worded items will use Cronbach's alpha as a measure of reliability. Conclusively, an instrument may be reliable but not valid for the purpose intended since an instrument may be consistent, even if it measures the wrong thing, but a valid instrument is reliable. Therefore, validity of data collection instruments is more crucial than reliability. This study will therefore ensure reliability of the data collection instruments through the employment of K-R 20 and Cronbach's alpha.

3.9 DATA COLLECTION INSTRUMENTS

There are many strategies of data collection, and the choice of an instrument or research tool depends mainly on the attributes of the subjects, research topic, problem question, objectives, design, expected data and results. Zohrabi (2013) avers that, data collection instruments are the fact-finding strategies used for obtaining relevant information concerning the problem under investigation. The choice of an instrument or research tool depends mainly on the characteristics of the subject under investigation, research topic, problem question, aims / objectives, design, data expected and results. Three data collection instruments used in the study were the Students' Learning Style Scale (SLSS), Availability and Utilization of Instructional Materials Inventory (AUIMI) and Mathematics achievement test (MAT). Let us see the details of each instrument.

3.9.1 Students' Learning Style Scale (SLSS)

Students' Learning Style Scale (SLSS) has two sections, section A and B. section A consists of biodata information; which are, Name, School and Gender. Section B has seventeen (17) items with the following response scales; **GE** = Great Extent, **SE** = Some Extent, **LE** = Little Extent, **NA** = Not at All (**See Appendix A**).

3.9.1.1 *Validity and reliability of SLSS*

According to Setati (2011), for a research study to be accurate and its findings reliable and valid, there is need for measuring validity and reliability of any instrument. Different writers addressed the issue of validity and reliability differently. Validity and reliability were utilized as criteria for judging the quality of the research design. There are different forms of validity, which this study was employed to ascertain its accuracy, meaningfulness and credibility (Leedy & Ormrod, 2013). These forms include construct validity; content; and concurrent validity. The expert opinion was sought to increase the instruments' validity. Research instruments were pilot tested by administering them to similar samples outside the chosen location (Amathole West), after which, the instruments were analyzed using Cronbach alpha, which showed the difficult and

ambiguous items which were either rephrased or removed. A co-efficient value of 0.87 was obtained. In this study, the questionnaire was regarded as valid and that these instruments elicited for accurate information. They provide a real measure of examining the learning style, availability, and utilization of instructional materials as it affects Grade 6 learners' Mathematics performance.

3.9.2 Availability and Utilization of Instructional Materials Inventory (AUIMI)

Availability and Utilization of Instructional Materials Inventory (AUIMI) has two sections, section A and B. section A consists of biodata information; which are, Name, School and Gender. The biodata information is necessary especially the gender of the participants in order to know if it influences performance in Mathematics. Section B has fifteen (15) items with the following response scales; **A** = Available, **NA** = Not Available, if available, **U** = Use, **NU** = Not Use **(See Appendix A)**.

3.9.2.1 Validity and reliability of AUIMI

As alluded to in this study, there are different forms of validity, which this study was employed to ascertain its accuracy, meaningfulness and credibility. These forms include construct validity; content; and concurrent validity. Research instruments was given to the experts in the field of Mathematics Education and the researcher's supervisor who assisted with the phrasing and selection of questions. The instrument was also pilot tested to increase the instruments' validity. This study ensures reliability of the data collection instruments by pilot testing the instruments using similar samples and calculating it using Cronbach's alpha. A co-efficient value of 0.89 was obtained. The questionnaire was regarded as valid and the level of internal consistency was high. Hence, this instrument elicited accurate information. The instrument provided a real measure of learning style, availability, and utilization of instructional materials and it effects grade 6 learners' Mathematics performance.

3.9.2.2 The Cronbach's alpha

Internal consistency refers to the degree of correlation between the various items of a measuring construct (Sekaran & Bougie, 2010:162). The Cronbach alpha coefficient is widely used as a reliable procedure to indicate how well various items are positively correlated to one another (Sekaran & Bougie, 2010:162). The Cronbach alpha is based on the inter-item correlations. If the items are strongly correlated with each other, their internal consistency is high, and the alpha coefficient was close to one (0.89). On the other hand, if the items are poorly formulated and do not correlate strongly, the alpha coefficient was close to zero. Guidelines for the interpretation of Cronbach's alpha coefficient have been suggested and the following seem widely and generally accepted by researchers:

- 0.90-high reliability
- 0.80-moderate reliability
- 0.70-low reliability

For this study, a statistical method was used to calculate the Cronbach alpha coefficient, to assess the internal consistency of the various question items of the questionnaire. The Cronbach alpha coefficient calculated for each group of items in order to illustrate the internal consistency of each subsection and was very reliable. It also served another purpose in indicating the level of measuring the same construct validity. Apart from the importance of the concept reliability in the context of measurement, validity is widely considered as important in the context of measurement to ensure the success of any study.

3.9.4 Mathematics Achievement Test (MAT)

This is a self-developed instrument. It is a multiple-choice objective test made up of 25 items from the content of the Grade 6 Mathematics Curriculum Assessment and Policy Statement (CAPS). The researcher and the supervisor preferred this (MAT) to assess the learners' performance in Mathematics which almost similar to an assessment that is

usually conducted by the school. Each item has one correct option (key) and four distractors, i.e. options A, B, C and D. The content area covers some topics in Mathematics. The scoring of MAT was done on a dichotomous basis. The correct response earned one mark, while an incorrect response earned zero (**See Appendix A**).

3.9.4.1 Validity and Reliability of Mathematics Achievement Test (MAT)

The MAT of 25 items were administered as a pilot test to 35 learners from another site in order to measure its reliability coefficient, using Kuder Richardson 20. This method makes use of psychometric data obtained from one test administration (Babbie, 2012). It is assumed that items in the instrument are homogeneous and so possess inter-item consistency. An instrument is reliable when it consistently produces the same numerical results each time when it's used (Babbie, 2012; Sanni, 2011). The Kuder Richardson 20 was computed to determine the internal consistency and reliability of each item and the value was 0.78. The instrument was given to experts in tests and measurement, and lecturers in the Mathematics Education who offered suggestions, and corrections were effected to improve the instrument.

3.10 DATA ANALYSIS

Descriptive and inferential statistics was employed to analyze the data in this study. The descriptive statistics of frequency count, percentage, mean, and standard deviation was used to describe the features of the data collected. Inferential statistics of Pearson Product Moment Correlation (PPMC) were employed to test the hypotheses raised in this study as it measures relationships between independent variables (Instructional Materials, Learning styles, and Gender) on the only dependent variable (Mathematics performance). The use of PPMC for this study was necessary because it shows the relationship among two or more variables. (Creswell, 2014). Multiple regression analysis (MRA) was used to answer the research questions; and used to determine which of the independent variables would predict the dependent variables. It was also used to determine the composite and relative effects of the independent variables on the

dependent variable. The t-test was employed to test for the differences between male and female (gender).

The current research adopted a quantitative research approach of the descriptive survey type. Quantitative data was obtained from questionnaires and achievement test. The results are presented using descriptive statistics like frequency count, percentages, and charts and tables for clarity. Inferences are also made from results obtained from the application of econometric tools. Various statistical tools were used to analyze the quantitative data, such as Excel and the Statistical Package for Social Sciences (SPSS).

The data are displayed through appropriate tabular and descriptive presentation techniques. Frequency distribution and cross tabulation of key dependent and independent variables are presented in various tables and discussion of their implications facilitates descriptive analysis of the data. This method of presentation enables an easy understanding and clearer view of findings in a short available time. The results are arranged under different broad sections. In the current study, means and standard deviations were calculated for each item to establish which are more positive or negative. The number of respondents to each questionnaire item in the tables varies due to some non-responses to certain items.

3.11 ETHICAL CONSIDERATIONS

Fouka and Mantzorou (2011) define ethics as a matter of principled sensitivity to the right of others. In conducting social science or education research, the well-being of all participants must be a priority. All the necessary processes should be adhered to, which protect the physical and mental integrity of the participants, respecting their moral and cultural values as well as their religious and philosophical convictions. Prime concern should be about confidentiality and potential consequences of the study.

Ethics is a philosophical term derived from the Greek word *ethos*, meaning character or custom and connotes a social code that conveys moral integrity and consistent values (Gratton & Jones, 2010:121). More in relation to the ethics of science, Gratton and Jones, (2010:121) is of the opinion that the ethics of science concerns what is wrong and what is right when conducting research. To this end all researchers, regardless of research

designs, sampling, techniques and choice of methods, are subjected to ethical considerations (Gratton & Jones, 2010:121). Ethics plays a major role in judging qualitative research because qualitative researchers spend a great deal of time with participants and should treat them with dignity.

According to Bryman (2015), ethics increase credibility of a study. Since the research is both quantitative there was anticipation of personal intrusive thus ethical considerations were prioritized. Policies regarding informed consent, deception, confidentiality, anonymity, privacy and caring was adopted. The research design not only involved selecting informants but also adhered to research ethics (McMillan & Schumacher, 2010:338). All ethical measures were taken into consideration, which includes informed consent, freedom to withdraw, confidentiality and anonymity, privacy and empowerment and finally caring and fairness. Ethical considerations in this study focused on; acquisition of informed consent, confidentiality, anonymity, permission, avoiding harm to participants, professionalism and plagiarism.

3.11.1 Informed consent

To ensure informed consent in this study, the researcher shared with participants what the study is all about and what it seeks to find out. The participants' informed consent was sought before the commencement of the study to avoid frustrations of both parties in the following processes. The time required for participation was none interfering and was in the natural setting as possible (McMillan & Schumacher, 2010).

According to Grinnell and Unrau (2008: 37), obtaining informed consent implies the following:

- All possible information on the goal of the investigation be known to participants;
- The anticipated length (days, weeks or months) of the participants' involvement;
- The procedures that will be followed during the study;
- The possible merits and demerits and likely dangers the respondents might be exposed to; and

- Render credibility of the researcher to potential subjects or their legal representatives.

3.11.2 Confidentiality

Polit and Beck (2010) described confidentiality as the protection of study participants such that individual identities are not linked to information provided and are not divulged. In this study, the researcher clearly assured the participants that no unprofessional ways would be used to access information from them. In addition, assurance that gathered data would only be used for the purpose of the study.

According to Polit and Beck (2010), confidentiality can be described as shielding participants in a study to avoid their individual identities being linked to information provided and are not divulged publicly. Macmillan and Schumacher (2014:134), who stated that confidentiality could be guaranteed by making certain that any data collected cannot be linked to individual participants by name, equally share this definition.

They offered the following suggestions regarding the maintenance of confidentiality:

- Data collected must be anonymous;
- The researcher can use an interim system of names that are linked to data and destroy those names later on;
- Participants can adopt pseudo names during the period of the study;
- The researcher can use a third party to link names to data and can receive results without names; and
- The researcher can also report group instead of individual results (McMillan & Schumacher, 2014:134).

In the current study, care was taken not to attach names to returned questionnaires. The principal investigator (researcher) and the supervisor are the only ones who have access to the research data including returned questionnaires. The questionnaires were to be destroyed after data obtained therein would have been used and the research project concluded. The very act of using questionnaires points to the fact that data would be

collected anonymously, while results would be aggregated per group as against individual participant responses (compare with what McMillan and Schumacher, (2014:134) point out regarding this as cited above). This would further keep the data collected confidential. The principle of anonymity, which is close to confidentiality, is discussed thereafter.

3.11.3 Anonymity

This is closely related to the aspect of confidentiality but empathizes on privacy. McMillan and Schumacher (2014), assert that all participants have the right to privacy, anonymity, and confidentiality. The information that each participant shares with the researcher should not be passed on to others in any form unless specific consent has been given. To ensure this consideration, no real and actual names was used in both data collection and data analysis processes. Instead, fictitious names and codes was employed. No names were indicated on the questionnaires.

Every individual has the right to privacy, and it is the sole prerogative of such a person to decide when, where, to whom and to what extent his or her beliefs, attitudes and behaviour will be revealed (De Vos et al., 2011). The information that each participant shared during the study remained intact. To ensure this consideration, no actual names were used in both data collection and data analysis processes all in an attempt to maintain the principle of anonymity; instead fictitious names and codes were employed. No names were indicated on the questionnaires to maintain the principle of anonymity.

3.11.4 Permission

The researcher sought clearance from the Faculty of Research Ethics Committee and Institutional Research Ethics Committee of the University of Fort Hare. In addition, permission was sought from the gatekeepers, which are the Department of Education and Principals of primary schools that were used.

3.11.5 Avoiding harms to participants

Ethical rules guiding research is that participants (respondents) suffer no harm be it physical and/or emotional (De Vos et al., 2011). The obligation of the researcher is to ensure that participants are protected within all possible reasonable limits against any form of physical or emotional discomfort, which may be as a result of involvement in the study. According to De Vos et al. (2011: 115), participants were fully briefed before the commencement of the study about the impact of the study; this enabled the respondent to disengage from the study anytime he/she wishes.

AERA (2011) observes that participants in a study must be protected from physical and mental discomfort, harm and danger, and that if there is a possibility for any of the foregoing to occur, the researcher must inform participants of any impending risk. In educational research, the most likely harm may be more emotional than physical. McMillan and Schumacher (2014:131) add that protection from harm implies not “revealing information that may result in embarrassment or danger to home life, school performance, friendships, and the like, as well as direct negative consequences”.

In the current study, the paper embodying the questionnaire was a standard A4 size type of paper that learners often used at school without any harmful chemicals. Participants were kindly asked to use their own pens whose ink would be guaranteed not to cause any harm to them. No outrageous, potentially dangerous equipment that could compromise the welfare of participants was involved or used in the execution of the current study.

3.11.6 Professionalism

Research deals with human beings, hence they deserve to be treated with respect and professionalism. According to McMillan and Schumacher (2014), the culture of the community used for the study is not subject to value judgments under any circumstances. One way of maintaining professionalism is to allow the participants enough time to respond to the questionnaires, since they have consented to participate in the study. For those participants who needed a push before they respond, friendly reminders were sent

to them through the principal and the educators of the school concerned. For the purpose of credibility of this study, the aspect of plagiarism demands attention.

3.11.7 Plagiarism

Plagiarism is a serious offence and it is against the standard procedure of ethics in research. Avoidance of plagiarism ensures the researcher's academic and professional integrity. McMillan and Schumacher (2014:136), citing the American Psychological Association (APA) (2012), posit that avoiding plagiarism is to pursue dual goals of ethical principles, namely:

- to ensure that scientific and scholarly (academic) knowledge is accurate; and
- to protect the rights pertaining to intellectual property.

McMillan and Schumacher (2014:28) further stated that plagiarism could be avoided by always giving credit to the contributions of other scholars and people, including organizations that were used in a study. They illustrate the point regarding plagiarism succinctly by saying: "There's a branch of law known as intellectual property. This field is based on the idea that original work – speeches, publications, and artistic creations – is not free for the taking. Anyone who borrows from these works is obligated to acknowledge the work's creator. This is the purpose behind copyrights, patents and trademarks".

This research acknowledges all sources from which the researcher garnered all the information that seemed both useful and relevant to the current research, including her master's dissertation that originated from him.

3.12 CHAPTER SUMMARY

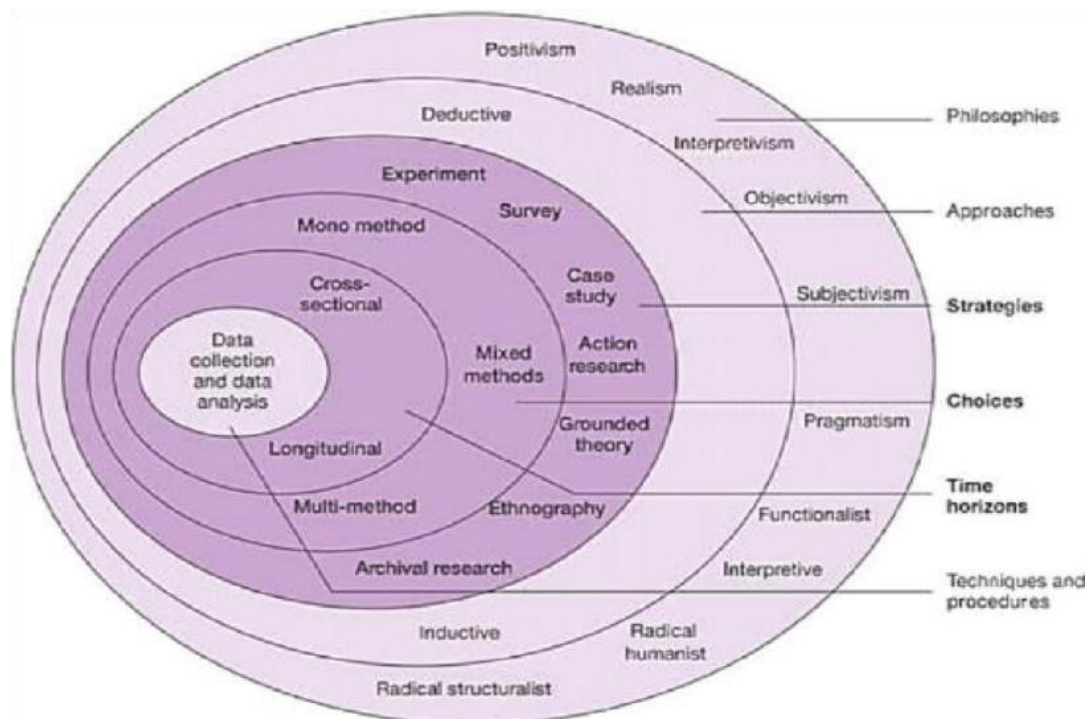


Figure 3.2: Research onion (Saunders et al., 2012)

In concluding this chapter, the above research onion gives a brief overview of Chapter 3 with an explanation that follows.

Philosophy layer

The first layer of the onion looks at the underpinning philosophy this study rests on. The philosophy is the positivism paradigm, which is based on the scientific principle of testing knowledge through theories based on research hypotheses generated (Kura, 2012). This paradigm is concerned with observing and predicting outcomes (Flick, 2015), is highly structured and usually measurable without the researcher's value influencing the research. It is objective and makes use of large samples of quantitative data (Wellington, 2015) that are subjected to statistical testing for the purpose of generalization and testability of the result (Wyk, 2010). It is based on deductive reasoning (Vos et al., 2011), and based on pure scientific laws (Kura, 2012).

Approach (es) layer

Peeling off the philosophical layer of the onion reveals the next layer of the onion: approach (es), which include the deductive and inductive approach. For this study, the deductive approach (Vos, 2011) was employed to deduce the relationship that exists between learning styles, instructional materials and learners' academic performance in Mathematics and this is done through the three research hypotheses that were raised in Chapter 1 of this study.

Strategy (ies) layer

The third layer of the onion is the strategy layer. The strategy adopted for the purpose of this study is the survey (descriptive) that is non-experimental because there is neither the experimental nor the control group in the study. Survey research can be described as any form of descriptive, quantitative research that involves acquiring information from one or more groups of people by asking questions and tabulating their answers, with the aim of gathering data from a large population by surveying a sample of that population (Leedy & Ormrod, 2010).

Choice of methodology layer

The next layer of onion is the choice of methodology most suitable for the study in which the researcher chose the quantitative method. The quantitative method reflects the philosophical basis of this study: positivism. Three instruments were used for data collection for the purpose of this study: the questionnaire comprising of many sections in line with the research hypotheses and questions, the Mathematics Achievement Test (MAT) comprising of 25 multiple-choice objective questions. All the instruments were analyzed statistically.

Time horizon layer

The final layer of the research onion is the time horizon layer that specifies the period of the study. For the purpose of this study, cross-sectional study was adopted instead of longitudinal study. The cross-sectional study involves addressing problems and proffering solutions to such problems in no distance time, hence the adoption of a

descriptive survey design by the researcher to investigate learning styles, availability, and utilization of instructional materials as correlates of grade 6 learners' mathematics

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 INTRODUCTION

This study examines the correlation of learning styles (visual, auditory, and kinaesthetic), availability and utilization of instructional materials and grade 6 learners Mathematics performance in Buffalo City. The previous chapter dealt with the research paradigm and approach; design; population, sample and sampling techniques; ethical considerations, and data collection instruments, which were, structured questionnaires and achievement tests.

This chapter presents the analysis, interpretation and inferences of the data collected from the respondents. The data were analysed using descriptive and inferential statistics. In projecting the benefits of a quantitative approach to understand educational phenomena, He, sun, Li, and Wan (2017) upheld a researcher's independence to select methods that quantitatively unveil the underlying judgments and dubiety of the assessment. Quick and Hall (2015) restated that quantitative research is founded on the positivist principles and affirmed that a researcher carrying out this type of study should prioritize the gathering and assessment of numerical data (Topping 2010; Gerrish & Lacey, 2010).

The data were analyzed with hierarchical regression analysis, Analysis of variance, T-test, and Pearson Product Moment Correlation (PPMC). These data analytical programs were used to answer the sub-research questions and test the hypotheses that guided the data analyzed in this study. The questions are:

- What is the relative effect of learning style, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance?
- What is the composite effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners Mathematics

performance?

- Which of the variables learning styles, gender, availability and utilization of instructional materials would predict Grade 6 learners' Mathematics performance?

These questions sought to quantitatively demonstrate the underlying effects of predictors such as learning style, availability, and utilization of instructional materials on the criterion of Grade 6 learners' Mathematics performance. The following hypotheses were also tested at 0.05 level of significance:

1. There is no significant influence of learning style (visual, auditory, and kinaesthetic) on Grade 6 learners Mathematics performance.
2. There is no significant relationship between availability and utilization of instructional materials on learners' performance in Mathematics.
3. There is no significant difference between male and female Grade 6 learners' performance in Mathematics.

These hypothesized statements were used to establish influence, relationship, and differences between the predictors and Mathematics performance of the selected Grade 6 learners in schools at Buffalo City.

4.2 DEMOGRAPHIC CHARACTERISTICS/INFORMATION OF RESPONDENTS

The descriptive nature of this study necessitates the analysis of demographical information provided by the Grade 6 learners selected for the fieldwork. The biographical information (i.e. gender) is central to understanding the extent to which the outcome of this study could be generalized, and the learners' characteristics underlying the data analyzed in this study.

Table 4.1 below shows that 1225 Grade 6 learners participated in this study. 770 were female Grade 6 learners while 455 were males. The female Grade 6 learners that took part in the study were more than the male learners. 62.9% of the respondents are female learners while 37.1% were male learners.

Table 4.1: Information of respondents

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	455	37.1	37.1	37.1
Female	770	62.9	62.9	100.0
Total	1225	100.0	100.0	

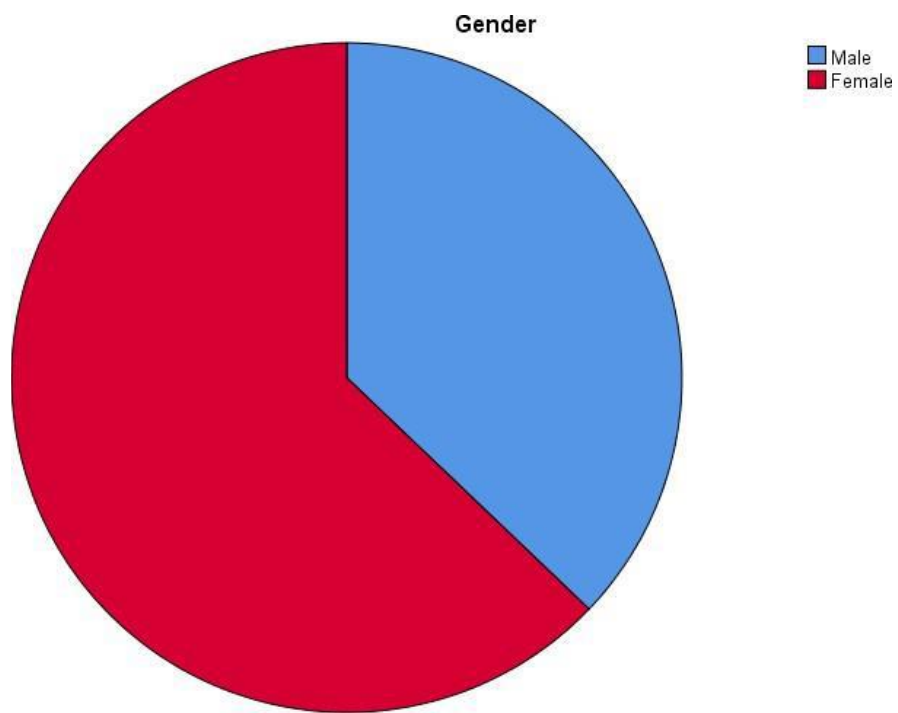


Figure 4.1: Gender of the respondents

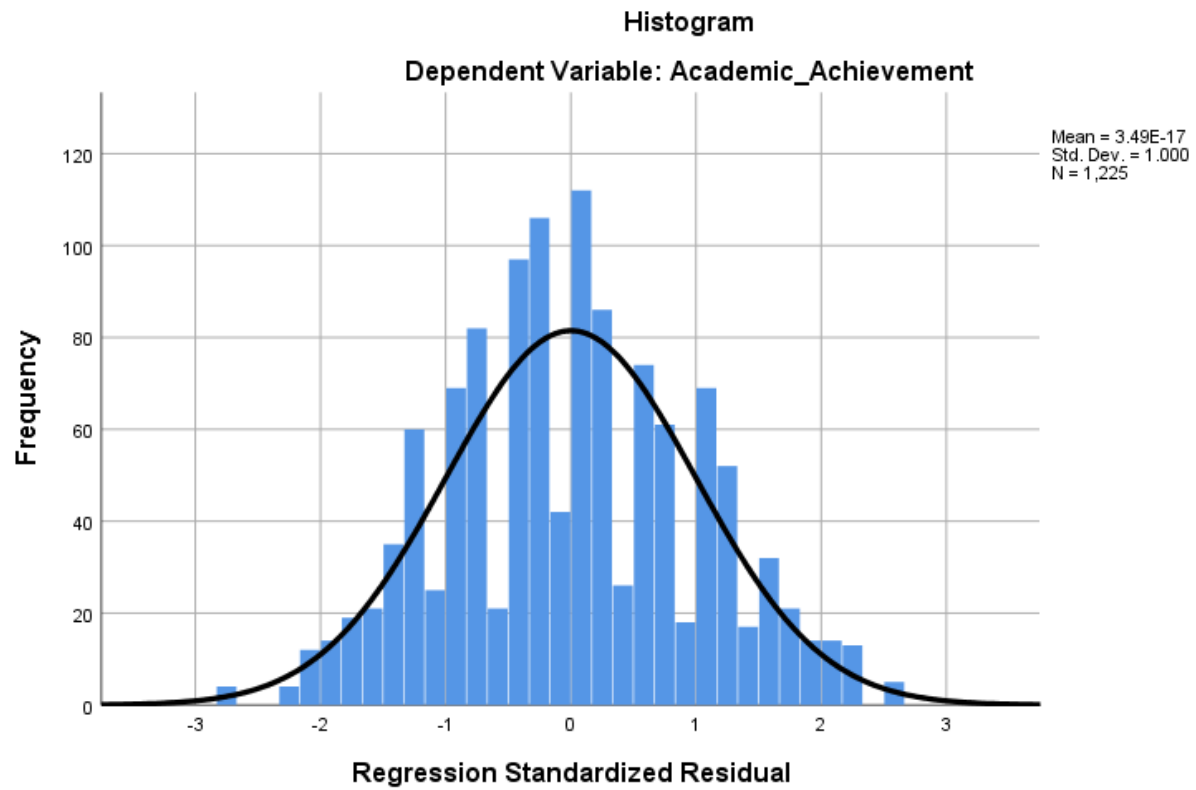


Figure 4.2: Histogram showing data distribution

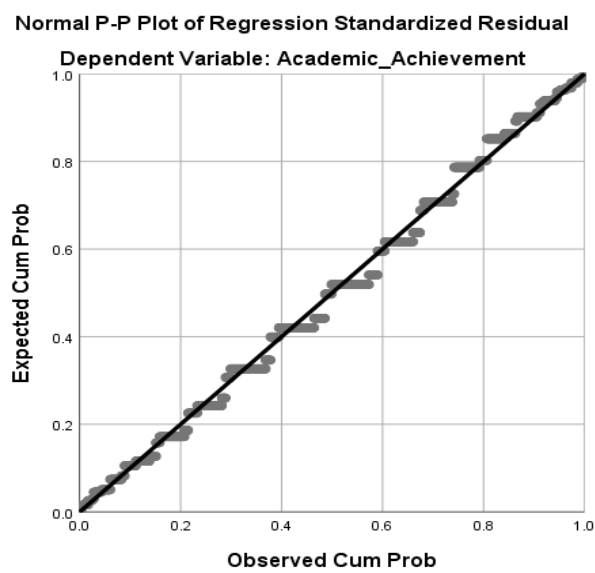


Figure 4.3: Normal P-P Plot of Regression Model

Figures 4.2 and 4.3 shows the Gaussian distribution of the data analysed in this study. The bell-shaped line in Figure 4.2 connotes a 'normal distribution'. The data are coded and analysed in this study are approximately normally distributed. Figure 4.3 shows the observed cumulative probability, which affirms that the data are normally distributed because the plots follow the normality line.

4.3 RESULTS AND DISCUSSION

Research Question 1: What is the relative effect of learning styles, availability, and utilization of instructional materials on grade 6 learners' Mathematics performance?

Table 4.3: Relative effects of the independent variables on Grade 6 learners Mathematics performance

<i>Model</i>	<i>Unstandardized Coefficients</i>		<i>Standardized Coefficient s Beta</i>	<i>t</i>	<i>Sig.</i>	<i>Collinearity Statistics</i>	<i>VIF</i>
	<i>B</i>	<i>Std. Error</i>				<i>Tolerance</i>	
1 (Constant)	14.128	.508		27.816	.000		
Students' Learning Style	-.814	.209	-.113	-3.886	.000	.957	1.045
AUIMI	.0006	.007	.023	.804	.422	.957	1.045

a. Dependent Variable: Mathematics performance

Table 4.3 Shows that students learning style (visual, auditory, and kinaesthetic) have a significant relationship on Grade 6 learners Mathematics performance ($B = -.113$, $t = -3.886$, $p < 0.05$). This result corroborates the assertions of Dunn, Beaudry, and Klavas (2009) that specifically said that through voluminous studies, it has been indicated that both low and average achievers earn higher scores on standardized achievement and aptitude tests when they are taught within the realm of their learning styles.

This in addition, in line with the study conducted by Chuah Chong-Cheng (2008) which succinctly described the importance of learning styles as being not only necessary, but also important for individuals in academic settings. They further proclaimed that most students favour learning in particular ways with each style of learning contributing to the success in retaining what they have learned.

Table 4.3 however, shows that the availability and utilization of instructional materials have significant relationship on the Mathematics performance of selected grade 6 learners ($B = .023$, $t = .804$, $P < 0.05$). This opposed the view of Ogundiran (2015), which confirmed in his study; that one of the problems facing or infringing on the academic performance of the learners in Mathematics at public primary schools includes non-use of instructional materials. He also mentioned others like; lack of funds to acquire some of the materials that cannot be improvised, lack of adequate room facilities for storage and security facilities, inadequate regular electricity supply to sustain specific audio-visual resources that require specific room temperature.

The multi-collinearity among the independent variable was assessed using tolerance statistics and variance inflation factor. Table 4.4 shows that there is no multi-collinearity among the independent variables because the tolerance and Variance Inflation Factor (VIF) values appear normal.

Research Question 2: What is the composite effect of learning styles availability and utilization of instructional materials on Grade 6 learners' Mathematics performance?

Table 4.4: Combined effects of independent variables on the Dependent variable

<i>Model</i>	<i>Sum of Square s</i>	<i>Df</i>	<i>Mean Square VIF</i>	<i>F</i>	<i>Sig.</i>	<i>Remark</i>
1 Regression	243.990	2	121.995	7.552	.001	Significant
			1.045			
Residual	145.316	1222				
			16.153			
Total	166.000	1224				
*R=.110	R Square= .011	Std. Error of Estimate =				
**Adjusted R Square= .012		4.01914				

a. Dependent Variable: Mathematics performance

Table 4.4 presents the output of the multiple regression analysis computed to answer research question two. The regression outputs presented R^2 as .012(1.2%), and $R=.110$, which implies that the students learning styles, availability, and utilization of instructional materials accounted for 1.2% of the variance in learners' Mathematics performance at schools in Buffalo City. This is in support of Adu et al. (2016), who explained that instructional materials as resources or teaching materials, which a teacher utilizes in the course of presenting a lesson in order to make the content of the lesson understandable

to the learner. The use of appropriate learning styles are key factors to the success of Mathematics. They explained that one of the principles of Mathematics education is that the instructional materials to be used in training the learners should be a replica of what is obtained in the learners' environment.

Similarly, according to Adler and Pillay (2015), students learn more when the teacher does not use only single approach and information is obtainable in a variety of approaches. The researchers strongly believe that approach and learning styles are determined by the availability of instructional materials. Much experiential research indicates that learning styles can either hamper or increase academic performance in several aspects (Adler & Pillay, 2015).

Research Question 3: Which of the variables learning styles, gender, availability and utilization of instructional materials would predict Grade 6 learners' Mathematics performance?

Table 4.5: Variables computed into the model

Model	Variables Entered	Variables Removed	Method
1	Gender ^b		Enter
2	AUIMI ^b		Enter
3	Students_Learning_Style ^b		Enter

a. Dependent Variable: Academic Achievement

b. All requested variables entered.

Table 4.6: Contributions of the independent variables to the Grade 6 learners' Mathematics Performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.005 ^a	.000	-.001	4.04219
2	.005 ^b	.000	-.002	4.04383
3	.111 ^c	.012	.010	4.02071

a. Dependent Variable: Mathematics_Performance

b. Predictors: (Constant), Gender

c. Predictors: (Constant), Gender, AUIMI

d. Predictors: (Constant), Gender, AUIMI, Students_Learning_Style

The Durbin Watson's d value of 1.696 confirms the non-existence of first order linear auto-correlation on the hierarchical linear regression model. To determine the best predictor of Grade 6 learners' performance in Mathematics, a hierarchical regression analysis was conducted in which gender, availability and utilization of instructional materials, and students learning styles were regressed on Mathematics performance of Grade 6 learners in Buffalo City.

Students learning style ($\Delta R^2 = .012$, $\Delta F(1,1223) = 5.047$, $p < 0.05$) emerged as the best predictor of Grade 6 learners Mathematics performance in Buffalo City, while the availability and utilization of instructional materials ($\Delta R^2 = .000$), $\Delta F(1,1223) = .018$, $P > 0.05$), and gender ($\Delta R^2 = .000$, $\Delta F(1,1223) = .036$, $p > 0.05$) emerged as better predictors.

Drews (2017) advised that learners should be encouraged to use a variety of the same type of resource so that they do not form misconceptions based on experience with limited resources. Teachers too should study the learner's style for better performance. Learners' ability to use mathematical resources in various ways can stimulate more opportunities for cooperative leaning which is more likely to encourage effective classroom practice and promote independent learning (Drews, 2017:22).

According to the same table, students' learning style is seen as the best predictor and this contradicts the view of Ng, Pinto, and Williams (2011) the investigated the effects of learning styles on Mathematics performance of approximately forty students (40). The study found that learning style was not a significant determinant of students' overall Mathematics scores.

Table 4.7: Combined contributions of the variables computed into the model

<i>Model</i>		<i>Sum of squares</i>	<i>Df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig</i>	<i>Remark</i>
1	Regression Residual Total	.580 19982.971 19983.551	1 1223 1224	.580 16.339	.036	.851 ^b	Not Sig.
2	Regression Residual Total	.580 19982.971 19983.551	2 1222 1224	.290 16.353	.018	.982 ^c	Not Sig
3	Regression Residual Total	244.748 19738.803 19983.551	3 1221 1224	81.583 16.166	5.047	.002 ^d	Significant

a. Dependent Variable: Mathematics_Performance

b. Predictors: (Constant), Gender

c. Predictors: (Constant), Gender, AUIMI

d. Predictors: (Constant), Gender, AUIMI, Students_Learning_Style

Table 4.7 affirmed that learners' learning style ($\Delta R^2=.012$, $(\Delta F_{(2,1221)}=5.047$, $p < 0.05$) turned up as the best predictor of Grade 6 learners' mathematics performance in Buffalo City.

Table 4.8: Combined contributions of the variables by ranking

Model	Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1 (Constant)	12.811	.250		51.215	.000
Gender	.025	.133	.005	.188	.851
2 (Constant)	12.812	.446		28.750	.000
Gender	.025	.133	.005	.188	.851
AUIMI	-1.551E-5	.007	.000	-.002	.998
3 (Constant)	14.082	.551		25.575	.000
Gender	.029	.132	.006	.216	.829
AUIMI	.006	.007	.023	.800	.424
Students_Learning_Style	-.814	.210	-.113	-3.886	.000

It is evident from the outputs that students' learning styles ($B=-.113$, $t=-3.886$, $p<0.05$) have a significant relative influence on Grade 6 learners Mathematics performance at Buffalo City. However, gender ($B=.005$, $t=.188$, $p>0.05$) and AUIMI ($B=.023$, $t=.800$, $p>0.05$) have no significant relative influence on the selected Grade 6 learners Mathematics performance.

Table 4.9: Partial correlation of the variables (independent and dependent) in the study

Model	Zero-order	Correlations Partial	Part	Collinearity Tolerance	Statistics VIF
1 (Constant)					
Gender	.005	.005	.005	1.000	1.000
2 (Constant)					
Gender	.005	.005	.005	1.000	1.000
AUIMI	.000	.000	.000	1.000	1.000
3 (Constant)					
Gender	.005	.006	.006	1.000	1.000
AUIMI	.000	.023	.023	.957	1.045
Students_Learning_Style	-.108	-.111	-.111	.957	1.045

a. Dependent Variable: Mathematics_Performance

The existence or non-existence of multi-collinearity was evaluated in Table 4.9. The tolerance statistics and the variance inflation factor show that there is no multi-collinearity among gender, AUIMI, and learners' learning style. Allen (2007) explained the phenomenon (i.e. multi-collinearity) evaluated in this regression model as the high correlation of an independent variable with one or more of the other independent variables in a multiple regression model as used in this study.

Patel, et al. (2019) avoided the problems associated with high correlation between variables (i.e. multi-collinearity) by subtracting the mean from the variable before squaring the median. However, in this study the tolerance statistics and variance inflation factor were normal since the output of 1.045 is less than 10. Yoo, et al., (2014) stated that despite no formal rule, scholars accepted that a variance inflation factor that is greater than ten is harmful.

4.4 TESTING THE HYPOTHESES

Hypothesis One: There is no significant influence of learning styles on Grade 6 learners' Mathematics performance.

Table 4.10: Descriptive Aspect of One-way Analysis of Variance

Mathematics_Performance

	N	Mean	Std. Deviation	Std. Error
Visual_Learning_Style	231	13.2424	4.56572	.30034
Auditory_Learning_Style	836	12.9964	3.88348	.13431
Kinesthetic_Learning_Style	158	11.5253	3.80027	.30233
Total	1225	12.8531	4.04060	.11545

Table 4.10 shows that Grade 6 learners with visual learning style ($\bar{x} = 13.242$, $SD = 5.565$) had the best performance in Mathematics at Buffalo City, followed by learners with auditory learning style ($\bar{x} = 12.996$, $SD = 3.883$), and learners with Kinaesthetic learning style ($\bar{x} = 11.525$, $SD = 3.800$). The above table is expedient according to Amran et al. (2011) stated that for any student to be empowered to perform better academically, their preferred learning styles must be considered. Learners' preferred learning styles will improve and enhance their understanding of what is being taught.

The finding supports the argument of Felder and Henriques (2009), which categorised visual learners as sensing learners. 'Sensing' learners are concrete and methodical; they are good at memorizing facts and doing hands-on work and are more comfortable with following rules and standard procedures, hence, they perform better than the other categories. However, it contradicts Chuah Chong-Cheng (2008), who say, learners retain 30% of what they see and 50% of what they see and hear while 90% of what they say as they do something since visual learners learn visually by means of charts, graphs, and pictures.

Table 4.11: Output of ANOVA: the combination of the three types of learning styles understudy

Mathematics_Performance

	Sum of Square	Df	Mean	F	Sig.	Remark
Between Groups	330.739	2	165.369	10.283	.000	Sig.
Within Groups	19652.812	1222	16.082			
Total	19983.551	1224				

Table 4.11 shows the combination of the three learning styles influence on learners Mathematics performance. It revealed that there is a significant influence of learning style (visual, auditory, and kinaesthetic) on Grade 6 learners Mathematics performance ($F(2,1222) = 10.283, p < 0.05$). Therefore, hypothesis one is rejected.

The above findings is supported by Abidin et al. (2011), who are of the view that learning styles make an impact on the students' overall achievement and students in their study possessed multiple learning styles or a combination of different learning styles, thus, they are able to learn effectively.

The above findings are congruent with Kolb's experiential theory which emphasises the importance of a student's preferred learning style, depending on the available instructional materials. According to Kolb, a learning style is not a fixed trait but a differential preference for learning which changes slightly from situation to situation and influence by availability of instructional materials (Azevedo & Akdere, 2010:192; Bhatti & Bart, 2013:2).

Hypothesis Two: There is no significant relationship between the availability and utilization of instructional materials on Grade 6 learners' Mathematics performance.

Table 4.12: The Pearson Product Moment Correlation Summary of Relationship between availability and utilization of instructional materials on learners' Mathematics Performance

Variables	N	Mean	Standard Deviation	Sig. (P)	Remark
Availability and Utilization of Instructional Materials	1225	51.002	15.827	.999	.000
Maths Performance		12.853	4.041		Significant

Table 4.12 Shows that there is a significant relationship between availability and utilization of instructional materials on Grade 6 learners Mathematics performance ($r = 0.999$; $p > 0.05$)

The above finding is corroborated by Orhun (2013), that the use of instructional materials at primary level has become an accepted fact in the world over since the use of instructional materials in teaching and learning will enable the learner to develop manipulative skills, positive attitude, and problem-solving skills, acquire and develop functional knowledge. In addition to this, Eke (2010) carried out a survey study on the various roles of using instructional materials in teaching Mathematics in primary schools. The finding showed that instructional materials make abstract ideas concrete and easier to understand. Similarly, the constructive theorists believe that through interaction with the physical situations, or concrete objects, a child's physical experience accumulates, and he is able to conceptualize, think creatively and logically. The child, therefore, develops skills to solve abstract problems.

According to Bosman and Schulze (2018), Bruner's theory concurs with Piaget's theory which states that learning is promoted by direct manipulation of objects, for example, in Mathematics education, the use of algebra tiles, coins and other items that can be

manipulated, help learners to get a better understanding. When learners directly manipulate objects, they should be encouraged to construct visual representations, such as the drawing of a shape or a diagram

Hypothesis Three: There is no significant different between male and female Grade Six learners' performance in Mathematics

Table 4.13: Output of T-test on differences between Male and Female performance in Grade 6 mathematical concepts

	Gender	N	Mean	Std. Deviation	T	Df	Sig(P)	Remark
Maths Performance	Male	455	12.8198	3.96883	-.217	128	.061	Not Sig
	Female	765	12.8719	4.09818				

Table 4.13 shows that there is no significant difference between male and female Grade 6 Mathematics performance at Buffalo City ($t = -.217$, $df = 1218$, $p > 0.05$). The mean difference between male learners ($\bar{x} = 12.820$, $SD = 3.969$) and female learners ($\bar{x} = 12.872$, $SD = 4.098$) was negligible. Therefore, hypothesis three is not rejected.

The finding of this study agrees with the findings of Josiah and Adejoke (2014) that revealed insignificant effect of gender on Mathematics performance. It is however in contrast with the findings of Abubakar and Oguguo (2011) and Abubakar (2010) which, found that they considered male students more proficient in mathematics than females. Overall, it is hoped that if both genders are given proper orientation, opportunities and training gender will no longer be an issue in mathematics achievement in general.

4.5 CHAPTER SUMMARY

This chapter presented information on the data collected and analysed for this study. The data was collected using standardized questionnaires, while the findings were presented by answering the sub-research questions and testing the null hypotheses at 0.05 level of significance. The findings of this study imply that schools at Buffalo City should consciously cultivate visual, auditory, and kinaesthetic learning styles, and not focus on availability and utilization of instructional materials of Grade 6 learners Mathematics lessons. Finally, the researcher added a modern scholarly dimension by demonstrating the non-existence of multi-collinearity among the predictor variables. The scholarly significance of the findings in this study was further authenticated by the computation of Durbin Watson to confirm/ascertain the non-existence of first order linear auto-correlation in the linear regression model designed for this study.

Furthermore, the findings showed that the learners with visual learning style had the most attainment in mathematical concepts at schools in Buffalo City. This learning style (i.e. visual) is best cultivated with images that are associated with the subject matter or contents that Mathematics learners are expected to master. This implies that Mathematics teachers at Buffalo City should develop instructional materials that

have visual properties to enhance the teaching and learning of mathematical concepts at schools in Buffalo City. The visual instructional materials are not gender specific consequent on the non-significant difference between male and female learners' Mathematics performance in this study. The subsequent chapter will discuss the findings summary, conclusions and recommendations of this study.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

Chapter 4 presented the analysis, interpretation and inferences of the data collected from the respondents. The data was analyzed using descriptive and inferential statistics being a quantitative approach. The data were interpreted and discussed, using current literature, practice, and the theoretical framework of the study. This chapter presents a summary of findings, recommendations made, and suggestions for further studies. The chapter commences with restatement of research objectives and sub-research questions. This is followed by a summary of key findings based on the quantitative feedback from respondents. The summary of findings are followed by the conclusions that were drawn from the presentation and discussion of the findings.

5.2 RESTATEMENT OF THE RESEARCH OBJECTIVES AND RESEARCH QUESTIONS

Stratified sampling techniques was used to select schools used in this study. The objectives that guided the study are thus:

1. To examine the relative effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance
2. To investigate the composite effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance
3. To find out which of the variables (learning styles, gender, availability and utilization of instructional materials) would predict Grade 6 learners' Mathematics performance?

The study also answered the following research questions;

1. What is the relative effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance?
2. What is the composite effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance?
3. Which of the variables (learning styles, gender, availability and utilization of instructional materials) would predict Grade 6 learners' Mathematics performance?

The study also formulated the following hypotheses and tested at the level of 0.05 level of significant

1. There is no significant influence of learning style (visual, auditory, and kinesthetic) on Grade 6 learners Mathematics performance.
2. There is no significant relationship between availability and utilization of instructional materials on learners' performance in Mathematics.
3. There is no significant difference between male and female grade 6 learners' performance in Mathematics.

5.3 SUMMARY OF THE FINDINGS

This section presents a summary of the study findings. The summary focuses on the summary of all chapters, learning styles, availability and utilization of instructional materials as correlate of Grade 6 learners' Mathematics performance.

5.3.1. The relative effect of learning styles, availability, and utilization of instructional materials on grade 6 learners' Mathematics performance

This study discovered that students learning style (visual, auditory, and kinaesthetic) have a significant relationship on Grade 6 learners Mathematics performance ($B = -.113$, $t = -3.886$, $p < 0.05$). This result corroborates the assertions of Dunn, Beaudry, and Klavas (2009) that specifically said that through voluminous studies, it has been

indicated that both low and average achievers earn higher scores on standardized achievement and aptitude tests when they are taught within the realm of their learning styles. Nevertheless, the availability and utilization of instructional materials have no significant relationship on the Mathematics performance of selected grade 6 learners ($B=.023$, $t=.804$, $P<0.05$). This opposed the view of Ogundiran (2015), which confirmed in his study; that one of the problems facing or infringing on the academic performance of the learners in Mathematics at public primary schools includes non-use of instructional materials.

5.3.2. The composite effect of learning styles availability and utilization of instructional materials on Grade 6 learners' Mathematics performance

The regression outputs presented R^2 as .012(1.2%), and $R=.110$, which implies that the students learning styles, availability, and utilization of instructional materials accounted for 1.2% of the variance in learners' Mathematics performance at schools in Buffalo City. This is support of Adu et al. (2016), which, explained instructional materials as resources or teaching materials, which a teacher utilizes in the course of presenting a lesson in order to make the content of the lesson understandable to the learner. Moreover, the use of appropriate learning styles are key factors to the success of Mathematics. The instructional materials to be used in training the learners should be a replica of what is obtained in the learners' environment.

5.3.3 The variables (learning styles, gender, availability and utilization of instructional materials) that would predict grade 6 learner's Mathematics performance

Students learning style ($\Delta R^2=.012$, $\Delta F(1,1223) = 5.047$, $p < 0.05$) emerged as the best predictor of Grade 6 learners Mathematics performance in Buffalo City, while the availability and utilization of instructional materials ($\Delta R^2 = .000$), $\Delta F(1,1223) = .018$, $P > 0.05$), and gender ($\Delta R^2 = .000$, $\Delta F(1,1223) = .036$, $p>0.05$) emerged as better predictors.

The above findings are in support of Drews (2017) which advised that learners should be encouraged to use a variety of the same type of resource so that they do not form misconceptions based on experience with limited resources. Teachers too should study the learner's style for better performance. Learners' ability to use mathematical resources in various ways can stimulate more opportunities for cooperative learning which is more likely to encourage effective classroom practice and promote independent learning (Drews, 2017:22).

5.3.4 The influence of learning styles on Grade 6 learners' Mathematics performance.

Grade 6 learners with visual learning style ($\bar{x} = 13.242$, $SD = 5.565$) had the best performance in Mathematics at Buffalo City, followed by learners with auditory learning style ($\bar{x} = 12.996$, $SD = 3.883$), and learners with Kinaesthetic learning style ($\bar{x} = 11.525$, $SD = 3.800$). The finding supports the argument of Felder and Henriques (2009), which categorized visual learners as sensing learners. 'Sensing' learners are concrete and methodical; they are good at memorizing facts and doing hands-on work and are more comfortable with following rules and standard procedures, hence, they perform better than the other categories.

5.3.5 The relationship between the availability and utilization of instructional materials on Grade 6 learners' Mathematics performance.

The findings show that there is a significant relationship between availability and utilization of instructional materials on Grade 6 learners Mathematics performance ($r = 0.999$; $p > 0.05$). The above finding is corroborated by Orhun (2013), that the use of instructional materials at primary level has become an accepted fact in the world over since the use of instructional materials in teaching and learning will enable the learner to develop manipulative skills, positive attitude, and problem-solving skills, acquire and develop functional knowledge. In addition to this, Eke (2010) carried out a survey study on the various roles of using instructional materials in

teaching Mathematics in primary schools. The finding showed that instructional materials make abstract ideas concrete and easier to understand

5.3.6 The significant different between male and female Grade Six learners' performance in Mathematics

Table 4.5d shows that there is no significant difference between male and female Grade 6 Mathematics performance at Buffalo City ($t = -.217$, $df = 1218$, $p > 0.05$). The mean difference between male learners ($\bar{x} = 12.820$, $SD = 3.969$) and female learners ($\bar{x} = 12.872$, $SD = 4.098$) was negligible.

The finding of this study agrees with the findings of Josiah and Adejoke (2014) that revealed insignificant effect of gender on Mathematics performance. It is however in contrast with the findings Abubakar and Oguguo (2011) and Abubakar (2010) which, found that they considered male students more proficient in mathematics than females. Overall, it is hoped that if both genders are given proper orientation, opportunities and training gender will no longer be an issue in mathematics achievement in general.

5.4 CONCLUSIONS OF THE STUDY

The study sought to investigate Learning Styles, Availability, and Utilization of Instructional Materials as Correlates of Grade 6 Learners' Mathematics Performance in Buffalo City. Major findings include the fact that the three variables have positive effect in the performance of learners in Mathematic. Nevertheless, learning styles emerged as the best predictor of Grade 6 learners Mathematics performance in Buffalo City, while the availability and utilization of instructional materials, and gender emerged as better predictors. When going into details, the study shows that among the three types of learning styles under investigation viz: visual, auditory, and kinaesthetic. Visual was more powerful in predicting the learners' in Mathematics; this is in line with Chinese philosophers that says, "what I see I remember what I hear I

forget'. Findings in the study also show that gender has no significant effect on learners' performance. However, the female has the highest mean score than their male counterpart.

5.5 RECOMMENDATIONS

Based on the findings of this study, the following recommendations are hereby made which the researcher believes will be of benefit to the following various stakeholders in education: the parents, government, society (community) and the students themselves.

5.5.1 Teachers

It is recommended that teachers should be trained to know the different type of learning style exhibit by their learners to use them to impact knowledge and disseminate information to them since learning style could be described as a set of factors, behaviours and attitudes that facilitate learning for an individual in a given situation. These styles influence how students learn, how teacher teach, and how the two interact during classroom activities.

5.5.2 Parents

Parents should endeavour to assist the government on the aspect of ensuring that their children have the prescribed instructional materials before the beginning of the new section. They should have a good relationship with the school leadership and teachers so that they can agree on time on which the materials prescribed by Curriculum and Assessment Policy Statement (CAPS) to be used. There is also need for partnership of parent with the government on this because government cannot be solely responsible for their children education.

They need to supplement where necessary. Some parents are influential and well connected. They should see to the timely procurement of instructional materials and delivery from the manufacturers and publishers by assisting the school to contact them at the right time and make valuable contribution during the parent-teacher association meetings. Not everything should be left in the hands of the school. Parents should be more involved in the monitoring of their wards' academics performance by attending school programmes and showing up on open days in schools with close collaboration with the school authorities to find out about their wards and also provide instructional materials as at when due.

5.5.3 School and other stakeholders

School heads in South Africa should place requisition for instructional materials needed long ago before school resumes since South Africa government supplies materials to all public schools. They should also try improvising for materials that are not available.

Regular meetings should be held periodically with all stakeholders – parents, teachers, government, community leaders or representative NGOs and students – to create awareness about the needs for using appropriate learning styles, instructional materials and its utilization in teaching Mathematics.

5.5.4 Department/Policy makers

Policy makers should evaluate the content of the curriculum to cater for learners with more than one learning styles. They should also visit the schools periodically to find out if the instructional materials needed are there or utilized. They should monitor the supply of instructional materials to the schools.

5.6 LIMITATIONS OF THE STUDY

The study covered selected secondary schools in Buffalo City of East London in Eastern Cape Province of South Africa. Therefore, the study could only be generalized to learners in Eastern Cape and not from other remaining eight provinces in South Africa. The study covers a class level (Grade 6 being the strategic grade and the last level of intermediate phase). Due to financial constraints, the study could have used mixed method and triangulate it. Despite these limitations, the findings of this study would add to the existing knowledge in the field of Mathematics Education in South Africa and the world at large.

5.7 EDUCATIONAL IMPLICATIONS

The study determined the effect of learning styles and availability and utilization of instructional materials on Grade 6 learners' Mathematics performance in Buffalo City Education District. It covers a class level (Grade 6 being the strategic grade and the last level of intermediate phase) in the sample schools in the district.

Consequent to the growing concern is finding solutions to the dwindling learners' academic performance in Mathematics. This has been a great concern to all stakeholders since Mathematics is the foundation for the economic and technological development of any nation and Mathematics is expected to help in accelerating social, economic and technological progress of any society. Performance of this subject is very important.

The findings of the study show that without the understanding of learning styles and use of appropriate instructional materials during the course of teaching Mathematics, there cannot be better performance in Mathematics, the implication of this is that all hands of stakeholders must be on deck to foster this. Availability and utilization of instructional materials with commensurate learning styles are not enough it is also vital to have sufficient and adequate human resources in terms of teacher quality for the

teaching of all subjects in the primary school curriculum. Without the teachers as an executing factor, the goals of education can never be achieved.

Another major implication of this study is that if the performance of Mathematics is not enhanced, it has adverse effects on national and international development. Such as falling standard of education. Therefore, the curriculum formulators should be ready to review the contents of the curriculum. They should make it more practical to accommodate different learning styles with the use of appropriate instructional materials. There is need for collaboration between the Department of Education and NGOs to have periodic workshop to update the knowledge of the teachers and the supply of relevant instructional materials.

5.8 RECOMMENDATIONS FOR FURTHER STUDY

The study investigated the effect of learning styles, availability and utilization of instructional materials on Grade 6 learners Mathematics performance in Buffalo City of East London, South Africa. Further study could be carried out using other grade level like Grade 9 or 12. Another study could focus on schools in another province of South Africa. A mixed method approach method can be adopted using both interview schedules and questionnaires to do a sort of triangulation. Better still, the study can use pure qualitative.

5.9 CHAPTER SUMMARY

This chapter gave a presentation of the summary of the findings, conclusions of the study, limitation of the study, recommendations and the educational implications of the study including suggestion for further study. The study purpose was to ascertain the effect of learning styles, availability and utilization of instructional materials on Grade 6 learners Mathematics performance in Buffalo City of East London, South Africa.

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APPENDIX A: RESEARCH INSTRUMENTS

Students' Learning Styles Scale (SLSS)

SECTION A

Name...

School...

Gender: Male [], Female []

SECTION B

Instruction: Please mark [X] in the box that matches the extent of your agreement or disagreement with each statement. The letters stand for the following:

GE = Great Extent, **SE** = Some Extent, **LE** = Little Extent, **NA** = Not at All

S/N	Items on Students' Learning Style	GE	SE	LE	NA
1	I can remember best about a subject by listening to a lesson that includes information, explanations and discussions,				
2	I prefer to see information written on a chalkboard than inside the book				
3	I like to write things down or take notes for a reading				
4	I prefer to use posters, models and other activities in class				
5	I require explanations of diagrams, graphs from my teacher				
6	I enjoy working with using instructional materials				
7	I am skillful in making graphs and charts				
8	I can remember best by writing things down several times,				
9	I can easily understand and follow directions on maps				
10	I do best in Mathematics by listening to teaching				
11	I learn Mathematics concepts better by repeating the words out loud than by writing the words on paper				
12	I remember something well by picture it in my head				
13	I understand calculation in Mathematics well by—finger counting				

- 14 I would rather listen to a good lesson than read about it in a text book
- 15 I am good at working and solving puzzles in Mathematics
- 16 I prefer obtaining information about Mathematics concepts by reading about it
- 17 I follow oral directions better than written ones.

Adapted from Barsch Learning Style scale (2009)

INSTRUMENT 2

Availability and Utilization of Instructional Materials Inventory (AUIMI)

Dear learners

This scale was developed to find out the availability and utilization of instructional materials for teaching Mathematics. Your replies to items in this scale will be used only for this study and will not be involved in another study. Therefore, your honest answer will be appreciated.

Section A

Name :(optional)

School :(optional)

Gender: Male ☐ Female ☐

Section B

Instruction: Please mark [X] in the box that matches the extent of your agreement or disagreement with the level of availability and utilization of the under listed items.

S/N	Mathematics Instructional Materials	Available	Not Available	If Available	
				Use	Not Use
1	Hand-on-materials				
2	Graphs				
3	Pictures (motion)				
4	Diagrams				
5	Maps				
6	Models Objects				
7	Photographs				
8	Chalkboards				
9	Textbooks				
10	Exhibits				

Adu, K.O. (Researcher)

Instrument 3

Mathematics Achievement Test (MAT)

Circle the letter of the correct answer.

- 1 What is the place value of the underlined digit in 45 678 921?

 (A) 10 000 000
 (B) 1 000 000
 (C) 100 000
 (D) 100 000 000

- 2 $3,893 \times 1000 =$

 (A) 3 893
 (B) 3, 893
 (C) 398,3
 (D) 0,3893

- 3 Round 35 563 off to the nearest 100.

 (A) 35 600
 (B) 35 960
 (C) 35 900
 (D) 36 000

- 4 Which number is represented by $(50 \times 1\,000\,00) + (3 \times 10\,000) + (900) + (7 \text{ tens}) + 9$

 (A) 53 979
 (B) 530 979

- (C) 5 300 979
(D) 503 979

5 What is the ratio of the number of black balls to the number of white balls?



- (A) 4:8
(B) 2:1
(C) 1:1
(D) 1:2
- 6 What is the value of **D**? $33 - \mathbf{D} = 37 - 17$
- (A) 27
(B) 6
(C) 21
(D) 13
- 7 Which number is a multiple of 10?
- (A) 475
(B) 600
(C) 878
(D) 1005
- 8 Which of the numbers is **NOT** an even number?
- (A) 24684 (B) 28680 (C) 26821 (D) 26810

- 9 Which of the numbers is **NOT** an odd number?
(A) 37930 (B) 35791 (C) 42863 (D) 12485
- 10 7654 is the same as
(A) $700 + 4000 + 300 + 2600 + 40 + 4$
(B) $7000 + 60 + 50 + 4$
(C) $7000 + 6000 + 50 + 4$
(D) $7000 + 600 + 50 + 4$
- 11 When you take nine hundred and ninety-nine from four hundred and twenty thousand, you will get ...
(A) 419,999 (B) 419,909 (C) 419,001 (D) 419,989
- 12 What is the value of the underlined digit $7\underline{1}4895$?
(A) 100 (B) 1000 (C) 10 000 (D) 100 000
- 13 Arrange these numbers in ascending order: 676, 667, 697, 679, 677
(A) 676, 677, 667, 679, 697
(B) 676, 677, 679, 667, 697
(C) 667, 676, 677, 679, 697
(D) 676, 667, 677, 679, 697
- 14 Round off R49, 57 to the nearest 5
(A) R49,50 (B) R50,00 (C) R49,55 (D) R49,60
- 15 Find the equivalent fraction of $\frac{24}{42}$
(A) $\frac{4}{7}$ (B) $\frac{12}{22}$ (C) $\frac{7}{4}$ (D) $\frac{4}{21}$

- 16 Which expression below is **NOT** equivalent to the number sentence?

$$\boxed{} = (30 \times 55) + (30 \times 55)$$

(A) $(15 \times 55) + (45 \times 55) = \boxed{}$

(B) $(15 \times 55) + (15 \times 55) + (15 \times 55) + (15 \times 55) = \boxed{}$

(C) $(30 \times 50) + (30 \times 50) + (30 \times 5) = \boxed{}$

(D) $(20 \times 55) + (40 \times 55) = \boxed{}$

- 17 What is the middlemost score in the data set below?

11; 12; 11; 14; 14; 13; 12; 11

(A) 11

(B) 12

(C) 13

(D) 14

- (18 – 19) The following are the shoe sizes of some Grade 6 learners.

7 8 7 6 5

5 7 4 6 7

8 4 7 5 6 p

- 18 What is the mode of the shoe sizes?

(A) 4 (B) 5 (C) 6 (D) 7

- 19 What is the median of the shoe sizes?

(A) 4 (B) 5 (C) 6 (D) 7

- 20 Which number has resulted from rounding off a certain number to the nearest 100 000?

A 278 300

B 345 670

C 750 000

D 800 000

- 21 39 569 was rounded off to 40 000.
To which number was it rounded off?
A 5 B 10 C 100 D 1 000
- 22 Round 35 963 off to the nearest 100.
A 35 000 B 35 960 C 35 900 D 36 000
- 23 What is the missing decimal number in the following number sequence?
13,25; 13,3; 13,4 ; 13,45
A 13,30 B 13,35 C 13,5 D 13,40
- 24 Write down the next decimal number.
0,79; 0,76; 0,73; 0,7; _____
(A) 0,61 (B) 0,63 (C) 0,67 (D) 7, 1
- 25 Complete the following number pattern.
1, 24; 1, 23; 1, 22; 1, 21; 1, 20; _____
(A) 1, 21 (B) 1, 22 (C) 1, 19 (D) 1, 91

TOTAL MARKS = 25

(Good luck)

Mathematics Achievement Test (MAT) Memo

1. B
2. A
3. A
4. C
5. B
6. D
7. B
8. C
9. A
10. D
11. C
12. C
13. C
14. B
15. A
16. C
17. B
18. D
19. C
20. D
21. D
22. D
23. B
24. C
25. C

APPENDIX B: PERMISSION LETTER TO THE DEPARTMENT

50 Summerwoods
37 Main Road
Abbotsford
East London 5241
2018/08/17

The Director

Department of Education

Zwelitsha

Bisho

Dear Sir/Madam

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH ON LEARNING STYLE, AVAILABILITY, AND UTILIZATION OF INSTRUCTIONAL MATERIALS AS CORRELATES OF GRADE 6 LEARNERS' MATHEMATICS PERFORMANCE IN BUFFALO CITY

I hereby request permission, from your office, to conduct a research on Learning Style, Availability, and Utilization of Instructional Materials as Correlates of Grade 6 Learners' Mathematics Performance in Buffalo City. I am a PhD student at the University of Fort Hare and carrying out a research towards helping learners to know the effect of resources and there learning styles on their performance. This will enable the educators too to focus on some variables that can assist their learners' performance.

The title of the study is "**LEARNING STYLE, AVAILABILITY, AND UTILIZATION OF INSTRUCTIONAL MATERIALS AS CORRELATES OF GRADE 6 LEARNERS' MATHEMATICS PERFORMANCE IN BUFFALO CITY**"

All necessary documents in support of this application have been attached forthwith.

Yours faithfully



Kemi O. Adu

APPENDIX C: APPLICATION COVER LETTER TO UREC

50 Summerwoods
37 Main Road
Abbotsford
East London 5241
2018/08/17

The Chairperson
University Research Ethics Committee
Thru' Faculty Research Ethics Committee

Dear Sir/Madam

RE: APPLICATION COVER LETTER

I hereby apply for ethical clearance to enable the researcher to conduct research with learners from Buffalo City in East London.

The title for the study is "Learning style, availability, and utilization of instructional materials as correlates of grade 6 learners' mathematics performance in buffalo City."

All necessary documents in support of this application have been attached forthwith.

Thanks

Yours faithfully



Kemi O. Adu (Mrs.)

APPENDIX D: APPLICATION FOR ETHICAL CLEARANCE



University of Fort Hare
Together in Excellence

UNIVERSITY RESEARCH ETHICS COMMITTEE APPLICATION FOR ETHICAL CLEARANCE: HUMANS

Please indicate (x)

New application	X
Re-submission	
Renewal application	

SECTION 1: DETAILS OF APPLICANT/PRINCIPAL INVESTIGATOR		
Name: KEMI OLAJUMOKE	Surname: ADU	Professional Status: EDUCATOR
University Division / Faculty and Department: EDUCATION		SGCE, Education
Complete Postal Address: 50 SUMMERWOODS, 37 MAIN ROAD, ABBOTSFORD, EAST LONDON 5241		
Telephone No: N/A	Fax No: N/A	Cell No: 084 849 5221
E-mail address: <u>201510102@ufh.ac.za</u> OR <u>kemiadu78@yahoo.com</u>		
SECTION 2: TITLE OF STUDY		
Title of Research Project:		

LEARNING STYLE, AVAILABILITY, AND UTILIZATION OF INSTRUCTIONAL MATERIALS AS CORRELATES OF GRADE 6 LEARNERS' MATHEMATICS PERFORMANCE IN BUFFALO CITY		
Sponsor's Protocol No (if applicable) N/A		
Sponsor's Details (if applicable) N/A		
SECTION 3: STUDY FOR DEGREE PURPOSES	Not applicable	
Name of Degree: PHYLOSOPHY OF EDUCATION (PhD)	Supervisor: DR N. PYLMAN	
Division/Department: EDUCATION	E-mail: <u>201510102@ufh.ac.za</u>	
Contact No: 084 849 5221		

SECTION 4: DETAILS OF SUB-INVESTIGATORS		
Name and Title	Position	Division/Department
1. N/A		
2. N/A		
3. N/A		
4. N/A		
5. N/A		
SECTION 5: DETAILS OF COLLABORATING INVESTIGATORS		
Name and Title	Position	Division/Department
1. N/A		
2. N/A		
3. N/A		
4. N/A		

5. N/A		
SECTION 6: WHERE WILL THE STUDY BE CONDUCTED?		
1. PRIMARY SCHOOLS IN BUFFALO CITY		
2.		
3.		
4.		
5.		
SECTION 7: STUDY TYPE		
1. Industry Sponsored		2. Self Initiated
3. Retrospective Record Review		4. Laboratory-Based Research
5. Qualitative Research		6. Prospective Descriptive Study
7. Other	X	8. Please state type if 'Other':
		QUANTITATIVE
SECTION 8: HOW IS THIS RESEARCH FUNDED? STATE APROXIMATE TOTAL BUDGET		
1. Industry	R	2. NIH
3. Internal/Self	R	4. Other/ US Fed Agency
5. External SA Grant	R	6. Internat. Grant
SECTION 9: SIGNING OF APPLICATION		
Applicant: Supervisor: *Departmental Head:		

*** Or the Dean of the Faculty or the Chairperson of the Faculty Research Ethics Committee**

The following obligatory documentation must be attached to this application form:

PROTOCOL SUMMARY / SYNOPSIS (Obligatory)

Please provide a protocol synopsis or summary of the proposed research, **in addition to the full Protocol**, that is between **800 and 1 000 words** long. The Protocol Synopsis or summary should contain the following:

- **Title:** LEARNING STYLE, AVAILABILITY, AND UTILIZATION OF INSTRUCTIONAL MATERIALS AS CORRELATES OF GRADE 6 LEARNERS' MATHEMATICS PERFORMANCE IN BUFFALO CITY
- **A short introduction (1 paragraph only):** Every child follows its own unique way to learn and process information with the availability and utilization of instructional materials. They learn the material in different ways. Some learn by oral repetition, some may learn by writing it out, while others may learn through practical work. Individuals thus differ in the way they learn. Learning style can be described as a set of factors, behaviours, and attitudes that facilitate learning for an individual in a given situation. It is the ability of learners to perceive and process information in learning situations (Iyunade, 2014).
Sub-research question:
 - What is the relative effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance?
 - What is the composite effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance?
 - Which of the variables (learning styles, availability and utilization of instructional materials would predict Grade 6 learners' Mathematics performance?

Aims and Objectives:

- To examine the relative effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance
- To investigate the composite effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance
- To find out which of the variables (learning styles, availability and utilization of instructional materials would predict Grade 6 learners' Mathematics performance?
- **A concise summary of the methodology:** will include the following sections: research paradigm, research approach, design of the study, study site, population of the study, sample size, sampling technique, instrument for data collection, data

collection procedure, data analysis procedure, validity and reliability of the instrument, and ethical considerations and requirements.

- **Description of subject population including characteristics, age range and number of subjects:** According to Sanni, (2011), a research sample helps to inform the quality of inferences made by the researcher that stem from the underlying findings. Stratified sampling will be used to select participants. Stratified sampling is a process of dividing the sample frame into strata to obtain relatively homogenous subgroups (Sanni, 2011). East London district consists of twelve (12) circuits, out of these, seven (7) circuits will be randomly selected. Disproportionate stratified sampling technique will be used to select five (5) schools from each of the circuit. This will give a total of 35 schools selected across all the circuits in the district. From each selected school, one arm of Grade 6 will be randomly selected and total enumeration will be used to involve all the learners in the selected class. Averagely, 35 learners are expected in each class, this should give a total of 1225 Grade 6 learners selected across 35 schools in Buffalo City as the sample of the study.
- **Ethical Considerations:** Issues pertaining to the respondents in terms of gaining entry or permission, informed consent, confidentiality, and achieving anonymity.

Checklist (Obligatory):	X
Investigator Declaration for principal, co- and sub investigators (Obligatory)	X
Investigator CVs	X
Protocol	X
Supervisor's declaration, where applicable	X
Questionnaire / list of questions	X

Recommendation from the Faculty Research Ethics Committee

.....

Chairperson:..... **Date:**.....

Recommendation from the University Research Committee

.....
.....
.....
.....
.....

Chairperson:..... Date:.....

OFFICE USE ONLY

Approved by UREC				Project ID
Conditional				
Provisional				
Final				



University of Fort Hare
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UNIVERSITY RESEARCH ETHICS COMMITTEE

The completed form must be submitted with the application. An incomplete checklist form will result in the return of the whole application to the originator

CHECKLIST-GENERAL

Section A. To be completed by Applicant and checked by GMRDC Office

PROTOCOL TITLE:

PROTOCOL NUMBER		PROTOCOL VERSION		PROTOCOL DATE	
----------------------------	--	-----------------------------	--	--------------------------	--

	CV (max 2 pages)	Investigator Declaration	Conflict of Interest statement signed.	Admin Office Comments
PRINCIPAL INVESTIGATOR:	X	X	X	
SUPERVISOR:				
CO- INVESTIGATORS				
1.				

2.				
3.				
4.				
5.				
6.				
OTHER STAFF				

	Applicant	Comments	Admin Office
	Y /N / NA		
Applicant Signature	Y		
Supervisor Signature	Y		
HOD Signature	Y		
Protocol synopsis	Y		
Full protocol	Y		
Page numbers on protocol?	Y		
Budget	Y		
Informed Consent Form	Y		
Questionnaires	Y		
Other measuring tools/instruments	N/A		
Recruitment material/ Advertisement(s)	N/A		
DoH or other letters of approval	N/A		

to conduct research			
Material Transfer Agreement	N/A		

Section B: To be completed by Applicant. The Reviewer will cross check

INFORMED CONSENT FOR RESEARCH CHECKLIST

	Yes / No or NA (PI)	Yes/No/ NA (Reviewer)
1. That consent is being sought from the participant to participate in research.	Y	
2. The purpose of the research and where it will be conducted.	Y	
3. The expected duration of the participant's involvement in the research.	Y	
4. The total number of participants that will be involved at this site and/or South Africa and worldwide.	Y	
5. A description of all the processes and procedures to which the participant will be subjected,	Y	
6. The principal investigator's name and contact details.	Y	
7. Explanation of participants responsibilities.	Y	
8. Explanation of any randomization process if applicable).	NA	
9. Circumstances that may result in the project being terminated or the participant being withdrawn.	NA	
10. A description of foreseeable risks and discomforts.	NA	
11. A description of benefits to the participant or others both during and after the research. If there are no expected benefits, the participant must specifically be made aware of this.	Y	
12. Disclosure of alternative procedures and course of treatments available if applicable	NA	

13. Description of extent to which confidentiality will be maintained and protected.	Y	
14. Statement that sponsors of the study, study monitors or auditors or UREC members may need to inspect research records.	NA	
15. Statement that the UREC has approved the research.		
16. Contact details of the committee.		
17. Explanation of how research related injury will be managed and details of insurance if applicable.	N/A	
18. Explanation as to whom to contact in the event of research related injury.	N/A	
19. Participation in the study is entirely voluntary	Y	
20. Participants are free to withdraw at any point without explanation or any negative consequences. Their routine health care will not be adversely affected.	Y	
21. Participants must be informed of their rights to be told any new relevant information that arises during the course of the trial and the ICF should be revised, where appropriate to incorporate this information.	Y	
22. That the study will be conducted according to the International Declaration of Helsinki and other applicable international ethical codes for research on human subject.	Y	
23. Any expense to which the participant may be liable.	NA	
24. Explanation regarding payment for participation or out of pocket expenses	NA	
25. Identity of the funder, where applicable and any potential conflict of interests.	NA	
26. Where appropriate, the participant should also be requested/advised to inform his general practitioner and life insurance company or medical aid of his/her participation. ☐ Not considered appropriate/necessary	NA	
27. Simple, clear language has been used (Maximum Grade 8 reading level) and all medical and technical terms have been explained.	Y	

Section C. To be completed by Applicant

	Yes(PI), NA	Yes/No/NA (Reviewer)
1. Does the study have relevance and scientific or clinical value and applicability to the proposed research population?	NA	
2. Does the protocol include an adequate literature review?	Y	
3. Is the selection of subjects equitable and appropriate; adequate consideration and protection of vulnerable research populations.	Y	
4. Is the design and methodology appropriate to answer the research question?	Y	
5. Is the methodology clearly described, in sufficient detail?	Y	
6. Is the statistical analysis plan, including sample size calculations, clearly outlined and justified?	Y	
7. Are the inclusion and exclusion criteria clearly defined and appropriate?	N/A	
8. Have risks been minimized and is there an acceptable balance between potential risks and benefits?	Y	
9. Does the PI have the necessary qualifications, expertise, facilities, and time and support staff, to carry out the proposed research?	Y	
10. Has a section on 'Ethical Considerations' been included in the protocol?	Y	
11. Has the informed consent process been clearly explained in the protocol?	Y	
12. Are issues relating to protection of privacy and confidentiality of data adequately addressed, especially if the study involves a retrospective review of clinical records?	Y	
13. Has a waiver of informed consent been requested if the study involves a retrospective review of clinical records?	NA	
14. Does the study involve collection of DNA/RNA and, if so, has consent been adequately sought for this?	NA	



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UNIVERSITY RESEARCH ETHICS COMMITTEE SUPERVISOR'S DECLARATION

The supervisor must sign a declaration for each student project supervised.

A. RESEARCHER

Surname	ADU			Initial	KO	Title	MRS
Department	EDUCATION						
Telephone	Cell	084 849 5221	emai	<u>201510102@ufh.a</u>		Fax	N/A

B. SUPERVISOR

Surname	PYLMAN			Initial	N	Title	DR
Capacity	SUPERVISOR						
Department	Faculty of Education						
Present	SENIOR LECTURER			E-	<u>jpylan@ufh.ac.za</u>		
Telephone no.	(w)	043 704 7182	Cell	073 269 5739		Fax	

B. PROJECT TITLE (MAXIMUM OF 250 CHARACTERS FOR DATABASE PURPOSES)

LEARNING STYLE, AVAILABILITY, AND UTILIZATION OF INSTRUCTIONAL MATERIALS AS CORRELATES OF GRADE 6 LEARNERS' MATHEMATICS PERFORMANCE IN BUFFALO CITY

I, (Title, Full name) DR NICKY PYLMAN declare that

- I have read through the submitted version of the research protocol and all supporting documents and am satisfied with their contents. I am satisfied that the scientific content of the research is satisfactory and up to standard for an educational qualification at this level.
- I am suitably qualified and experienced to supervise the above research study.
- I undertake to fulfill the responsibilities of the supervisor for this study as set out in the university policy
- I take responsibility for ensuring that the applicant is up to date and complies with the requirements of the law and relevant guidelines relating to security and confidentiality of research subjects and other personal data, in conjunction with supervisors as appropriate.
- I take responsibility for ensuring that the applicant is up to date and complies with all regulatory and monitoring requirements of the UREC
- I agree to supervise the described study in accordance with the relevant, current protocol and **will only change the protocol after approval by the UREC.**
- I agree to ensure the applicant maintains **adequate and accurate records.**
- I take responsibility for ensuring that this study is conducted in accordance with the ethical principles underlying the Declaration of Helsinki as well as South African and ICH GCP Guidelines and the Ethical Guidelines of the Department of Health as well as applicable regulations pertaining to health and other research with supervisors as appropriate.
- I agree that I am conversant with the above **guidelines.**
- I will ensure that the applicant treats every participant **in a dignified manner and with respect.**

Supervisor: DR N. PYLMAN :
(print name)

Signature :

Date :

CONFLICT OF INTEREST DECLARATION (OBLIGATORY)
--

The researcher is expected to declare to the University Research Ethics Committee (UREC) the presence of any potential or existing conflict of interest that may potentially pose a threat to the scientific integrity and ethical conduct of any research in the University.

The UREC will decide whether such conflicts are sufficient as to warrant consideration of their impact on the ethical conduct of the study.

Disclosure of conflict of interest does not imply that a study will be deemed unethical, as the mere existence of a conflict of interest does not mean that a study cannot be conducted ethically. However, failure to declare to the UREC a conflict of interest known to the researcher at the outset of the study

will be deemed to be unethical conduct.

Researchers are therefore expected to sign *either* of the two declarations below:

a) As the Principal Researcher in this study (name: ADU, K.O.)

I hereby declare that I am **not aware** of any potential conflict of interest which may influence my ethical conduct of this study.

Signature:

Date:

b) As the Principal Researcher in this study (name: ADU, K. O.)

I hereby declare that I am **aware** of potential conflicts of interest which should be considered by the UREC:

Signature:

Date:



University of Fort Hare
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RESEARCH ETHICS COMMITTEE

RESEARCHER'S DECLARATION AND CONFLICT OF INTEREST DECLARATION

(To be completed in typescript)

The principal investigator, as well as all sub- & co-investigators must each sign a separate declaration.

A. RESEARCHER

Surname	ADU			Initial	KO	Title	MRS
CapaCity	Principal	X	Sub-			Co-investigator	
Department	EDUCATION						
Present	EDUCATOR			E-	<u>201510102@ufh.ac.za</u>		
Telephone	(w	N/A	Cel	084 849 5221	Fax	N/A	

B. PROJECT TITLE (MAXIMUM OF 250 CHARACTERS FOR DATABASE PURPOSES)

LEARNING STYLE, AVAILABILITY, AND UTILIZATION OF INSTRUCTIONAL MATERIALS AS CORRELATES OF GRADE 6 LEARNERS' MATHEMATICS PERFORMANCE IN BUFFALO CITY

I, (Title, Full name) MRS KEMI OLAJUMOKE ADU declare that

- I have read through the submitted version of the research protocol and all supporting documents and am satisfied with their contents
- I am **suitably qualified and experienced** to perform and/or supervise the above research study.
- I agree to conduct or supervise the described study **personally** in accordance with the relevant, current protocol and will only change the protocol after approval by the

UREC, except when urgently necessary to protect the safety, rights, or welfare of subjects. In such a case, I am aware that I should notify the UREC without delay.

- I agree to timeously report to the UREC **serious adverse events** that may occur in the course of the investigation.
- I agree to maintain **adequate and accurate records** and to make those records available for inspection by the appropriate authorised agents when and if necessary.
- I agree to comply with all other requirements regarding the obligations of clinical investigators and all other pertinent requirements in the Declaration of Helsinki, as well as South African and ICH GCP Guidelines and the Ethical Guidelines of the Department of Health as well as applicable regulations pertaining to health and other research.
- I agree to comply with all regulatory and monitoring requirements of the UREC.
- I agree that I am conversant with the above **guidelines**.
- I will ensure that every research subject or other involved persons, such as relatives, shall at all times be **treated in a dignified manner and with respect**.
- I will submit all required reports within the stipulated **periods**.

Principal / Sub- / Co-investigator /Supervisor

: ADU, K.O.

(print name)

Signature

Date August 2018

CONFLICT OF INTEREST DECLARATION (OBLIGATORY)

The researcher is expected to declare to the University Research Ethics Committee (UREC) the presence of any potential or existing conflict of interest that may potentially pose a threat to the scientific integrity and ethical conduct of any research in the University.

The UREC will decide whether such conflicts are sufficient as to warrant consideration of their impact on the ethical conduct of the study.

Disclosure of conflict of interest does not imply that a study will be deemed unethical, as the mere existence of a conflict of interest does not mean that a study cannot be conducted ethically. However, failure to declare to the UREC a conflict of interest known to the researcher at the outset of the study

will be deemed to be unethical conduct.

Researchers are therefore expected to sign *either* of the two declarations below:

c) As the Principal Researcher in this study (name: ADU, K.O.)

I hereby declare that I am **not aware** of any potential conflict of interest which may influence my ethical conduct of this study.

Signature:

Date: August 2018

d) As the Principal Researcher in this study (name: ADU, K.O.)

I hereby declare that I am **aware** of potential conflicts of interest which should be considered by the UREC:

Signature:

Date:



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Ethics Research Confidentiality and Informed Consent Form

Please note:

This form is to be completed by the researcher(s) as well as by the interviewee before the commencement of the research. Copies of the signed form must be filed and kept on record

(To be adapted for individual circumstances/needs)

Our University of Fort Hare / Department is asking people from your community / sample / group to answer some questions, which we hope will benefit your community and possibly other communities in the future.

The University of Fort Hare / Department/ organization is conducting research regarding Learning Style, Availability, and Utilization of Instructional Materials as Correlates of Grade 6 Learners' Mathematics Performance in Buffalo City. We are interested in finding out more about the critical preschool programmes to make all young children ready for formal schooling, in order to address any possible educational shortcomings early on. We are carrying out this research to help policy makers not to depart from preschool education models that have proven highly effective, it will also change the orientations of the caregivers about their functions and products and parents will be assured of holistic preparation of their children when the ECCE practices are improved. A low-quality provision of preschool education will inevitably lead to very little gains and will most likely just perpetuate educational inequalities in the Eastern Cape and in South Africa.

Please understand that you are not being forced to take part in this study and the choice whether to participate or not is yours alone. However, we would really appreciate it if you do share your thoughts with us. If you choose not take part in

answering these questions, you will not be affected in any way. If you agree to participate, you may stop me at any time and tell me that you don't want to go on with the interview. If you do this there will also be no penalties and you will NOT be prejudiced in ANY way. Confidentiality will be observed professionally.

I will not be recording your name anywhere on the questionnaire and no one will be able to link you to the answers you give. Only the researchers will have access to the unlinked information. The information will remain confidential and there will be no "come-backs" from the answers you give.

The interview will last around 45 minutes (*this is to be tested through a pilot*). I will be asking you questions and ask that you are as open and honest as possible in answering these questions. Some questions may be of a personal and/or sensitive nature. I will be asking some questions that you may not have thought about before, and which also involve thinking about the past or the future. We know that you cannot be absolutely certain about the answers to these questions but we ask that you try to think about these questions. When it comes to answering questions there are no right and wrong answers. When we ask questions about the future we are not interested in what you think the best thing would be to do, but what you think would actually happen.

Two different questionnaires will be used and will have questions that are similar and other questions will be differently phrased for each of the two entities. This will be done to determine the exact perceptions and opinions of the respondents

If possible, our organisation would like to come back to this area once we have completed our study to inform you and your community of what the results are and discuss our findings and proposals around the research and what this means for people in this area.

INFORMED CONSENT

I hereby agree to participate in research regarding caregivers' and parents' views about preschool education as a readiness programme. I understand that I am participating freely and without being forced in any way to do so. I also understand that I can stop this interview at any point should I not want to continue and that this decision will not in any way affect me negatively.

I understand that this is a research project whose purpose is not necessarily to benefit me personally.

I have received the telephone number of a person to contact should I need to speak about any issues which may arise in this interview.

I understand that this consent form will not be linked to the questionnaire, and that my answers will remain confidential.

I understand that if at all possible, feedback will be given to my community on the results of the completed research.

.....

Signature of participant

Date:.....

I hereby agree to the tape recording of my participation in the study

.....

Signature of participant

Date:.....

Insert

Cover letter requesting for clearance

Research proposal

Researcher's CV

Questionnaire

Research questions/interview guide

Budget / total cost of the research e.g. transport, data collection, data analysis etc.

APPENDIX E: CHILD ASSENT TEMPLATE

NAME OF APPLICANT

Ethics Human 2011

<<Approved

>>

OFFICE USE ONLY

Ref:

Date:



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CHILD ASSENT TEMPLATE

NB! DELETE THIS PAGE BEFORE ADAPTING THE TEMPLATE TO YOUR PROJECT!

Please note:

1. Children who are able to understand the basic concepts of research should be given the opportunity to assent to a research study. Generally children between the ages of 7 to 17 should assent to research. This is not a fixed rule and some children younger than 7 may well have sufficient insight and understanding to give assent for a study.
2. If they refuse assent then this refusal should be accepted, even if the parents have consented. There may be exceptional cases where this rule may not apply. The University Research Ethics Committee (UREC) should be consulted.
3. This template is specifically for 7-12 year olds and can be adapted to suit adolescents.
4. If you are including a wide range of children in your project you will need 2 different versions of assent, one for younger children and a more detailed one for adolescents.
5. You can adapt the template to suit the needs of your specific project including deleting sections which are seen as not applicable/appropriate.

6. This assent document must be used in conjunction with a parental Information Leaflet and Informed Consent form, which should obviously cover the project in more depth and detail.
7. Once your project has been approved and you have a reference number, you should replace the information in the 'footer' with your own information e.g. Project No..... Assent template Version 1.1; Date 22 01 2012

PARTICIPANT INFORMATION LEAFLET AND ASSENT FORM



TITLE OF THE RESEARCH PROJECT: Learning style, availability, and utilization of instructional materials as correlates of grade 6 learners' mathematics performance in Buffalo City

RESEARCHERS NAME(S): Mrs. K. O. Adu

ADDRESS: 50 Summerwoods, 37 Main Road, Abbotsford, East London 5241

CONTACT NUMBER: 0848495221

What is RESEARCH?

Research is something we do to find new knowledge about the way things (and people) work. We use research projects or studies to help us find out more about disease or illness. Research also helps us to find better ways of helping, or treating children who are sick.

What is this research project all about?

4. *To examine the relative effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance*
5. *To investigate the composite effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance*
6. *To find out which of the variables (learning styles, availability and utilization of instructional materials would predict Grade 6 learners' Mathematics performance*

The duration of the research project?

Eight Weeks

Why have I been invited to take part in this research project?

You are invited to participate in this study in order to provide information on the effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance.

Confidentiality

The information of the participant will be kept with utmost secrecy.

If a sponsor is to be involved

No sponsor is involved.

Who is doing the research?

Mrs. Kemi O. Adu. This work is conceived in order to examine the effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance.

What will happen to me in this study?

You are to serve as participant in one of the schools to be selected for this study as a learner. It is envisaged that no harm will occur in the process since you are free to disengage any time you wish.

Can anything bad happen to me?

No risk is envisaged because the study is strictly for academic purpose.

Who else is involved in the study?

Nobody, the study involves Grade 6 learners alone in schools selected from Buffalo City.

Can anything good happen to me?

Yes, as it will enable you to identify some of the factors leading to performance maximization in Mathematics.

Will anyone know I am in the study?

Yes, since it involves instructional materials for Mathematics teaching, the school principal must know, however, the information gathered will be kept with utmost secrecy and used strictly for the purpose of research

Who can I talk to about the study?



Dr N. Pylman- Faculty of Education, University of Fort Hare, East London Campus -

What if I do not want to do this?

Yes, you are free to decline your interest if you so wish, no punishment is attached. Disengagement could be done at any stage of the experiment since rooms have been created for that.

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

YES

NO

Has the researcher answered all your questions?

YES

NO

Do you understand that you can pull out of the study at any time?

YES

NO

Signature of Child

Date

APPENDIX F: PARENT CONSENT FORM

NAME OF APPLICANT

Ethics Human 2011

<<Approved

>>

OFFICE USE ONLY

Ref:

Date:



University of Fort Hare
Together in Excellence

PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM FOR USE BY PARENTS/LEGAL GUARDIANS

TITLE OF THE RESEARCH PROJECT: Learning style, availability, and utilization of instructional materials as correlates of grade 6 learners' mathematics performance in buffalo City

REFERENCE NUMBER: N/A

PRINCIPAL INVESTIGATOR: Mrs. K. O. Adu

ADDRESS: SCHOOL OF GENERAL AND CONTINUING EDUCATION, EAST LONDON

CONTACT NUMBER: 0848495221

Your child (*or ward, if applicable*) is being invited to take part in a research project. Please take some time to read the information presented here, which will explain the details of this project. Please ask the study staff or doctor any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how your child could be involved. Also, your child's participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you or your child negatively in any way whatsoever. You are also free to withdraw him/her from the study at any point, even if you do initially agree to let him/her take part.

This study has been approved by the University Research Ethics Committee at the University of Fort Hare and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about?

The study intends:

7. To examine the relative effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance
8. To investigate the composite effect of learning styles, availability, and utilization of instructional materials on Grade 6 learners' Mathematics performance
9. To find out which of the variables (learning styles, availability and utilization of instructional materials would predict Grade 6 learners' Mathematics performance

Why has your child been invited to participate?

- *Your child is invited to participate in this study in order to provide information on the availability and the use of instructional materials for the teaching of Mathematics and also to know the influence of learning styles on their performance.*

What will your responsibilities be?

- *You are not going to participate in the research. Your responsibility is to give your child consent and to explain and guide the learner to objectively answer questions that will be used in this study*

Will your child benefit from taking part in this research?

- Yes, as it will enable you to identify some of the factors leading to performance maximization in Mathematics.

Are there any risks involved in your child taking part in this research?

- No risk will be involved because of the nature of the study.

If you do not agree to allow your child to take part, what alternatives does your child have?

- *Your child will not be affected in any way. The information that will be collected about you will not be available to anyone else and will be treated as confidential.*

Who will have access to your child's medical records?

The information that will be collected is not about your child medical record.

What will happen in the unlikely event of your child getting injured in any way, as a direct result of taking part in this research study?

- *Your child participating in answering the research questionnaire will not involve any injury.*

Will you or your child be paid to take part in this study and are there any costs involved?

- *You or your child will not be paid to take part in the study, but out-of-pocket expenses will be covered for each study visit. There will be no costs involved for you if your child does take part.*

Is there anything else that you should know or do?

- You should inform your family practitioner or usual doctor that your child is taking part in a research study. *(Include if applicable)*
- You should also inform your medical insurance company that your child is participating in a research study *(Include if applicable)*
- You can contact Dr..... at tel..... if you have any further queries or encounter any problems.
- You can contact the Chairperson of the University Research Ethics Committee if you have any concerns or complaints that have not been adequately addressed by your child's study doctor.

- **You will receive a copy of this information and consent form for your own records.**

Assent: Children with an age of 7 and above must give assent to participate in research

Declaration by parent/legal guardian

By signing below, I (*name of parent/legal guardian*)

..... agree to allow my child (*name of child*)
..... who is years old, to take part in a research
study entitled (*insert title of study*)

I declare that:

- I have read or had read to me this information and consent form and that it is written in a language with which I am fluent and comfortable.
- If my child is older than 7 years, he/she must agree to take part in the study and his/her ASSENT must be recorded on this form.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurized to let my child take part.
- I may choose to withdraw my child from the study at any time and my child will not be penalized or prejudiced in any way.
- My child may be asked to leave the study before it has finished if the study doctor or researcher feels it is in my child's best interests, or if my child do not follow the study plan as agreed to.

Signed at (*place*) On (*date*)

.....

.....
Signature of parent/legal guardian

.....
Signature of witness

Declaration by investigator

I *Mrs. K. O. Adu* declare that:

- I explained the information in this document to **Participants**.
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understand all aspects of the research, as discussed above
- I did/did not use an interpreter (*if an interpreter is used, then the interpreter must sign the declaration below*).

Signed at (*place*) On (*date*)

.....
Signature of investigator

Declaration by interpreter (Only complete if applicable)

I (*name*) declare that:

- I assisted the investigator (*name*) to explain the information in this document to (*name of parent/legal guardian*) using the language medium of Afrikaans/IsiZulu.
- We encouraged him/her to ask questions and took adequate time to answer them.
- I conveyed a factually correct version of what was related to me.
- I am satisfied that the parent/legal guardian fully understands the content of this informed consent document and has had all his/her questions satisfactorily answered.

Signed at (*place*) On (*date*)
.....

.....
Signature of interpreter

.....
Signature of witness

APPENDIX G: PERMISSION LETTER SAMPLE TO SCHOOLS

50 Summerwoods,
37 Main Road
Abbotsford
East London
5241
20st May 2019.

The Principal,

XXX Primary School

East London

Dear Sir/Madam,

REQUEST FOR PERMISSION TO UNDERTAKE RESEARCH IN YOUR SCHOOL

I am currently a doctoral student in the faculty of Education at the University of Fort Hare. My research topic is

LEARNING STYLES, AVAILABILITY, AND UTILIZATION OF INSTRUCTIONAL MATERIALS AS CORRELATES OF GRADE 6 LEARNERS' MATHEMATICS PERFORMANCE IN BUFFALO CITY

The research will be conducted in your school between 20th to 31st May making uses of Grade Six Mathematics learners as respondents. The administration of the questionnaire will take 30minutes. Every information supplied by the respondents will be treated with utmost confidentiality.

I will appreciate it if my request is granted to use the Grade 6 learners. The Mathematics teacher for Grade 6 will assist me to administer the questionnaire in which I will come back to collect. Waiting patiently to receiving feedback from you for the day chosen for me to come. I can be reached on 0848495221 or 201510102@ufh.ac.za , attached is a letter of approval from the Department.

Yours truly,



Kemi O. Adu (Mrs.)

APPENDIX H: ETHICAL CLEARANCE CERTIFICATE



University of Fort Hare
Together in Excellence

ETHICAL CLEARANCE

CERTIFICATE REC-270710-028-RA Level 01

Certificate Reference Number: PYL021 SADU01

Project title: **Learning style, availability and utilization of instructional materials as correlates of grade 6 learners' mathematics performance in Buffalo City.**

Nature of Project PHD in Education

Principal Researcher: Kemi O. Adu

Supervisor: Dr N. Pylman

Co-supervisor: N/A

On behalf of the University of Fort Hare's Research Ethics Committee (UREC) I hereby give ethical approval in respect of the undertakings contained in the above-mentioned project and research instrument(s). Should any other instruments be used, these require separate authorization. The Researcher may therefore commence with the research as from the date of this certificate, using the reference number indicated above. This certificate **is** valid for a year from the date of approval; thereafter, the Principal investigator/s will be expected to apply for renewal.

Please note that the UREC must be informed immediately of

- Any material changes in the conditions or undertakings mentioned in the document; any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research.

The Principal Researcher must report to the UREC in the prescribed format, where applicable, annually, and at the end of the project, in respect of ethical compliance.

Special conditions: Research that includes children as per the official regulations of the act must consider the following:

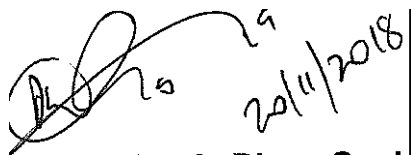
Note: The UREC is aware of the provisions of Department of Health Charter of Ethics in Health Research Principles, Processes and Structures; DOH 2015, signed

The UREC retains the right to

- Withdraw or amend this Ethical Clearance Certificate if
 - o Any unethical principal or practices are revealed or suspected;
 - o Relevant information has been withheld or misrepresented;
 - o Regulatory changes of whatsoever nature so require;
 - o The conditions contained in the Certificate have not been adhered to.
- Request access to any information or data at any time during the course or after completion of the project.
- In addition to the need to comply with the highest level of ethical conduct principle investigators must report annually as an evaluation and monitoring mechanism on the progress being made by the research. Such a report must be sent to the Dean of Research's office.

The Ethics Committee wished you well in your research

Yours sincerely



**Professor Pumla Dineo
Gqola Dean of
Research**

12 November 2018

APPENDIX I: PERMISSION LETTER FROM THE DEPARTMENT

STRATEGIC PLANNING POLICY RESEARCH AND SECRETARIAT SERVICES

Steve Vukile Tshwete Complex • Zone 6 • Zwelitsha • Eastern Cape

Private Bag X0032 • Bhisho • 5605 • REPUBLIC OF SOUTH AFRICA

Tel: +27 (0)40 608 4773/4035/4537 • Fax: +27 (0)40 608 4574 • Website: www.ecdoe.gov.za

Enquiries: B Pamla

Email: babalwa.pamla@ecdoe.gov.za

Date: 10 April 2019

Mrs. Kemi O Adu

50 Summerwoods

Abbotsford

East London

5241

Dear Mrs. Adu

PERMISSION TO UNDERTAKE A DOCTORAL RESEARCH: LEARNING STYLE, AVAILABILITY AND UTILISATION OF INSTRUCTIONAL MATERIALS AS CORRELATES OF GRADE 6 LEARNERS' MATHEMATICS PERFORMANCE IN BUFFALO CITY

1. Thank you for your application to conduct research.
2. Your application to conduct the above mentioned research involving 1 225 learners from 10 selected primary schools in the Buffalo City District, under the jurisdiction of the Eastern Cape Department of Education (ECDoE) is hereby approved based on the following conditions:
 - a. there will be no financial implications for the Department;
 - b. institutions and respondents must not be identifiable in any way from the results of the investigation;
 - c. you seek parents' consent for minors;
 - d. it is not going to interrupt educators' time and task;
 - e. you present a copy of the written approval letter of the Eastern Cape Department of Education (ECDoE) to the Cluster and District Directors before any research is undertaken at any institutions within that particular district;
 - f. you will make all the arrangements concerning your research;
 - g. the research may not be conducted during official contact time, provided that an arrangement to do research at the school including getting inside a classroom has been arranged and agreed upon in writing with the Principal and the affected teacher;

- h. should you wish to extend the period of research after approval has been granted, an application to do this must be directed to Chief Director: Strategic Management Monitoring and Evaluation;
 - i. your research will be limited to those institutions for which approval has been granted, should changes be effected written permission must be obtained from the Chief Director: Strategic Management Monitoring and Evaluation;
 - j. you present the Department with a copy of your final paper/report/dissertation/thesis free of charge in hard copy and electronic format. This must be accompanied by a separate synopsis (maximum 2 – 3 typed pages) of the most important findings and recommendations if it does not already contain a synopsis.
 - k. you present the findings to the Research Committee and/or Senior Management of the Department when and/or where necessary.
 - l. you are requested to provide the above to the Chief Director: Strategic Management Monitoring and Evaluation upon completion of your research.
 - m. you comply with all the requirements as completed in the Terms and Conditions to conduct Research in the ECDoE document duly completed by you.
 - n. you comply with your ethical undertaking (commitment form).
 - o. You submit on a six monthly basis, from the date of permission of the research, concise reports to the Chief Director: Strategic Management Monitoring and Evaluation
3. The Department reserves a right to withdraw the permission should there not be compliance to the approval letter and contract signed in the Terms and Conditions to conduct Research in the ECDoE.
 4. The Department will publish the completed Research on its website.
 5. The Department wishes you well in your undertaking. You can contact the Director, Ms. NY Kanjana on the numbers indicated in the letterhead or email nelisa.kanjana@ecdod.gov.za should you need any assistance.



NY KANJANA
DIRECTOR: STRATEGIC PLANNING POLICY AND RESEARCH
FOR SUPERINTENDENT-GENERAL: EDUCATION



APPENDIX J: LANGUAGE EDITING CERTIFICATE

EDITING/PROOFREADING CERTIFICATE

To whom it may concern

This serves to certify that I, Emmanuel Alalade, have edited Mrs K.O. Adu's thesis to ensure that the language, grammar, punctuation and spelling are academically sound and appropriate, by rectifying errors, wherever these have been identified, and rephrasing sentences that would possibly make one lose sight of the flow of the argument.

Topic: **"LEARNING STYLES, AVAILABILITY, AND UTILIZATION OF INSTRUCTIONAL MATERIALS AS CORRELATES OF GRADE 6 LEARNERS' MATHEMATICS PERFORMANCE IN BUFFALO CITY"**

Editor's Name: Emmanuel Alalade

Signature:

A handwritten signature in black ink, appearing to read 'Emmanuel Alalade', written over a horizontal line.

Date: 23/03/2020

Contact Details: ralalade@yahoo.com

Qualifications: ***B.Ed. (Hons) linguistic; M. Ed (Language Education); PhD (Education)***