EFFECT OF COOPERATIVE LEARNING METHOD ON ACHIEVEMENT OF PRE-SCHOOLERS' COMPETENCES IN MATHEMATICAL CONCEPTS IN KIRINYAGA COUNTY, KENYA

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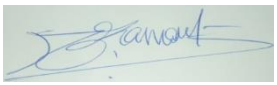
A THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY (PHD) IN EARLY YEARS EDUCATION IN THE DEPARTMENT OF EDUCATIONAL COMMUNICATION TECHNOLOGY AND PEDAGOGICAL STUDIES, SCHOOL OF EDUCATION, UNIVERSITY OF NAIROBI

2022

DECLARATION

This thesis, being my original work, has never been presented for an award of any degree in any given institution.

Signature  Date 20th July 2022

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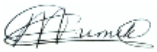
Signature  Date 20th July 2022

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I dedicate this work to all stakeholders who value, cherish and strive to make early childhood development and education achieve its goals in spite of the pedagogical challenges thereof.

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LIST OF ABBREVIATIONS AND ACRONYMS

CBC	:	Competency-Based Curriculum
CEMASTEA	:	Centre for Mathematics, Science and Technology Education in Africa
CLM	:	Cooperative Learning Method
DICECE	:	District Centre for Early Childhood Education
EYE	:	Early Years Education
KCPE	:	Kenya Certificate of Primary Education
KNEC	:	Kenya National Examination Council
MCCAT	:	Mathematical Concepts Competences Achievement Test
MCCA	:	Mathematical Concepts Competences Acquisition
NACOSTI	:	National Commission for Science, Technology & Innovation
PP2	:	Pre-Primary Two
SPSS	:	Statistical Packages for Social Science
TAC	:	Teacher Advisory Centre

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ABSTRACT

The Cooperative Learning Method (CLM) is a teaching method in which small groups of learners with varying degrees of ability work collaboratively on carefully devised tasks using a range of learning activities designed to ensure knowledge construction and competence. The purpose of this study was to explore effect of CLM on the achievement of competences in mathematical concepts in pre-school learners in Kirinyaga County, Kenya. Drawing on Piaget and Vygotsky's cognitive development theory, Bandura's behavioural learning theory and Johnson and Johnson's social interdependence theory, the study was undertaken to establish the difference between groups of pre-school learners, firstly in the mean score index of those taught using CLM compared to those not taught by this method; and secondly, the difference in mean score index of pre-school learners taught by teachers with a favourable attitude to CLM compared to those whose teachers had a negative attitude to it. The study also sought to assess the difference in mean score index between pre-school learners with a favourable attitude to CLM and those whose attitude was unfavourable. Correlational and comparative research designs were applied to ascertain the existing differences in acquisition of mathematical concepts competences by pre-schoolers and in establishing the relationships between variables when using CLM in comparison with traditional teaching methods without manipulating those variables. The unit of sampling was pre-schools; and stratified and proportionate sampling procedures were used to determine sample size. Teacher and learner respondents' sample sizes were derived using purposive sampling on the basis of the pre-schools sampled. This procedure led to a sample size of 20 pre-school teachers and 639 Pre-Primary Two learners from twenty pre-schools out of the five sub-counties of Kirinyaga County. The key data collection instruments from the respondents in the study were: an observation schedule, a documentary analysis guide, a teacher questionnaire and a mathematical concepts competences achievement test. Descriptive and inferential statistics were used to analyse the data collected. The key findings were that learners taught using CLM achieved higher mean score indices than those who were not. Comparatively, the learners whose teachers had a favourable attitude towards CLM registered higher mean score indices than those whose teachers were unfavourable towards it. Learners who were favourable towards CLM achieved higher mean score indices than those with a negative attitude towards it. Among the recommendations from the study are the development of Ministry of Education policies and programmes to provide regular in-service training, in which CLM training forms a key part of the agenda, to refresh the mathematical concepts competences instructional skills of pre-school teachers; along with the restructuring of teacher training programmes to ensure that, in addition to other methods for teaching mathematical concepts competences, trainee teachers are able to embed CLM effectively into their delivery of learning in the classroom.

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

One of the most vital aspects of pre-school education is the acquisition of mathematical concepts, as this equips learners with the skills required for developing logical thinking (Shinn, 2003). Mathematical concepts cover a wide range of aspects and are used in many fields. Singh, Granville and Dika (2012) posit that providing pre-schoolers with a solid base in core mathematical concepts is fundamental for progress in all areas of their education, as these underpin many aspects of learning and everyday life.

Furthermore, by acquiring mathematical concepts at an early stage, pre-schoolers increase their learning capabilities at later stages of life and are able to perform better as they progress through their education. Nevertheless, despite the importance attached to the learning of mathematical concepts for daily life as well as education, Fraser and Kahle (2014) observe a decline in learners' competences in these skills, and the decline in achievement in mathematical concepts among pre-school learners is of greatest concern.

The aim of Kenya's Vision 2030 is for Kenya to become a middle-income country within the next decade. As part of that Vision, the Kenyan state emphasises education in mathematical concepts as a vital instrument in sustaining innovation at national level. At national level, a monitoring report on learner achievement in literacy and numeracy by the Kenya National Examination Council (KNEC) (2017) highlighted that 52% of pre-school learners across the country were unable to solve problems involving mathematical concepts.

Traditional teaching methods emphasise the manipulation of expressions and algorithms as an essential base for solving mathematical problems. Teachers in their role as facilitators of learning habitually ignore the fact that understanding normally arises as a result of engaging in problem solving.

They may often spend the greater part of their time in lessons lecturing, demonstrating, offering examples and talking, rather than giving their learners sufficient time to practise mathematical problem solving on their own.

A number of studies examine the methods that are most suitable for teaching mathematical concepts (Ajaja and Eravwoke, 2010; Aziz and Coop Hossain, 2010; Johnson and Johnson, 2010). Lafi (2001) identifies the importance of replacing the expository method with a paedo-centric one, in order to actively involve learners in the construction of their own knowledge. Uwezo (2010) also recommends that teachers should adopt teaching methods which are learner-centred. Gubbad (2010) asserts that pre-school learners ought to feel responsible for their own and their group's efforts, by encouraging and supporting one another. In line with this, Ngusa, Begi and Ndani (2018) advocate that teachers should introduce cooperative groups with pre-school learners to practise problem-solving strategies by manipulating materials in order to solve tasks based on mathematical concepts. After solving a problem based on mathematical concepts, pre-school learners should be able to explain their answer to a peer.

Pre-school teachers undertake an essential role in ensuring the country’s development through the teaching of mathematical concepts, by providing pre-schoolers with solid foundations in early mathematical literacy, which is fundamental for educational attainment

and everyday living, and ensuring that their learners obtain good grades in assessments. This can only be achieved by adopting teaching methods that avoid the mundane and boring and improve pre-school learners' competences in mathematical concepts.

As Gillies (2014) observes, many teachers and learners consider mathematical concepts to be among the most complex pre-school and school subjects. Aunola, Leskinen, Lerkkanen and Nurmi (2006) submit that the acquisition of competence in mathematical concepts is a particularly strong predictor of later academic achievement. However, many learners experience difficulties in understanding mathematical concepts, and these comprehension difficulties often persist; children who begin school with poor numeracy skills are at an extreme disadvantage as they tend not to catch up with their peers in acquiring the same levels of competency in mathematical concepts.

Anobile et al. (2012) assert that difficulties in comprehending and applying mathematical concepts are widespread among pre-school learners. They observe that up to 10% of learners are diagnosed with a learning disability in mathematical concepts competences at some point in their schooling and many more without a formal diagnosis struggle in mathematical activities.

Fraser and Kahle (2014) express that many pre-school learners in places such as India lack core numeracy skills, such as counting, ordering and basic operations, which is often presented in their assessment. Rudhumbu (2014) found that learners in Zimbabwe often have limited ability in solving problems involving mathematical concepts, which is compounded in cases where pre-school teachers feel frustrated when endeavouring to address the needs of individual learners. In places such as South Africa, Tanzania and Uganda, as well as Kenya,

Clindiebere (2013) found that pre-school learners lack competence in solving problems based on mathematical concepts due to the pedagogical processes involved, often because many teachers still use teacher-centred methods that hinder the learning of mathematical concepts.

In addition to the assertion by Fraser and Kahle (2014) that learners consider mathematical activities to be difficult and boring, there are a number of other factors which may be contributing to the decline in learners' competences in mathematical concepts, particularly in pre-schools. Attitude and interest appear to play a substantial role in pre-school learners' beliefs, feelings, emotions and behaviours when they are studying mathematical concepts and, even at such a comparatively young age, they react positively or negatively towards teaching methods used in class. Han and Carpenter (2014) define attitude as cognitive, affective and behavioural responses based on feelings or interest that learners exhibit towards their teacher's instructional methods. In the majority of instances, these derive from teacher traits, such as warmth, empathy and friendliness, most strongly associated with positive learner attitudes, whereas a negative emotional classroom atmosphere has been linked to lowered learning achievement.

Farooq and Shah (2008) identify pre-school learners' attitude towards pre-school, lessons and mathematical success as one of the most significant factors that affects their acquisition of mathematical concepts, and that this attitude plays an exceptionally significant role in determining the kind of instructional methods that teachers adopt for teaching mathematical concepts. When underscoring the importance of learner involvement and attitude, Farooq and Shah (2008) further affirm that the contexts where learners interact with peers and with mathematical concepts are key points. This implies that learning mathematical concepts does

not only entail thinking and logic, but is also dependent on learner attitudes towards learning and methods applied in order to acquire mathematical concepts.

These findings require teachers to adopt instructional strategies and methods to improve the academic achievement of pre-school learners, particularly in mathematical activities. It is against this backdrop and the urgent need to ensure that all pre-school learners in Kirinyaga County fully develop their comprehension and application of mathematical concepts that this assessment of the suitability of the Cooperative Learning Method (CLM) as an instructional technique has been undertaken.

The Cooperative Learning Method (CLM), sometimes called small-group learning, is a learner-centric method to teaching. Johnson and Johnson (1999) refer to CLM as an instructional method in which small groups of learners with varying degrees of ability work together on carefully devised assignments or projects in conditions that guarantee knowledge construction and competences using a range of learning activities that assume certain criteria: positive interdependence, individual and group accountability, face-to-face interaction, suitable utilisation of collaborative skills along with effective group processing.

Johnson, Johnson and Stanne (2000) redefined these five key elements for effective small-group learning as: positive interdependence, face-to-face interaction, individual and group accountability, group behaviours and group processing. When undertaken according to these criteria, CLM is capable of producing enhanced effort and accomplishment, better behaviour and turnout, increased self-confidence and feelings of dependability, which in return have a significant influence on knowledge acquisition.

CLM entails grouping learners for instruction to maximise opportunities to learn, and the type of grouping can produce different results based on the circumstances (Shimazoe and Aldrich, 2010). Chester (2009) maintains that by learning in small groups, learners help each other to construct meaning and make sense of their learning. To gain maximum benefit from CLM, learners must work collaboratively towards meeting each individual group member's needs in order to successfully acquire and apply concepts, including mathematical concepts.

Because groups of learners, even at pre-school level, share classroom learning facilitation collectively, so that it is no longer the exclusive duty of the instructor, Gubbad (2010) states that CLM changes classroom learning dynamics. The CLM environment encourages discussion and eye contact, and learners gain direct experience of the interpersonal, social, and collaborative skills needed to work with others and, above all, to analyse their own and the group's ability to work together.

By the nature of its increased levels of interaction between the members of each group, CLM helps to reduce monotony and avoid boredom, in addition to improving competency, including for the acquisition of mathematical concepts. Abdulwahab, Oyelekan and Olorundare (2016) argue that CLM may also help to lessen the fatalistic attitude toward schooling that is often found among learners who have experienced repeated failure.

Each CLM group is accountable for meeting its specified learning aim, thereby making learners responsible for completing their part successfully. Mentz, Van der Walt and Goosen (2010) observe that, in some cases, each group member is individually accountable for part of the task; in other cases, group members work together without formal role assignments.

According to Altun (2015), cooperative learning groups should hold regular reflection meetings to evaluate their members' actions in relation to group goals, behaviours that need to change or continue, and the continuous improvement of group effectiveness and the learning process through analysis of how members are working and learning together. These reflections are important in identifying the strengths and weaknesses of the learning group in informing future planning.

Overall findings show that CLM improves the learning environment for the class community. Johnson and Johnson (2009) demonstrated that CLM has a positive effect on learning in comparison to more traditional, individualistic or competitive instructional methods, and other studies undertaken in a range of settings have had similar findings. When Herrmann (2013) studied the impact of cooperative learning on learner engagement at Aarhus University in Denmark, he found that learners increased their in-class participation following the introduction of cooperative learning in tutorials.

The comparison by Adebayo (2014) in the use of traditional methods and CLM in Zambia demonstrated that cooperative learning strategies achieved better results in improving learner competence. After examining the impact of the cooperative learning method on achievement in mathematics of high school students in Murang'a, Kenya, Kamau (2015) found that learners taught using CLM outperformed those receiving more traditional types of instruction. This leaves one asking whether this would be the case in pre-schools in Kirinyaga, Kenya.

Besides mathematical concepts being a researcher's area of interest, Kirinyaga county was an accessible research location to him and that enabled him to get adequate time that was needed

to conduct the required participant observation. He needed to be in the data collection cites (the sampled preschools) at the right time. Undertaking the study on pre-schoolers afforded the researcher an opportunity to observe more of natural learning behaviours; for they have less conducts to hide, even when they understand that they are being research subjects.

Nawaz, Hussain, Abbas, & Javed. (2014) cite Iqbar 2004, who studied the effects of cooperative learning on the academic achievement of secondary school students in Mathematics and concluded that cooperative learning is a far better teaching method for Mathematics and sciences compared to traditional methods. They conclude that teachers of Mathematics should be encouraged to incorporate CLM in their lessons; nevertheless, they emphasise that staff training for this should be carried out as a matter of course in order to ensure that this is achieved successfully (Nawaz et al., 2014).

Urgent action is essential to address the issue of really low levels of achievement in mathematical concepts, and to avoid undesirable repercussions in other curriculum areas which require a sound understanding and ability in them, in order to prevent high rates of school dropout as a result of learner frustration due to their academic performance.

1.2 Statement of the Problem

Kenya has not been immune to the decline in learner competences in mathematical concepts. It is essential to address this situation to halt the decline in academic achievement in Mathematics, particularly as the logical thinking skills necessary to succeed in Mathematics are also essential in many areas of education and daily life in order to solve problems as they emerge. It is apparent that levels of competency need to be raised for a large proportion of pre-school learners. If learners are to develop both their comprehension of mathematical

concepts and their competence in using these concepts inside and outside the classroom, greater focus must be placed on enabling them to become proficient in these skills.

Anobile, Cicchini and Burr (2012) recommend that teachers ought to focus instruction in pre-school on the basic skills that underpin competence in mathematical concepts at primary, secondary and tertiary education settings. Studies in recent years have highlighted that Kirinyaga County in Kenya is no exception to the current decline in learner competence in mathematical concepts, hence its selection for this research. A report by Uwezo (2010) indicated that 60% of learners in public pre-schools in Kirinyaga County lacked comprehension of the elementary mathematical concepts and were unable to perform basic operations in mathematical activities. A subsequent survey, also undertaken by Uwezo (2012), found that seven in ten learners in standard three classes in Kirinyaga County were unable to do standard two class mathematical problems; and 34% of the learners in class three were unable to carry out simple tasks to prove their basic numerical skills.

Furthermore, the Kenya Primary Education Development PRIEDE Baseline and Midline Early Grade Mathematics Achievement surveys in 2016 and 2018 noted that Kirinyaga County registered the third highest decrease (20.4%) after Nyamira and Bomet counties. The PRIEDE surveys targeted standard two class and sought to determine the level of numeracy competence of Early Year Education learners in order to assess the pedagogy used in the same classes and identify areas that required improvement.

The areas of mathematical operations that the PRIEDE surveys identified as requiring improvement were: number recognition, number patterns, number values, addition and subtraction. These automatically affect learners' achievement in other mathematical

operations throughout their education and beyond; notwithstanding that mathematics is a requirement in all the academic pathways in order to equip learners fully for the future.

The current Competency-Based Curriculum (CBC, 2017) for Early Years Education highly recommends the use of CLM as well as communication and collaboration as core values to be incorporated into lesson delivery. At present, in many parts of Kenya, extra-large class sizes, lack of suitable learning resources and adequate facilities are likely to encourage the use of teacher-centred methods.

Overall findings of Uwezo and PRIEDE appear to indicate that in order to address the pedagogical gap, pre-school teachers should adopt CLM as a mitigant to low grades in the acquisition of mathematical concepts. One of the benefits of CLM is that it shifts the focus in classrooms from having the teacher centre-stage imparting knowledge to pupils, as is often the case at present in many classrooms in Kirinyaga County, to a learner-centred environment where learners communicate and collaborate, with the result that they play a much greater role in constructing their own knowledge.

Nevertheless, despite the assertions of its benefits, introducing CLM into classrooms has been a difficult task in many areas of Kenya due to inadequate teacher training, experience and exposure in using CLM for teaching mathematical concepts. Efforts, including teacher inductions through a series of workshops on the use of learner-centred learning methods under the umbrella of the TUSOME programme in order to alleviate these challenges, have borne little fruit and have so far been unsuccessful in improving learner levels of achievement.

1.3 Purpose of the Study

This study has been undertaken in order to explore effect of Cooperative Learning Method on achievement of pre-schoolers' competences in mathematical concepts in Kirinyaga County, Kenya

1.4 Specific Objectives

This study was undertaken with the objectives to:

i. Establish the difference between the mean score index of pre-school learners taught by a teacher who facilitates learning using the Cooperative Learning Method (CLM) and those taught by a teacher who does not.

ii. Establish the difference between the mean score index of pre-school learners taught by teachers with favourable and unfavourable attitudes towards CLM.

iii. Assess the difference between the mean score index of pre-school learners with favourable and unfavourable attitudes towards CLM.

1.5 Research Hypotheses

The study sought to investigate the following hypotheses:

i. There is no significant difference between the mean score index of pre-school learners taught by a teacher who facilitates learning using the Cooperative Learning Method (CLM) and those taught by a teacher who does not.

ii. There is no significant difference between the mean score index of pre-school learners taught by teachers with favourable and unfavourable attitudes towards CLM.

iii. There is no significant difference between the mean score index of pre-school learners with favourable and unfavourable attitudes towards CLM.

1.6 Significance of the Study

The findings of this study are expected to help policy makers in enhancing competence in mathematical concepts and literacy among graduates at various levels of education in Kenya and other countries. Application of the findings may benefit education policy makers in their work towards raising standards of competence in mathematical concepts, particularly in the pre-school sector. The study also seeks to assist these decision makers in making and applying new policies regarding the provision of the most suitable resources to aid teaching and learning in mathematical activities.

Early Years Education forms the foundation of schooling for all other levels of education. This fact singles out pre-schoolers as the key beneficiaries of this study. This is especially given to the paradigm shift in pre-schooling; with the introduction of competency-based curriculum. The study sheds light on the implementation progress of Curriculum Based Curriculum for Early Years Education in Kenya.

Teachers and other education stakeholders are likely to benefit from the study by applying the findings to help to improve learner retention of mathematical concepts, supporting different learning needs and devising strategies to include learners who would otherwise not have the opportunity to participate in lessons. Teachers and instructors could also benefit from pre-prepared lesson plans to enhance the facilitation of mathematical concepts to enable learners to quickly gain competence in taught content. Pre-school teachers could benefit from the study in gaining new insight into their knowledge of teaching and learning of mathematical activities in pre-schools.

The findings of the study are also likely to benefit the wider education community by increasing awareness, engagement and action that would enable them to work together to raise standards in learners' performance in mathematical activities and for schools in general. This study could also form a foundation for academics to conduct research in a related area.

1.7 Limitations of the Study

Measures to curb external validity could not be overlooked. The results of this study can be generalised for past or future situations. It is recommended that a study be undertaken to determine whether the results would be repeated in other situations.

The sampled respondents may not be truly representative of the total target population. However, the sample was as inclusive as possible to guarantee maximum representation.

1.8 Delimitations of the Study

This study was confined to Pre-Primary Two (PP2) classes in the 197 public pre-schools in Kirinyaga County: Mwea West (34), Mwea East (41), Kirinyaga West (42), Kirinyaga Central (35) and Kirinyaga East (45). It did not include private pre-schools because of the generally held view that the average competence in mathematical concepts of private pre-school learners tends to be better than that of their public pre-school counterparts.

In the public pre-schools studied, there were a total of 14,412 learners: 7,324 boys and 7,088 girls. 447 pre-school teachers participated in the study: 9 males and 438 females. Data was collected from learners and their teachers by means of mathematical concepts achievement test results, teacher questionnaires, observation schedule, and documentary analysis schedule.

The study results may not be generalised to other pre-schools in other regions, as other dynamics could affect competences in mathematical concepts among pre-school learners other than the use of CLM. Consequently, the recommendation is that further studies be conducted on competences in mathematical concepts among pre-school learners, but focussing on other teaching methods and dynamics than CLM.

1.9 Basic Assumptions of the Study

CLM plays a key role in promoting competence in pre-school learners' acquisition of mathematical concepts; it creates a more inspiring setting for learning, due to effective teacher facilitation, favourable teacher and learner attitudes, with the result that, higher evaluation grades are more likely to be associated with CLM.

Also, the study assumed that learning mathematical concepts in early life is critical for future learning in mathematics, as well as in other subjects. Therefore, responsibility for developing competence in mathematical concepts and later academic success lies not only with the learner but also with those teaching them, who must adopt teaching and learning methodologies that support growth and achievement in these competences. In this regard, the study assumed that all teachers participating in the study were competent in using the methods of assessment defined by the Competences-Based Curriculum (CBC) introduced in 2017.

1.10 Operational Definition of Terms

Competence: An individual learner's capability to perform a specific task

Competency Based A revised system of education in Kenya launched in 2017

Curriculum (CBC):

Cooperative Learning Method (CLM):	A teaching technique in which learners work collaboratively in small groups on task-based activities, specifically mathematical ones in this study, in order to achieve a common objective
Learner:	An individual studying in education, in this study, specifically a Pre-Primary Two class pupil, normally aged five years.
Learner attitude:	The response of pre-school learners to CLM, taking into account their motivations, interests, feelings, beliefs, likes and dislikes regarding CLM for helping them to improve their achievement in mathematical activities
Mathematical activity:	A class-based activity that involves number work
Mathematical concepts achievement:	The level of outcome of pre-school learners in specific mathematical subjects
Mathematical Concepts Competence Acquisition (MCCA):	The acquisition of understanding of pre-primary mathematical concepts by pre-school learners which leads to their being able to demonstrate that they can use these concepts competently in practical situations, for example, identifying a given number of objects and then adding this number to a set of other objects
Mathematical Concepts	An assessment designed for the purpose of this study to

Competences Achievement Test (MCCAT):	measure how well a sample group of Pre-Primary 2 teachers ensured their learners' acquisition of competence in a defined set of mathematical concepts
Pre-Primary Two (PP2):	Second level of pre-school education for children age five years
Pre-school:	Pre-Primary Two school education for learners aged 5 to 6 years old
Kenya Primary Education Development (PRIEDE):	A project funded by the World Bank intended to improve early grade mathematics competency in Kenya
Teacher attitude:	The response of pre-school teachers to CLM, taking into account their motivations, interests, feelings, beliefs, likes and dislikes regarding CLM as a method for improving their learners' achievement in mathematical activities
Teacher facilitation:	Activities which pre-school teachers undertake to make CLM effective, including planning, organising and facilitating of the learning process
Traditional teaching methods:	Didactic teaching strategies focused on expository techniques, such as lecture, demonstrations, questioning and answering

1.11 Organisation of the Study

This study is organised in five chapters. The first chapter provides the background to the study and the statement of the problem, followed by the purpose, objectives, research hypotheses, significance, delimitation, limitations and basic assumptions of the study, as well as a glossary of significant terms. Chapter Two consists of a review of related literature based on the research objectives, citing research and knowledge gaps to be filled, along with the theoretical and conceptual framework for the study. Chapter Three contains the research design, target population, sampling procedures and sample size, research instruments, validity of research instruments, reliability of research instruments, procedure of data collection, data analysis, and ethical considerations and operationalization of variables. Chapter Four presents the research. Finally, Chapter Five summarises, concludes and recommends pertinent aspects arising from the study.

CHAPTER TWO
REVIEW OF RELATED LITERATURE

2.1 Introduction

The purpose of this literature review is to provide a critical analysis of the concept of the Cooperative Learning Method (CLM) in pre-schools; to examine study and research in this area undertaken previously by other academics in order to identify key concepts and themes from scholarship which inform and influence this research concerning the effect of CLM on the acquisition of competence in mathematical concepts by pre-school learners, including the effect of the teacher's facilitation role in CLM, as well as teacher and learner attitudes to CLM. Theoretical and conceptual frameworks guiding the study are also presented.

2.2 Cooperative Learning Method (CLM) in Pre-schools

As an amplification of the explanation given in Chapter 1, Alshammari (2015) defines the Cooperative Learning Method (CLM) as a teaching method where small, manageable groups of pre-schoolers work together as a team on a common task, which can be as simple as solving a multi-step mathematical problem or as complex as developing a design for a new kind of school. Using CLM for mathematical activities, small groups of learners make use of a variety of criteria, such as social skills, academic skills, pre-school learner interests and instructional objectives, in order to work towards improving each individual's academic achievement in mathematical concepts. Felder and Brent (2012) highlight the fact that CLM makes use of the personal experiences of others in addition to those of the individual learner.

Shimazoe and Aldrich (2010) recommend that for CLM to achieve maximum effect, pre-school learners should work cooperatively in groups of four, taking turns when talking, and their teachers should model positive interpersonal skills, ensure that all the pre-school

learners practise the skills, and encourage them to reflect on how effectively they are performing the skills. Tan, Lee and Sharan (2016) note that pre-school learners should understand the objectives, instructional tasks, and criteria for success and the teacher should review and assign roles to learners in order to smooth the transition to CLM groups.

Slavin (2015) recommends that once groups have been determined, instruction, the most important phase in CLM, should begin and it should be based on solid content, with grouping of the learners used to enhance and customise their learning. Furthermore, during instruction, teachers should monitor groups and reinforce collaborative behaviours, conduct observations, assess social skills, and interview their learners (Tan et al., 2016). This enhances the concept of CLM as an instructional method in which groups of learners work together with the aim of maximising their own and each other's learning in the pursuit of a common objective.

Angadi and Darga (2015) observe that although implementing full-scale CLM in pre-schools in Nigeria has not been a simple task, cooperative learning strategies give learners opportunities to do Mathematics by themselves, speak their thoughts, offer and receive explanations, introduce several procedures for solving mathematical problems and therefore enables them to profit from the mathematical knowledge available in the group as a whole.

When pre-school learners interact, they are exposed to different relationships, such as giving and receiving help, expressing their point of view, learning about others' perspectives, looking for new ways to clarify differences, solving problems, and formulating renewed understanding and knowledge. In other words, CLM necessitates mutual group help in solving basic tasks in mathematical concepts, the sharing of materials, discussion on a topic,

production of a common product, and the fulfilment of the tasks necessary to achieve the group aim.

Parsons and Ward (2011) and Slavin (2015) assert that pre-school learners using CLM have more opportunities to actively participate in their learning, question and challenge each other, share and discuss their ideas, and internalise their learning. At pre-school level this is considered as a very good developmental milestone of learners' cognitive abilities. Besides improving the learning of mathematical concepts, CLM enhances the engagement of pre-school learners in thoughtful discussion and helps them to examine concepts from a variety of perspectives.

Evidence also appears to indicate that CLM increases pre-school learners' self-esteem, motivation and empathy. Njoroge and Githua (2013) assert that the results of positive cooperative experiences lead to higher level thinking and analytical skills in mathematical concepts, greater attempts within the group at achieving successful working relationships, and enhanced psychological wellbeing. Furthermore, when pre-school learners notice the value of their input and effort in CLM, this fosters a more internal locus of control and belief in their own ability, in addition to the embedding of social and work skills.

2.3 Mathematical Concepts Competence Acquisition (MCCA) and the Role of CLM in Pre-schools

Chen and Li (2014) maintain that individuals display numerical competence almost from the day they are born and that, even when they were less than six months old, some individuals have shown they are able to perform a rudimentary kind of addition and subtraction. These abilities suggest that number is a fundamental component of the world that children know.

Whether and how this early sensitivity to number affects later achievement in mathematical activities remains to be demonstrated, but it is evident that children enter the world prepared to notice number (including numerals) as a feature of their environment.

Mathematical concepts competences taught in pre-school are intended to provide the foundational learning that children need in order to thrive from their early years, through all levels of their education and beyond. At pre-school level, these concepts include number sense, learning of numbers through representation or pictures, counting, ordering, geometry and performance of basic operations, such as addition and subtraction. Anobile, Cicchini and Burr (2012) recommend that teachers ought to focus instruction in pre-school on the basic skills that underpin competence in mathematical concepts at primary, secondary and tertiary education settings, and that right from pre-school through elementary or primary school, learners should be preparing the groundwork for future life skills.

In their study entitled 'Why do early mathematics skills predict later mathematics and reading achievement? The role of executive function' Blair and Razza (2007) assert that pre-school education should introduce simple mathematical concepts, and that, by introducing children to pre-school mathematical concepts from the age of three onwards, teachers are able to make elementary learning more relaxed and help their learners to acquire competence more easily. Furthermore, Blair and Razza (2007) identify the sense of numbers as the critical mathematical concept that learners should acquire prior to reaching school and this key ability should be emphasised and developed during learning. Learners need to acquire the skills of counting forwards and backwards in early childhood in order to make it easier for them as they learn the connection between facts involving figures.

Similarly, in China, Chen and Li (2014) assert that while kindergarten classes review the basics of counting forward and backward, pre-school educators can set a stronger foundation by focusing on learning to count before reaching elementary school. By focusing on number sense, teachers are providing skills in mathematical activities that are necessary for future concepts and advanced calculations. This is consistent with the assertion by Fuhs and McNeil (2013) that pre-school mathematical education should focus on learning the basics of counting by representing numbers with items, pictures, such as apples or favourite fruit, or even family members, to help learners to recognise that the number represents whatever is depicted. According to Fuhs and McNeil (2013), teaching through representation or pictures enables learners to make connections between the real world and the mathematical activities skills that are vital for academic success. Without making a connection between real life and mathematical activities, learners can become confused about the information that they receive in the classroom.

In their study on Long-term relevance and interrelation of symbolic and non-symbolic abilities in mathematical-numerical development in Kuala Lumpur, De Smedt, Noël, Gilmore and Ansari (2013) reach a similar conclusion that much of pre-school learners' knowledge about number centres on the development of their understanding and mastery of counting. Furthermore, they maintain that number counting of a set of objects is an intricate undertaking comprising intellect, observation, and movement, where much of its complication is concealed by familiarity. Counting necessitates mastery of a symbolic organisation; it is a competence with a complicated set of procedures that entails pointing at objects and labelling them with symbols, and accepting that some aspects of counting are simply conventional, while others lie at the heart of the practicality of mathematical concepts.

In many countries in Sub-Saharan Africa, mathematical concepts competences rank highly in comparison to other disciplines in pre-schools and any learner who manifests excellence in such skills is considered to have high levels of cognitive abilities. For example, in Nigeria, Ojedapo, Fazio, Bailey, Thompson and Siegler (2014) note that a pre-school learner who scores above 75% in any mathematical concepts test is considered to be excellent in mathematical concepts. However, despite these findings, Ojedapo et al. (2014) observe that many pre-school learners still lack competence in many mathematical concepts. Counting is one of the mathematical concepts where these learners exhibit poor skills.

In Kirinyaga County, as elsewhere, mathematical concepts competences acquisition (MCCA) is critical to every pre-school learner's success. However, in many instances, pre-school learners' competence in mathematical concepts is extremely low. Based on the recommendation made by Uwezo (2010), it is important that teachers should adopt teaching methods which are learner-centred. Adams (2013) demonstrates an increase in academic achievement in learners who have acquired their subject knowledge through the use of CLM. However, the effectiveness of the key elements of CLM in enabling pre-school learners to achieve competence in mathematical concepts has yet to be fully examined and more still needs to be done to assess the level to which teachers' use of CLM influences pre-school learners' MCCA.

This section highlights research that shows an increase in academic achievement through the use of CLM. However, the effectiveness of its key elements in enabling pre-school learners to achieve competence in mathematical concepts has yet to be fully examined and more still needs to be done to assess the level to which teachers' use of CLM influences pre-school learners' MCCA.

2.4 Teacher Facilitation of CLM for MCCA in Pre-school Learners

Pre-school teachers play an imperative facilitation function in CLM and many of them use it or use a group-work learning strategy to boost their learners' competences in basic numeracy concepts. Whether the aim is to boost pre-schoolers' understanding of learning content, to construct careful transferable skills, or a combination of both, teachers routinely turn to small group work to make the most of the returns of peer-to-peer teaching.

Johnson and Johnson (2014) note that this cooperative instructional group work involves pre-school learners working collectively to make the most effective use of their own and each other's learning to support mutual development. In other words, CLM requires positive interdependence, where pre-school learners observe that improved achievement by individual learners results in improved performance for the whole group (Johnson and Johnson, 2014). It can either be formal or informal, but regularly demands precise teacher involvement to take full advantage of pre-school learner interaction and mutual learning. This gives learners control over their learning and allows to learn at their pace.

Rudhumbu (2014) observes that teachers in Zimbabwe have adopted CLM to make teaching of mathematical concepts effective amongst pre-school learners and that in doing so, they have changed the focus of classrooms from being teacher-centred, where teachers impart knowledge to learners, to learner-centred where learners are expected to play a more active part in the process of their own knowledge construction. Mentz et al. (2010) also maintain that CLM changes pre-school learners' and teachers' roles in classrooms.

In addition, Mentz et al. (2010) observe that ownership of teaching and learning is shared by groups of pre-school learners, and is no longer the sole responsibility of the teacher but also

of the learners. The authority of setting goals, assessing learning, and facilitating learning remains with the teacher, although it is shared by all. Slavin (2015) notes that in classes in Mexico where learning takes place using CLM, ultimate responsibility for setting goals, facilitating and assessing learning still lies with the teacher.

A study on 'Intragroup Conflict among Caribbean Students in Higher Education while engaging in Group Work' carried out by Shimazoe and Aldrich (2010) note that delivery of learning using CLM may present a few challenges for teachers in the classroom, which include releasing management of learning, controlling noise levels, resolving conflicts, and assessing what pre-schoolers actually learn from the process. Their recommendation for avoiding problems which might otherwise arise is to ensure thorough preparation beforehand. This should include well thought-out activities that enable pre-school learners to acquire the skills to work collectively effectively, as well as arrangements for controlled discussion and reflection on the group process.

Consequently, the role of the teacher as a facilitator (as opposed to being an instructor) is extremely important for ensuring that CLM has maximum impact on MCCA for pre-school learners. King (2012) established that teachers are critical factors in the implementation of CLM, as they define learning objectives for the activity and assign learners into groups, paying particular attention to the skills they will need for success in the task. Within the groups, King (2012) noted that pre-school learners may be assigned specific roles, with the teacher communicating the criteria for success and the types of social skills that will be needed.

Turner and Patrick (2014) observe that teachers in many pre-schools in India define tasks for group members in collaborative pedagogy in mathematical activities classes. Teachers design and define the roles that are needed with respect to learning goals to be achieved and the group dynamics that are desired; they also explain roles to the learners and design activities that capitalise on outcomes within groups, between groups and at the class level. Roles can be designed to trigger specific socio-cognitive processes and may be given out for shorter activities or longer ones that can span over a period of several hours (Turner and Patrick, 2014).

When encouraging kindergarten teachers in Kuala Lumpur to embrace group learning strategies, Capar and Tarim (2015) emphasise that the teacher's role is to set the goals for each exercise, such as completing an assignment. This requires structuring groups by selecting learners who not only work well together, but who also have the range of strengths needed to reach objectives.

In order to structure the CLM learning environment effectively, teachers need to understand how to structure classroom organisation features beyond merely establishing CLM learning groups. They should also ensure appropriate coordination of learning activities, provide the most appropriate learning resources, take sufficient time when undertaking CLM activities and interact with learners during the learning activities (Johnson and Johnson, 2005). Akinoglu (2014) argues that for CLM to be most effective as a teaching tool in pre-schools, teachers need to be completely familiar with it in order to apply it in the classroom to enable their learners to acquire the requisite skills for competency in mathematical concepts.

In keeping with these findings, Lou, Abrami, Spence, Poulsen, Chambers and d'Apollonia (2013) conducted a study in Austria on Cooperative Learning: Developments in Research, which found that teachers using CLM continue to play an active role in the classroom while the groups work, by monitoring learners' work and evaluating group and individual performance. In addition, Lou et al. (2013) demonstrated that teachers also give confidence to the groups of learners, which enables them to reflect on their interactions in such a way that they recognise potential improvements for future group work. Ngusa et al. (2018) found that teachers who use cooperative groups have their pre-school learners able to choose a set of criteria to classify mathematical properties, such as geometric figures, and then explain their criteria to other groups. This indicates that, due to the nature of CLM, the role of the teacher changes from instructing by providing information to their students to facilitating learning allowing students to develop greater autonomy and to become more independent learners.

However, despite the well-documented benefits of CLM in teaching mathematical activities in pre-schools, implementing this pedagogical practice in classrooms, or indeed any of the structured peer-mediation programs, in many countries in Sub-Saharan Africa is a challenge and many pre-school teachers find it difficult to accomplish (Adebayo, 2014). In Nigeria, for example, Kalawole (2007) asserts that difficulties may occur because elementary school teachers often do not have a clear understanding about how to establish effective cooperative groups, the research and theoretical perspectives that have informed this method, and how they can translate this information into practical classroom applications as a strategy for improving academic achievement in mathematical activities among pre-school learners. This is indicative of the fact that embarking on CLM and conducting mathematical learning

sessions demands a dedication to articulating the procedures specified in the curriculum and in implementing, monitoring and evaluating them.

According to Njoroge and Githua (2013), pre-school teachers have the task of providing a brief historical overview of the theoretical underpinnings of CLM and then highlighting the key role social interdependence plays in establishing a stable group structure that motivates all of the group members to work together, to build quality relationships and to actively support each other's learning. In Kenya, including in Kirinyaga County, pre-school teachers play a vital function in enhancing the exchange of ideas by pre-school learners, as well as encouraging them in the learning progress.

Nevertheless, from the research that has been undertaken to date, there is a lack of information about pre-school teachers' verbal behaviours when they use CLM in the classroom and the degree to which they use CLM in order to increase pre-school learners' competence in basic numeracy skills Ngusa et al. (2018) note that further research is required to identify the degree to which teachers' use of CLM influences MCCA in pre-school learners. Furthermore, none of the empirical studies to date indicate how pre-school teachers can promote discussion of mathematical concepts competences among their pre-school learners and how, in turn, their pre-school learners can help each other.

This section's review identifies the current lack of information about a) the extent to which teachers use CLM in order to increase pre-school learners' competence in basic numeracy skills and how teachers' use of CLM influences MCCA in pre-school learners; b) teachers' verbal behaviours when using CLM; c) how pre-school teachers can promote discussion of

mathematical concepts competences among pre-school learners; and d) how pre-school learners can assist each other in learning during classes using CLM.

2.5 Teacher Attitude to Using CLM in Relation to MCCA in Pre-school Learners

Teachers' attitude is a significant factor in adopting any method of teaching in Mathematics classes. According to Abrami, Poulsen and Chambers (2014), teacher attitude is generally considered to be relatively positive. Furthermore, a positive attitude towards mathematical activities mirrors a positive emotional outlook with respect to the activity area and, equally, a negative attitude towards mathematical concepts competences corresponds to a pessimistic emotional disposition (Abrami et al., 2014).

These emotional dispositions have an impact on a teacher's behaviour, since teachers are most likely to adopt the method of teaching which they prefer, which is generally the one that they find helpful and that they feel confident in delivering (Abrami et al., 2014). This is particularly important in the area of attitudes towards instructional methods designed to deliver MCCA. In this regard, it is essential that teachers should have a positive attitude so that they are willing to use the most effective methods.

CLM is no exception and its successful adoption in pre-schools depends on the attitude of all the teachers involved in its delivery. Various studies have demonstrated that effective use of CLM is dependent on teachers' intentions, personal beliefs and attitude to teaching and learning for MCCA (Broussard and Garrison, 2011).

Cavas, Cavas, Karaoglan and Kisla (2010) conducted a study in Egypt on Teacher attitude towards the use of CLM. Their study established that learners whose teachers have a positive attitude towards any teaching method, such as the use of CLM, perform well in basic

numeracy skills. In a study of 11 teachers in Indonesia, Farrow as cited by Muthusi (2019) identified that among the factors that influence successful adoption of CLM in teaching basic arithmetic skills is the teacher's attitude and beliefs. In other words, if the teacher's attitude is positive towards employing CLM, then they are more likely to adopt it for teaching their learners.

Thanh (2011) conducted a similar study on teacher attitude to the use of CLM in Vietnam, using a questionnaire to collect data from 79 teachers in different elementary schools. The study revealed that although barriers existed, such as lack of certain resources, teachers' positive attitude towards CLM was an important determinant in the successful adoption of CLM in teaching mathematical activities, syllabus coverage and pre-school learners enhanced academic achievement in mathematical activities.

On the other hand, a study by Ogbonnaya (2007) of 75 teachers in Lesotho on 'The power of a teacher in classroom organization and management' identified that their reluctance to embrace CLM may have been due to the lack of time to learn about peer-mediated approaches, because of the challenge perceived that it might pose to their control of the learning process, the demands it places on classroom organisational changes or the professional commitments required to sustain their efforts. According to Gillies and Boyle (2010), if pre-school teachers perceive that CLM does not meet their needs or those of their learners, it is possible that they will not adopt the method for instructing mathematical concepts.

When Tan, Lee and Sharan (2016) conducted a survey of 139 pre-service teachers about their attitudes to the use of CLM in pre-schools in Singapore; the questionnaire they used sought

to identify four factors: affect (liking), perceived usefulness, perceived control and behavioural intention to use the method. In their findings, Tan et al (2016) noted that the teachers who responded to the survey were less positive in their attitude to CLM, and this was also the case in terms of their willingness to use it to teach mathematical activities in pre-schools and as a strategy for improving academic achievement in the assessment of mathematical activities for pre-school learners.

Research in Sub-Saharan Africa has shown that the attitude that pre-school teachers have towards CLM influences their acceptance of the usefulness of CLM in the teaching of mathematical activities in pre-schools (Worth, 2010). In a similar study conducted in Tanzania, Broussard and Garrison (2011) established that the more experience that teachers have with teaching methods such as CLM, the more likely that they are to exhibit a positive attitude towards it. More specifically, these findings show that a positive attitude on the part of teachers fosters their use of CLM in the teaching of mathematical activities in pre-schools.

In Ethiopia, Mikre (2011) found that teachers' attitude is a key determinant in their use of the elements of CLM in teaching mathematical activities and that unwillingness to use CLM in the classroom is primarily based on the risk they perceive in losing influence over the values and directions of classroom activity. The teacher's attitude is communicated verbally and nonverbally and, by whichever means, it influences classroom climate, learners' motivation and, ultimately, learners' learning.

The scenario is much the same in Kenya, with studies indicating that teacher attitude to CLM and other hands-on learning methods greatly influences whether or not a pre-school teacher will use any of these methods for the teaching and learning of mathematical concepts.

Muriithi (2013) and Kamau (2015) identified that a considerable number of teachers have a negative attitude towards hands-on teaching methods, such as CLM, as a strategy for enhancing subject competency in their learners. Among the reasons identified for avoidance of these teaching methods were anxiety, self-efficacy, dislike, perceived lack of usefulness, as well as teachers' lack of enthusiasm or confidence.

In Kirinyaga County, Kenya, in his study on effects of cooperative learning method approach on competences achievement of secondary school learners in mathematical activities, Kamau (2015) found that teachers' attitude and beliefs regarding teaching and learning methods are among the dynamics that influence successful use of CLM in pre-schools. Where pre-school teachers have a positive attitude regarding the use of instructional CLM, then they readily incorporate it into their teaching and learning processes. On the other hand, where teachers have a negative attitude to CLM, this becomes a key obstacle to successful use of CLM as a strategy for enhancing MCCA for pre-school learners. This ground obliges the researcher to unearth this premise with regards to facilitation of mathematical concepts competences in Kirinyaga pre-schools.

Abdulwahab et al. (2016) recommend that if pre-school teachers start with periodic lessons or units that use CLM and then begin to incorporate CLM progressively into their teaching delivery, the teachers are more likely to develop a positive attitude to CLM as a method of instruction.

The indication from the above findings is that where pre-school teachers have a learner-oriented pedagogical method, a positive attitude towards CLM, combined with exposure to and familiarity with CLM, in addition to their own professional development, these will all

have a direct positive influence on the innovative use of CLM by teachers. Nevertheless, none of the empirical studies reviewed have examined how a favourable or unfavourable attitude on the part of teachers to the components of CLM may affect MCCA in pre-school learners.

The findings of this section indicate that learner-oriented pedagogical methods, a positive teacher attitude towards CLM, exposure to and familiarity with CLM, in addition to teachers' own professional development, all have a direct positive influence on the successful implementation of CLM by teachers in pre-schools. Despite the evidence presented by Kamau (2015) to demonstrate that teachers' attitude and beliefs towards teaching and learning methods are among the dynamics that influence successful use of CLM in schools and that a negative teacher attitude to CLM is likely to be a major obstacle to using CLM in the classroom as a strategy for enhancing MCCA for pre-school learners, none of the empirical studies reviewed have examined how a favourable or unfavourable attitude on the part of teachers to the components of CLM may affect MCCA in pre-school learners.

2.6 Pre-school Learner Attitude to CLM for MCCA

In addition to the requirement for teachers to have a positive attitude when they are teaching, a positive attitude on the part of pre-school learners is also a requisite for the promotion of a positive learning environment that enables MCCA for all pre-school learners. In other words, pre-school learners who are motivated believe in group work, in sharing and in appreciating the efforts of their peers, tend to perform well in assessments of their competence in mathematical concepts.

Coolahan et al. (2000) established that positive learning behaviours are associated with positive classroom peer engagement and interaction. In contrast, Fantuzzo, Bulotsky, McDermott, Mosca and Lutz (2003) found that learners displaying early withdrawal problem behaviours registered the poorest learning outcomes. Fantuzzo, S et al. (2004) support this view and maintain that in the context of classroom social interaction, interest and a positive attitude to learning are key factors in remaining on task and displaying appropriate classroom behaviour. Downer and Pianta (2006) propose that learners' early social competency creates a connection between their early experiences and later academic achievement.

Cooperative learning can have a positive effect on learning achievement in a number of areas, in particular the cognitive, social and affective domains (Gomleksiz, 2007). Besides improving academic learning, CLM helps pre-school learners to examine different perspectives through reflective discussion with peers. To coordinate efforts to achieve mutual goals, participants must get to know and trust each other, communicate accurately and unambiguously, accept and support each other, and resolve conflicts constructively (Johnson and Johnson, 2009).

Downer and Pianta (2006) found that CLM boosts pre-school learners' self-esteem, motivation and empathy, although the degree to which teachers used CLM to advance pre-school learners' competences in basic numeracy skills was yet to be fully assessed. However, Jolliffe (2007) proved that systematic and frequent use of small groups in lessons has a profound positive impact on the learning environment, with the result that the classroom becomes a community of learners who are actively working together in small groups to enhance each other's mathematical knowledge, proficiency, and enjoyment, both individually and collectively.

It is important to note that in CLM the small groups of learners do not compete with each other as teams; on the contrary, learners within each small group work collaboratively to link achievement to effort, which is a very important factor in motivation. For any one group to succeed in their task, it requires individual member improvement. Han and Carpenter (2014) state that pre-school learners who feel confident in forming groups and undertaking mathematical activities tasks with peers are far more likely to be successful in mathematical activities, which is regarded as a positive behaviour. In other words, a key attitudinal dimension in using CLM amongst pre-school learners is confidence, and this has been identified as critical to effective numeracy development (Han and Carpenter, 2014).

The use of cooperative learning strategies results in improvements both in the achievement of learners and in the quality of their interpersonal relationships (Gomleksiz, 2007). Classrooms where these learning strategies are implemented are then enabled to maximise the active participation of each learner and to reduce the isolation of individuals (Paulsen and Chambers, 2004). The positive impact of CLM may be reflected in enhanced academic achievement and self-esteem; improved social interaction and inter-group relations; acceptance of and building positive attitudes to school, classmates and education, including Mathematics (Siegel, 2005).

Attitude and interests play a substantial role in the way in which pre-school learners study mathematical activities. These are exhibited in learners' beliefs, feelings, emotions and intended behaviours. This implies that they may exhibit a favourable or unfavourable evaluative reaction to teaching methods adopted by their teachers. Farooq and Shah (2008) submit that pre-school learners' attitude to CLM can be seen as either positive or negative.

Han and Carpenter (2014) observe that positive learner attitudes generally derive from their feelings or interest and in many cases, this is influenced by the warmth, empathy and friendliness of their teacher. This in turn will have an impact on the cognitive, affective and behavioural reactions that learners display towards their teacher's instructional method and approaches. Conversely, a negative emotional classroom atmosphere leads to more negative learner attitudes, which in turn are linked to lowered learning achievement.

According to Farooq and Shah (2008), one of the most significant factors affecting learners' academic success in mathematical activities is their attitude to school, lessons and academic success. In the same manner, pre-school learners' attitude plays a critical role in determining the kind of teaching methods which teachers adopt for mathematical activities.

When emphasising the importance of learners' experiences, Farooq and Shah (2008) further affirm that learners' attitude and the contexts where learners interact with others and with mathematical activities become important focal points. It is evident that learning does not only involve thinking and reasoning, it is also dependent on the attitude of the learners towards learning and the learning methods used, particularly for mathematical activities.

In their review of New Zealand's implementation of the mathematical activities' curriculum for pre-school learners, Kele and Sharma (2014) noted that although the majority of pre-school learners have a positive attitude towards learning mathematical activities, it appears that an increasing proportion of pre-school learners lose interest in the subject from a fairly young age, with an accompanying decline in their achievement. Conboy and Fonseca (2009) stipulate that for the use of CLM in teaching and learning of mathematical activities to be interesting and stimulating, there has to be motivation on the part of the pre-school learner in

order to ensure the achievement of a positive attitude and subsequently to achieve at the highest academic level in mathematical activities.

In Australia, the relationship between and among beliefs, attitude and feelings towards CLM in teaching mathematical activities and academic achievement in mathematical activities has been the focus of a number of studies (Ingram, 2015). For example, Ingram (2015) reported a positive correlation between the perceived usefulness of CLM in teaching mathematical activities and the academic achievement in mathematical activities among pre-school learners. By virtue of CLM promoting collaboration and reducing competition, the CLM learning group's goal is established for the team as a whole in a way that motivates learners to help each other and provide a stake in one another's achievement of success.

In their study of pre-schools in KwaZulu Natal Province in South Africa, Stipek, Givvin, Salmon and MacGyvers (2013) noted that learners generally have a positive attitude towards teaching methods, especially methods which incorporate hands-on activities. Of special interest, Stipek et al. (2013) found that pre-school learners who show a keen interest in learning using CLM scored high grades in assessments of their mathematical concepts competences.

Findings reported by Sanchal (2016) in a study of 53 pre-school learners in Moscow demonstrated that pre-school learners' attitude to CLM was influenced by the classroom practices adopted by their teachers of mathematical activities, and a study of 13 teachers of Mathematics in schools in Austria by Mensah, Okyere and Kuranchie (2019) demonstrated that learners' attitude to CLM is a critical factor in the effectiveness of CLM as a strategy for ensuring improved academic achievement in mathematical activities among pre-school

learners. These findings indicate that the relationship between pre-school learners' beliefs, interests and their teacher's teaching ability supports and consolidates existing learning theory that learners cannot acquire competency in the subject being taught unless their teacher has a keen interest in the teaching method that they use as the means of instruction.

In Kenya, notably in Kirinyaga County, there is recognition that pre-school learners' sense of efficacy and their attitude and belief in their teacher's use of CLM is important in relation to the adoption of CLM for teaching mathematical activities. Since CLM is based on a learner-oriented perspective, it encourages teachers to make learning about mathematical concepts more interesting, which consequently necessitates more effective organisation and better planning of lessons. This in turn has an impact on the interest, motivation and attitude of pre-school learners in the classroom and results in much improved grades in assessments of their abilities in mathematical concepts (Kamau, 2015).

In a study conducted in Nigeria into the effects of concept mapping and cooperative mastery learning strategies on learners' attitudes to instructional strategies and their subsequent subject achievement, Angura and Abakpar (2018) established that where pre-school learners have a positive attitude to their teacher's use of CLM for teaching mathematical activities, this enhances the learners' academic achievement in this subject. Angura and Abakpar (2018) recommend using a variety of CLM activities that have been designed to include tasks that start from an easy level and continue through to very challenging in order to enhance the self-esteem of pre-school learners, as this will in turn improve their attitude to the subject. This includes for the acquisition of competence in mathematical concepts. Through the use of CLM, Angura and Abakpar (2018) assert that pre-school learners should be able to answer

some questions correctly, irrespective of their level of ability. This should then have a significant impact on the motivation of the learners concerned to continue learning.

Similar findings were reported by Aire and Tella (2018) in a study of 127 learners in Ghana on the impact of motivation on pre-school learners' academic performance at school, in which Aire and Tella noted that there is a need to keep motivating pre-school learners in order to stimulate and sustain their interest in CLM as a teaching method for mathematical activities. Over three-quarters (79%) of the learners studied by Aire and Tella demonstrated that, with constant motivation from their teachers during their lessons, they were able to achieve significantly improved grades in assessments of their mathematical abilities. However, this same study did not indicate the level of pre-school learners' attitude to CLM with regard to increased sharing and group work among learners, nor the achievement of a spirit of academic resilience, creativity and problem-solving attributes, which are the key variables that determine pre-school learners' success in mathematical activities.

Mensah et al. (2019) further established that attitude can distort the perception of information and affect the degree of learner retention of learning from the groups in which they are placed during mathematical activities lessons. This implies that what pre-school learners like or dislike, appreciate and how they feel about CLM could have a significant effect on the effectiveness of CLM in improving learners' achievement in mathematical activities.

Although these studies and other similar ones have reported correlations between the effect of mathematical activities and achievement in mathematical activities, the nature of the relationship between the two dimensions and the effectiveness of CLM appears to be less straight-forward. Furthermore, none of the studies to date has established the extent to which

specific components of pre-school learners' attitude and beliefs about CLM affect their MCCA.

With regard to pre-school learners' attitude to the use of CLM in lessons, the literature reviewed in this section identifies that learner-oriented perspective of CLM ultimately increases learner interest in learning, resulting in improved academic grades in assessments of their abilities in mathematical activities. However, although studies have reported correlations between the effect of mathematical activities and achievement, the nature of the relationship between the two dimensions and the effectiveness of CLM seems less straight-forward, and at present there is an absence of research to establish the extent to which specific components of pre-school learners' attitude and beliefs in regard to CLM affect MCCA.

2.7 Comparison of CLM and Traditional Methods for MCCA in Pre-school Learners

A number of studies have examined the effectiveness of CLM in comparison with more traditional methods of instruction. In Bolu, Turkey, Bulut (2009) found greater levels of competence in cooperative learning groups compared to traditionally taught ones. In Pakistan, Ahmad and Mahmood (2010) concluded that in comparison with traditional instruction, cooperative learning enhances educational attainment and promotes enriched, enjoyable and interactive learning experiences. In Bijapur, India, Angadi and Darga (2015) compared CLM with traditional learning methods and found CLM to be more effective.

In contrast, in Nigeria, Adekola (2014) found no significant difference in the achievement of learners taught using cooperative instructional strategy and those taught using traditional

lecture-based instructional strategy and Abdulwahab, Oyelekan and Olorundare (2016) later confirmed this lack of difference in levels of achievement between students learning through collaborative methods and those taught more conventionally. On the other hand, also in Nigeria, Ajaja and Eravwoke (2010) found significantly higher achievement test scores in learners working in cooperative learning groups than those in traditional classrooms, and Alabekee et al. (2015) found that there was a significant difference in achievement scores in favour of a cooperative learning environment.

In the Netherlands, Acosta (2013) found that there was a significant impact on learners' academic achievement in classes where teachers were trained in cooperative learning; and when Adebayo (2014) studied the use of more traditional methods of instruction and CLM in Zambia, the results showed that using the cooperative learning strategy improved learners' academic achievement, as well as their motivation to learn, compared to what was achieved through traditional instructional methods. In his examination of the impact of CLM on learner achievement in mathematics in high school students in Murang'a in Kenya, Kamau (2015) found that learners taught using CLM performed better than those taught using more traditional teaching methods.

Despite the fact that Abdulwahab et al. (2016) found similar levels of attainment in mathematical skills for learners instructed using CLM compared to those instructed by traditional methods, they were nevertheless able to demonstrate how pre-schools in Nigeria that have effectively embraced CLM have raised their learners' competences in mathematical concepts, promoted positive self-esteem and improved relationships with others. These values have an important impact on school performance indicators and how best to prepare learners for the future.

Finally, we note that research demonstrates the increase in learner's mathematical concepts' competences achievement in CLM compared to more traditional methods. This lays much emphass in the need for greater use of CLM method; in order to increase learner levels of achievement, particularly with regard to the acquisition of competences in mathematical concepts.

2.8 Theoretical Framework

The study itself is based on several theoretical perspectives, including cognitive development by Piaget (1926) and Vygotsky (1978), behavioural learning by Skinner (1938) and Bandura (1999), among others, as well as social interdependence proposed by Johnson and Johnson (2003). All of these theories follow a constructivist method, and this study seeks to make use of them in order to establish whether there is a link between CLM and the acquisition of competence in key mathematical concepts during learning.

Nevertheless, although CLM overlaps constructivist learning theory, as both emphasise the importance of interactivity, Felder and Brent (2012) note that while constructivism focuses on the personal experience of the learner to grasp new knowledge, CLM not only focuses on and uses the individual learner's personal experience, but also the experiences of others.

2.8.1 Cognitive Development Theory

The cognitive developmental method was initially developed by Piaget (1926), with later additions by Vygotsky (1978). Piaget defines learning as a continuous process that results in acquisition of knowledge for an individual, but which can only take place in the right environment, which is one that promotes social interaction. His theory of cognitive development addresses the nature of knowledge and how humans gradually acquire,

construct and use it. Cognitive development is seen as a restructuring of mental processes as a result of the interaction between biological progression and environmental experiences. According to Piaget, in the process of constructing a worldview, children experience inconsistencies between concepts they already know and what they begin to discover in their environment, from which they gradually adjust their concepts accordingly. In this regard, the classroom environment in this study becomes critical for the effective implementation of any form of cooperative learning.

While Piaget perceived learning as a largely individual effort supported by the environment, Vygotsky saw the need for assistance from an individual with a higher set of skills than the subject. Vygotsky introduced the concept of the Zone of Proximal Development (ZPD), which he defined as the difference between what learners can do without help and what they are able to achieve with the assistance of someone else. He argued that, by following someone else's example, a child is able to gradually develop the ability to do certain things without help, which they were previously unable to achieve successfully. The role of education is therefore to give children experiences that are within their Zones of Proximal Development, thus inspiring and evolving their individual learning.

Combining Piaget's and Vygotsky's perspectives in this study highlights the essence of peer interaction in the learning process. This is particularly important for this study, as learners with different sets of skills are therefore able to help one another in the learning process. Such peer interaction also promotes a democratic educational setting in which teachers and learners are co-contributors in a collaborative learning process, as is the case in Reggio Emilia's method in Italy (Moss, 2005).

2.8.2 Behavioural Learning Theory

Behavioural learning emphasises the influence of group reinforcers and rewards on learning. Skinner (1938) developed the principle of reinforcement, in which he argued that human deeds are dependent on the consequences of past deeds. Therefore, if an individual concludes that the consequence of a given action has been bad or negative, it is highly likely that the action will not be repeated, whereas if the consequences of the same action are pleasant or positive, there is a greater probability that the individual will repeat the action on another occasion.

The same possibilities apply in a group setting. Homans (1961) perceived human relationships as social change to achieve stability through a process of negotiated exchanges between two parties that entails a cost-benefit analysis and the comparison of alternatives. After examining the basics of human learning and the disposition of children and adults to imitate behaviour observed in others, Bandura (1999) observed that models are an imperative reference for learning new behaviours and for attaining behavioural transformation, especially in an institutional setting, such as a pre-school.

In comparison to the dyadic exchange proposed by Homans (1961), Thibaut and Kelley (1978) advanced a differing view based on the balance of rewards and costs in social exchanges among interdependent individuals in a small group. The balance of rewards and costs in social exchanges is of particular interest for this study, as it determines the learning process in a group of learners.

2.8.3 Social Interdependence Theory

Johnson and Johnson (2003) developed the social interdependence perspective through their argument that social interdependence, which they describe as either cooperative or competitive, happens when individuals share common goals and that each person's success is affected by the actions of the others. For interdependence to take place, there must be more than one person or entity involved (a group), and the persons or entities involved in the group must have an impact on each other, with the result that a change in the state of one causes a change in the state of the others. It is the drive for goal accomplishment that motivates cooperative and competitive behaviour in a group.

Deutsch (1962) conceptualised three types of social interdependence: positive, negative and none. Positive interdependence tends to result in promotive interaction; negative inter-dependence tends to result in oppositional interaction; and no interdependence leads to an absence of interaction.

The concept of the function that groups can play in the learning process is founded on social interdependence theory, derived from the identification of groups by Kurt (1935) as being self-motivated entities which are able to demonstrate a varied interdependence among the members. In his hypothesis, Kurt (1935) stated that the underlying principle of any group is the interdependence of the members to the extent that as a group they become a dynamic whole, such that an alteration in the condition of any group member consequently changes the condition of any other member. The group members are energised to accomplish a common goal which, in the case of CLM, is improved accomplishment in mathematical concepts competences in pre-school learners.

The theory is based on the premise from constructivism that children learn through constructing their own knowledge by connecting new ideas and experiences to their existing understanding and experiences to produce novel or improved perception (Johnson and Johnson, 2003). The group members are rendered mutually dependent by their common goals (Johnson and Johnson, 2003) and as they identify their common aims, they become motivated to move towards the achievement of their goals.

The focus of this study is positive interdependence which results in promotive interaction that enhances learning. In the context of this study, CLM derives from the principle that group members work mutually to learn or solve tasks based on mathematical concepts, with every individual accountable for understanding all the expected aspects of any concept.

The small groups are critical in this process, because they ensure that pre-school learners are able to hear and be heard by their peers, contrary to a traditional classroom scenario where they may well spend more time listening to what the instructor has to say. However, for this to be effectively achieved, the teacher facilitation role, and the influence of teacher and learner attitude must be taken into account.

2.9 Conceptual Framework of the Effect of Cooperative Learning Method and Mathematical Concepts Competences Acquisition

The conceptual framework of this study is based on the different dynamics that can affect MCCA for pre-school learners when their teacher uses CLM. These include the teacher's facilitation role in CLM, and the attitude of both pre-school teachers and learners to CLM, which all constitute the independent variables for the study. On the other hand, pre-school learners' MCCA constitutes the dependent variable. CLM is the moderating variable in the

study, as illustrated in Figure 1. The framework illustrated highlights how teacher facilitation of CLM, teachers' attitude to CLM, and learners' attitude to CLM all influence participation in CLM during learning and have an impact on MCCA in pre-school learners:

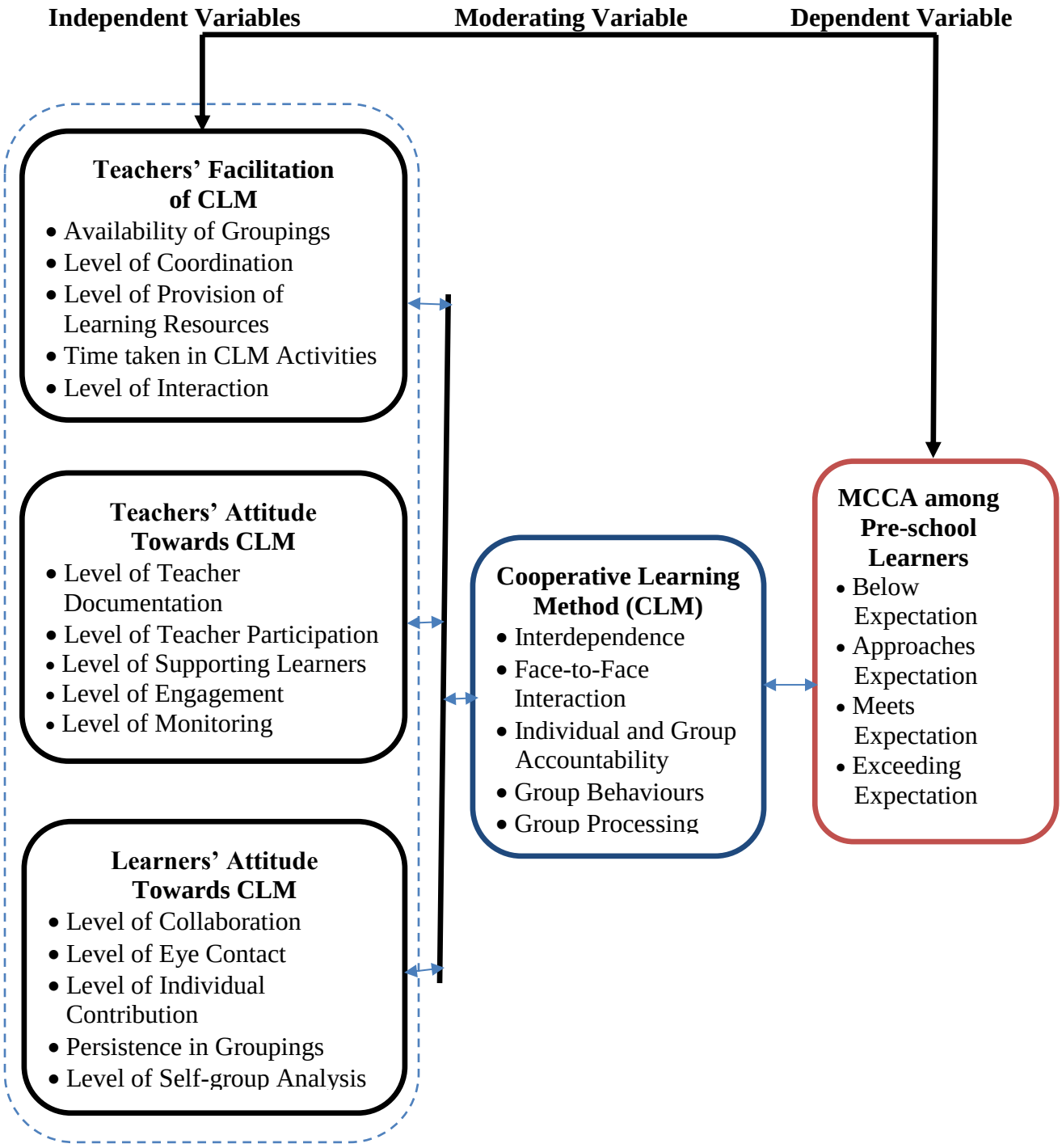

Figure 1: Conceptual Framework of the Relationship between CLM and MCCA

As shown in Figure 1, teacher facilitation of CLM during the learning process influences the dynamics in learning sessions, as evidenced by the types of groupings, the level of

coordination, the level of provision of learning resources, the time taken in CLM activities and the level of interaction. Positive teacher attitude to CLM, reflected in teachers' attitude and ideals, is vital for the success of CLM in the classroom. This attitude influences teachers' level of preparation of documents, the level of their participation, their level of supporting learners, their level of engagement and their level of monitoring. All of these factors may influence the quality of learning during lessons.

In addition, learners' attitude to CLM influences the level of success in learning and is evident in their levels of participation and interaction, eye contact, and individual contribution, as well as the time taken in the groupings and the level of group self-analysis. Through effective implementation of CLM, learners are enabled to acquire mathematical concepts competences in number recognition, number patterns, number values, addition &subtraction.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research methodology applied in order to undertake the study. It covers the research design; the target population; the sample procedures and sample size; the research instruments used, including an explanation of their validity and reliability; the procedures for collection and analysis of the data gathered; as well as logistical and ethical considerations.

3.2 Research Design

This study made use of correlational research design. Correlational research design helped in establishing the relationships between the variables when using the Cooperative Learning Method (CLM) in comparison with traditional teaching methods without manipulating the variables. The researcher used mixed method approach of data collection, where he collected both qualitative and quantitative sets of data.

The research design allowed for the researcher to analyse how, either singly or in combination, the several independent variables defined in the objectives of the study might affect the dependent variable. In addition, it helped the researcher to quantitatively determine the existence of any relationship between the use of CLM and the acquisition of competences in mathematical concepts (MCCA). The correlation between how the independent variables defined by the study might affect the dependent variable when CLM is the method of instruction was used to infer the expected findings and hence to support the deduced positive correlation between CLM and improved acquisition of mathematical concepts competences on the part of pre-school learners.

3.3 Target Population

The target population comprised 197 public pre-schools in Kirinyaga County: Mwea West (34), Mwea East (41), Kirinyaga West (42), Kirinyaga Central (35) and Kirinyaga East (45). These had a combined total of 14, 412 pre-school learners, of whom there were 7, 324 boys and 7, 088 girls. There was a total of 447 pre-school teachers; of these pre-school teachers, 9 were male and 438 were female, as shown in Table 1:

Table 1: Target Population

Sub-County	No. of Pre-Schools	Pre-School Teachers			Pre-School Learners		
		Males	Females	Total	Boys	Girls	Total
Mwea West	34	2	78	**80**	1, 407	1, 303	**2, 710**
Mwea East	41	2	90	**92**	1, 500	1, 579	**3, 079**
Kirinyaga West	42	1	92	**93**	1, 621	1, 484	**3, 105**
Kirinyaga Central	35	1	77	**78**	1, 185	1, 205	**2, 390**
Kirinyaga East	45	3	101	**104**	1, 611	1, 517	**3, 128**
Total	**197**	**9**	**438**	**447**	**7, 324**	**7, 088**	**14, 412**

(Source: Kirinyaga County Education Office, 2018)

3.4 Sampling Procedures and Sample Size

The unit of sampling was pre-schools. To obtain a satisfactory sample size to meet the purpose of this study, the researcher applied stratified sampling to create five strata in the Kirinyaga County, according to the number of sub-counties. Proportionate sampling of the pre-schools from each sub-county was undertaken to determine the number of pre-schools that had to be sampled.

The result of the proportionate sampling of the sub-counties determined that the number of pre-schools to be sampled for the study was 20 (see appendix XVI). This constituted a 10.15% of the pre-schools in Kirinyaga County, and was therefore a sufficient representation

for the purpose of the study, given that the prescribed minimum for this type of study is 10% for social sciences (Mugenda and Mugenda, 2004).

Teacher and learner respondents' sample sizes were derived using purposive sampling on the basis of the pre-schools that were sampled. This purposive sampling procedure allowed the researcher to achieve a sample size of 20 pre-school teachers. Appendix XVI shows the percentage sample size by gender of the learners.

3.5 Research Instruments

The research instruments employed to gather data for the study included, an observation schedule, a questionnaire for pre-school teachers and a document analysis guide in addition to a mathematical concepts competences achievement test (MCCAT) for pre-school learners. The researcher developed these research instruments specifically for the purpose after taking into consideration other globally-recognised related tools and adopting pertinent key components.

3.5.1 Observation Schedule

The use of the observation schedule was intended to enable the researcher, by taking the role of an observer, to be completely aware of the real-life learning situation in the classroom in order to determine exactly what each teacher did during the process of facilitating learning in mathematical concepts competences, rather than merely relying on what they might say that they do. The researcher observed live teaching and learning sessions and noted the extent to which pre-school teachers undertook the activities specified using CLM appropriately (Appendix XI).

3.5.2 Questionnaire for Pre-school Teachers

As a research instrument, a questionnaire comprises a series of questions and other prompts designed to compile data from respondents, with the intention of undertaking a statistical analysis of the responses given (Morse, 2000). In this case, the questionnaire for the study was purpose-made with sections designed to acquire information on the specified variables of the research study using closed-ended test items to gather qualitative and quantitative data from pre-school teachers (Appendix XII). It served the purpose of data collection efficiently, as it enabled a large amount of data to be collected within a short timeframe, while maintaining the confidentiality of the respondents, and was also cost effective, time efficient and easy to analyse.

Section A of the questionnaire collected demographic data on teachers' gender, their age bracket, their level of education, and the length of time they have been teaching in order to ascertain their level of experience. Sections B, C, D, E and F contained closed-ended test items drawn from the study objectives (pre-school teacher facilitation role, teacher and learner attitudes to CLM). The test items, which contained 4-point and 5-point Likert type questions based on the research objectives, were relevant for the study, as the Likert scale illustrates a scale with theoretically equal intervals (Creswell, 2009).

The Likert questionnaire was formatted in a self-report version to form a Standard Attitude Test in order to collect data relating to teachers. Statements about teachers' beliefs or their values regarding various aspects of CLM were made and these were followed by a series of numbers from which to choose in order to indicate the extent to which they agreed or disagreed with each statement. As such, it was possible to assess how much teacher attitude

would affect teaching and learning behaviour in the acquisition of competence in mathematical concepts.

The pre-school teacher's questionnaire was used to collect data on pre-school children's attitude towards CLM. The information required relating to the learners was filled in by their teachers. This is because the pre-school learners were not able to respond in writing to the eight question items that were addressing their perception towards CLM.

3.5.3 Document Analysis Guide

Documentary analysis was undertaken in order to collect data on planning as part of the role of the teacher in CLM (Bowen, 2009). The use of a document analysis guide enabled the researcher to collect data that was essential for triangulating the information across the data sets in order to obtain a confluence of evidence to ensure the credibility of the study. This involved several procedures in analysing and interpreting data produced from examining the professional documents that were appropriate to the study (Hefferman, 2001).

The documentary analysis guide applied in the study allowed the researcher to draw together data on levels of pre-school learners' acquisition of competence in mathematical concepts, how often pre-school teachers used CLM and whether those who used it did so appropriately (Appendix XIII). This involved examining relevant professional documents: schemes of work, lesson plans and lesson notes for the previous term (a total of 60 lessons). The researcher calculated the weighted frequencies of the teachers' preparation of the documents, according to the number of times there was evidence of preparation, as: 0–20 times: Low level preparation; 21–40 times: Mid-level preparation; 41–60 times: High level preparation.

3.5.4 Pre-school Learners' Mathematical Concepts Competences Achievement Test (MCCAT)

The purpose of the Mathematical Concepts Competences Achievement Test (MCCAT) was to measure how well the teacher met national expectations in ensuring the acquisition of mathematical concepts on the part of their learners. The researcher prepared a sample MCCAT. The test was designed to assess the competence of learners on a range of topics in five areas of mathematical concepts: Number Recognition, Number Patterns, Number Values, Addition and Subtraction Operations. There were five semi-structured questions, each with four sub-questions.

The Mathematical Concepts Competences Achievement Test (MCCAT) was then administered to pre-school learners from the sampled pre-schools with the help of their respective teachers (Appendices XIV and XV). The scores for each of the learners were evaluated in terms of a number-coded qualitative grading as follows: Above Expectation (4), Meeting Expectation (3), Approaching Expectation (2) and Below Expectation (1), in accordance with the recommended way of evaluation in the Competency-Based Curriculum (CBC).

3.6 Validity of the Research Instruments

To determine the content validity of the MCCAT, the researcher constituted a panel of pre-school teacher experts to set and verify its suitability for the target respondents. In addition, the researcher sought the assessment and judgment of all research tools (the observation schedule, documentary analysis guide, teacher questionnaire and mathematical concepts competences achievement test) for content validity from his three supervisors, who are Early Childhood Education specialists, in order to enhance value content validity.

For further establishment of content validity, all the research instruments were pilot tested to establish whether each of the items would generate the required information. Simon (2011) observes that piloting aims to address issues which may arise before the actual study. The researcher checked whether the instructions were comprehensive and correctly worded, as well as checking the statistical and analytical processes, in particular whether the reliability and validity of results would serve their purpose in order to produce the intended aim. Since the pilot sample should constitute 10% of the study sample (Kothari, 2005), the piloting was conducted in four pre-schools of the thirty-seven pre-schools in Kikuyu Sub-County, Kiambu County, Kenya. The respondents in the pilot were not included in the actual data collection.

Test items for the mathematical concepts competences acquisition test (MCCAT) that were not adequate in terms of generating the required information were removed, which were 3-tier addition and subtraction sums, any numeral or figure that had a value greater than 10 in any sum as well as reverse sequence pattern sums and items. The items that were suggested for improvement were adopted to generate additional information. The items that were revised included those which exceeded a sum total of 10 when added altogether, as well as those which exceeded a sum total of 10 in calculations requiring subtraction.

The removal and revision of items were carried out in order to realign the content of the research instrument with the PP2 curriculum design content. As previously noted, the qualitative grading for the questionnaire was realigned with that in the CBC rubric (Below average, Average and Above average were changed to Below Expectation, Approaching Expectation, Meeting Expectation and Exceeding Expectation).

The research tools were thoroughly checked to ensure the suitability of all items and to eliminate anything vague or imprecise; this including reversing some question items in the questionnaire in order to ascertain that the respondents understood them clearly. Other items revised included teachers' qualifications, so that bachelor degree, post graduate diploma in education, master's degree and doctor of philosophy were included in the demographic data.

After it became apparent that the original version of the research tool would not capture data deemed to be of relevance to the study, the observation schedule was changed from all close-ended structured question items to semi-structured items that included both open and closed ended questions. Grammatical errors were rectified and question items were rephrased to ensure that their intended meaning was explicit to the respondents.

3.7 Reliability of the Research Instruments

Data for the study was collected using a questionnaire for teachers, a classroom observation schedule, a documentary analysis guide, the MCCAT Pre-Test and a post-test. All of these research instruments were pilot-tested in four pre-schools in Kikuyu Sub-County, Kiambu County, which were not included in the actual research study undertaken in Kirinyaga County. A test-retest was also carried out to on all the tools to detect any weaknesses or errors (Copper and Schindler, 2011).

The research instruments were administered to the four pre-school groups of respondents and a similar one was re-administered two weeks later. After marking the MCCAT administered during piloting, the marks were recorded for analysis. The results produced from the pilot were applied to determine the level of reliability of the instruments by calculating a reliability coefficient between the two tests.

The reliability index for all the instruments was obtained using the Cronbach Alpha Method using the formula shown below:

$$\propto = \frac{N.\bar{C}}{\bar{v} + (N-1).\bar{c}}$$

Where:

N= the number of items

$\bar{c}$ = the average inter-item covariance among items

$\bar{v}$ = the average variance

The $\propto$ (alpha) values obtained for the teachers' questionnaire, the classroom observation schedule, the documentary analysis guide and the MCCAT were 0.708, 0.806, 0.877 and 0.802 respectively. According to Fraenkel and Wallen, as cited by Muriithi (2013), an alpha value of 0.7 is considered suitable to make group inferences that are sufficiently accurate.

3.8 Data Collection Procedures

Having been directly introduced by the Department of Educational Communication and Technology at the University of Nairobi (Appendix I), the researcher was able to procure a research permit from the National Commission for Science, Technology and Innovation (Appendices II and III. The researcher went in person to visit and deliver application letters to be permitted to carry out his study to; The County Commissioner, The County Director of Education to obtain written authorisation, which was subsequently issued to him (Appendices IV and V). At these offices, the researcher was advised to consult and seek the authority of the EYE County Director in order to gain access to the pre-schools and carry out the research. The EYE County Director declined to authorise the research unless the researcher

obtained prior authorisation from The County Secretary on behalf of the County Governor (Appendix VI), which he did.

These letters of authorisation, which were a requirement for most of the head teachers visited, provided a formal introduction for the researcher to all of the public pre-schools identified for the sample in which he was to undertake the study. The researcher pre-visited each sampled pre-school, where he presented his introduction letter to the head teachers (Appendix VII), who gave him permission to meet the pre-school teachers. The researcher discussed with the pre-school teachers and informed them of the nature and purpose of the research study and made a request for them to sign the consent forms (Appendix VIII). The researcher booked appointments with the head teacher and pre-school teachers for the particular days for him to be on the premises to carry out the data collection. That same day, he was introduced to the respondent groups of PP2 children, in advance of the actual data collection day.

The questionnaire and the Mathematical Concepts Competences Achievement Test (MCCAT) were distributed to pre-school teachers at their respective pre-school premises by the researcher on his first visit. Every pre-school teacher was asked to complete the questionnaire and to administer the MCCAT to their learners on behalf of the researcher within a fixed period of between one to three days.

During the course of the data collection day, the researcher collected the completed teacher questionnaire plus the MCCAT scripts for marking and observed three mathematical concepts competences lessons. In order to assess this lesson as it was taking place, the completed both the observation schedule and the documentary analysis guide, which

involved the researcher compiling data from the class teacher's archival documents, notably the schemes of work, lesson plans and lesson notes. At the same time, in order to avoid duplication during data entry, while in the classroom the researcher coded the data, which was then stored for analysis. The coding enabled the researcher to identify the study instruments with their respective pre-schools.

3.9 Data Analysis Procedures

Once all the data had been gathered, it was then compiled for analysis. The quantitative data was keyed into a computer database using the Statistical Package for Social Science (SPSS, version 25) for analysis. Following the two-month period of the data collection exercise, the researcher coded the qualitative data and categorised it into the various emerging themes from each of the research instruments.

Data analysis was carried out with the aim of fulfilling the research objectives and providing answers to research hypotheses. The qualitative data from the teacher questionnaire responses, the classroom observation schedule, and the documentary analysis guide was analysed. The qualitative data analysis of the teacher questionnaire responses included identifying common themes from the respondents' description of their experiences. All the materials relevant to a certain theme were placed together. Significant issues that emerged were identified in order to indicate theme categories. This analysis was also carried out for the classroom observation schedule and the documentary analysis guide.

The researcher then developed a summary report by specifically writing the narrative with the use of extracts, descriptive statements, and direct quotations from the raw data in order to

reflect the real situation of the setting. These were used to provide the evidence and justification in relation to the research hypotheses.

The unit of analysis in this research study was the pre-school learner. The responses to the close-ended items were assigned numerical codes and labels. Frequency counts of the responses were obtained to generate information about the respondents.

This quantitative data (numerically coded and labelled responses) was analysed descriptively (using frequencies, percentages, mean and standard deviation) and inferentially by use of the Multiple Regression Model and Pearson Correlation Coefficients. The Multiple Regression Model and Pearson Correlation Coefficients were used owing to the fact that the learners in the sample had different pedagogical instructional facilitation and therefore measurements were independent. This achieved the establishment of the effects and relationship between CLM and MCCA.

To determine the status of learners who had been taught mathematical concepts competences using CLM, the researcher made use of SPSS to compute the sum of all question items in all the research instruments according to their numerical coding. The question items or statements sought to explore hypothesis i (see section 1.5) and to establish to what extent there is a difference between the mean score index of learners taught by a teacher who facilitates the Cooperative Learning Method (CLM) and those taught by a teacher who does not.

Responses to the themes in the research question items related to CLM facilitation in the research tool, in this case the observation schedule, were assigned numerical codes. This was in order to make it quantifiable so that the data could be keyed into the SPSS spread sheet for

analysis. The SPSS system then computed the aggregate points of the various themes relating to the CLM facilitation-oriented research question items as per the numeral codes assigned by the researcher. The total aggregate points ranged between 95.00 and 168.00. With this information it was possible to determine the 75^{th} percentile (in this case, aggregate point as the cut-off point for identifying learners who were taught using CLM.

Learners in pre-schools which were above the cut-off point were deemed to have been taught mathematical concepts competences using CLM, whereas those whose aggregate points were below the 132 points-cut-off were categorised as having not been taught mathematical concepts competences using CLM. This status was used to compare the mean score indices across the two categories of learners using cross tabulations, descriptive statistics, regression model and Pearson Correlation Coefficient.

In order to determine teachers who were favourable or unfavourable to CLM, the researcher computed all question items or statements that sought to address hypothesis ii (see section 1.5) and to establish to what extent there is a difference between the mean score index of learners taught by teachers with favourable and unfavourable attitude towards CLM.

The total aggregate points of question items or statements about teacher attitude to CLM were between 54.00 and 94.00. The 75^{th} percentile was at 74.00 points, which the researcher established as the cut-off point. This implied that those learners whose teachers were above the 74.00 point were categorised as having been taught by teachers with a positive (favourable) attitude to CLM, whereas those learners whose teachers had aggregate points below the cut-off point were deemed to have been taught by teachers who were negative (unfavourable) towards CLM.

In the same way, the computation of aggregate points and percentiles was performed to determine learners' attitude to CLM. The aggregate points of learner attitude to CLM were calculated based on answers to all question items or statements that addressed hypothesis iii (see section 1.5) and to establish to what extent there is a difference between the mean score index of learners with a favourable and unfavourable attitude towards CLM.

The scores produced a minimum point of 33.00 while the maximum was 108.00. The 75th percentile fell on point 71.00, which was made the cut-off point. Learners who scored points of 71.00 and above were classed as having a positive (favourable) attitude to CLM, whereas those scoring below were considered to have a negative (unfavourable) attitude to CLM. This status was used to compare pre-school learners' MCCA, using cross-tabulations, descriptive statistics, regression model and Pearson Correlation Coefficient.

The researcher used the following model:

$$\gamma=\beta0 + \beta1X1+ \beta2X2 +\ldots\ldots + \beta nXn + \varepsilon$$

Where:

γ is the pre-school learners' MCCA (as the dependent variable)

Xn are the independent variables

$\beta0$ is the constant

βn are the regression coefficients or change induced in γ by each X

ε represents the level of error.

Coefficients of determinants were carried out for further analysis of the results generated to show the amount of variation derived from the impact of CLM on pre-school learners' MCCA.

Data on pre-school teachers' level of preparation when using CLM to facilitate their learners' acquisition of mathematical competences was collected through the document analysis guide, the observation schedule and the teacher questionnaire. The collected data on preparation covered the teachers having lesson plans, schemes of work, and lesson notes, in addition to the provision of learning aids as the teachers planned in their scheme of work and in their lesson plan. An aggregate of scores from eight aspects weighting teacher preparation was computed, where the 75^{th} percentile (12 scores and above) was classed at high level preparation, the 50^{th} to 75^{th} percentile (between 8 - 12 scores) rated as mid-level preparation, and below the 50^{th} percentile (below 8 scores) was classed as low-level preparation.

3.9.1 Analysis of the Observation Schedule Data

The purpose of the observation schedule was to collect data during the learning session as the researcher was observing. The data was collected on all dependent variables concerned: the teacher's facilitation role in CLM, teacher attitude to CLM, and learner attitude to CLM.

The values of one and zero were assigned to each of the responses Done and Not done, Available and Not available, Established and Not established respectively. Values of one and two were assigned to the responses Learner and Teacher respectively. The responses Inadequate, Moderate and Adequate were assigned the values of zero, one and two. These same values were also assigned in that order to Below 50%, 50 - 75% and 75% and above. Values of zero, one, two, three were assigned to None at all, Only one type, Two types and Three types consecutively.

Cross-tabulation of each question or statement was carried out against the pre-school learners' MCCA. The regression model and correlation coefficients were also carried out to

generate results that sought to substantiate hypotheses i to iii (see section 1.5). The information from the results provided the study with the actual position on the ground with regards to CLM and MCCA. The information generated with this instrument provided grounds for assessing any information that might appear to contradict it from the data obtained from the teacher questionnaire.

3.9.2 Analysis of the Teacher Questionnaire Data

The pre-school teacher questionnaire was used to collect data on pre-school teachers' perception on all the thematic aspects based on the objectives regarding the use of CLM and its effect on learners' MCCA. The researcher decoded the responses given by the pre-school teachers in their questionnaires.

Reversing of the negatively stated question items in the 4-point and 5-point Likert scale responses was carried out. The values of one and two were assigned to the responses Yes and No respectively. Values of one, two, three, four were assigned to the responses Never, Rarely, Often, Very Often and also to the responses Below Expectation, Approaches Expectation, Meets Expectation and Above Expectation. In contrast, values of one, two, three, four and five were assigned to the responses SD-Strongly Disagree, D-Disagree, U-Undecided, A-Agree and SA-Strongly Agree; as well as the following responses: Not at all, Less extent, Moderate extent, Great extent and Very great extent.

Cross-tabulation of each question or statement was carried out against the MCCA of all the pre-school learners. This was done in order to assess the questions raised by the hypotheses i to iii (see section 1.5). The results provided information which was triangulated with that

derived from the class observation schedule and the documentary analysis guide to make accurate inferences on the subject being researched.

3.9.3 Analysis of the Documentary Analysis Guide Data

The purpose of the Documentary Analysis Guide Data was to check the level of usage of CLM during lessons. The documentary analysis guide weighted the mean of the coded data from the teacher's professional records to calculate and prove usage of CLM in class. A weighted mean of two and a half (2.5) and above, out of the possible five (5), pointed to a high usage of CLM, while values of below the two and a half (2.5) index pointed to low usage.

The data obtained was then compiled against the grades attained by the pre-school learners in the MCCAT. This enabled a comparison to be made between levels of CLM usage and learners' level of MCCA. These statistics were presented in a table and then discussed in order to answer hypotheses i to iii (see section 1.5).

3.9.4 Analysis of the MCCAT Data

The MCCAT collected data on the MCCA of the pre-school learners in the sample. The MCCAT was marked out of 20, for which each of the five topic areas (number recognition, number patterns, number values, addition and subtraction) had a maximum of 4 (four) marks. With reference to the qualitative grading system specified by Kenya's Competency-Based Curriculum (CBC) – Below Expectation, Approaching Expectation, Meeting Expectation and Exceeding Expectation, the researcher assigned numerals to the grading in order to make it quantitative for the purpose of data analysis and gave a weighting of the scale 0-1 score to indicate that a learner is Below Expectation, a score of 1-2 to indicate Approaching

Expectation, scores of 2-3 are classed as Meeting Expectation and a score of 3-4 is taken to mean that a learner is Exceeding Expectation (see appendix XIV).

Each of the five topic areas was able to produce results in any of the four qualitative grades. From these, each learner's aggregate scores were averaged, using the same grading system. This weighing of the qualitative grading into scores made it possible for the calculation of mean score indices for the individual learners, as well as placing learners in one of two categories: learners classed as having been taught mathematical concepts competences using CLM and those who were not.

Pearson's Correlation Coefficients were calculated to establish any significant association between the independent variables and pre-school learners' MCCA. A Regression model was also calculated to evaluate the effect contributed by each one of the variables in the use of CLM and its predictive influence on MCCA in pre-school learners. These two statistical procedures were ran and separately analysed.

3.10 Ethical Considerations

Upholding ethical expectations throughout the study was a high priority, in particular because most of the school administration as well as the participants were very sensitive to this. Removing any obstacles of suspicion or mistrust was extremely crucial because Early Childhood Education in Kenya is a devolved function, run by the County Government.

The researcher assured the respondents of complete confidentiality regarding them and their personal lives and that no personal information whatsoever obtained by the researched would be passed on to a third party. Respondents were guaranteed that the data they provided would be employed solely for the stated intention of the research and that it would not be passed to

any unintended party for any purpose. Respondents' individual identity would not be disclosed at all. Furthermore, no identifying data with reference to individual institutions would be made known in written or other forms of communication.

The nature and the purpose of the research, and the procedure to be followed during the data collection were explained to participants by the researcher, who sought their consent to ensure that their participation was voluntary. Participating pre-school teachers were asked to indicate their consent by signing a consent form for themselves and on behalf of the pre-school learners for whom they had responsibility (Appendix VIII). Each of the participants was at liberty to withdraw from the study at any point, which was essential for ensuring that all participation in the study was truly voluntary (Creswell, 2003). All of this was undertaken on the orientation (first visit) day to the school prior to the actual data collection day.

Recommendations made in this study were based on the research findings. It is, therefore, the researcher's hope that these recommendations will lead to more effective implementation of CLM in order to ensure improved MCCA, not just for pre-school learners but also for improving MCCA at all other academic levels.

3.11 Operationalisation of Variables

Operationalisation allows variables to be expressed in measurable terms. The indicator to be measured for each variable was identified, as shown in Table 2.

Table 2: Operationalisation of Variables

Type of Variable	Indicators	Scales	Type of Data	Tools	Methods of Analysis
Teacher Facilitation of CLM (Independent)	Availability of groupings Level of coordination Level of learning resource provision Time taken in CLM activities Level of interaction	Ordinal Interval	Quantitative Qualitative	Documentary Analysis Guide Observation Schedule Questionnaire MCCAT	Descriptive statistics One-Sample Linear Regression
Teacher Attitude to CLM (Independent)	Level of preparation Level of involvement Level of resource provision Amount of time taken in CLM activities Level of monitoring	Ordinal Interval	Quantitative Qualitative	Documentary Analysis Guide Observation Schedule Questionnaire MCCAT	Descriptive statistics Linear Regression
Learner Attitude to CLM (Independent)	Level of interaction Level of eye contact Level of individual contribution Time taken in groupings Level of self-group analysis	Ordinal Interval	Quantitative Qualitative	Documentary Analysis Guide Observation Schedule Questionnaire MCCAT	Descriptive statistics Pearson's Correlations Coefficient Linear Regression
MCCA in Pre-school Learners (Dependent)	Mean index scores in MCCAT	Interval	Quantitative	MCCAT	Descriptive statistics Pearson's Correlations Coefficient Linear Regression

CHAPTER FOUR
DATA ANALYSIS, INTERPRETATION AND PRESENTATION

4.1 Introduction

This chapter focuses on data analysis, presentation of analysis per objective and interpretation in order to address the following study hypotheses:

There is no significant difference between the mean score index of pre-school learners taught by a teacher who facilitates learning using the Cooperative Learning Method (CLM) and those taught by a teacher who does not; there is no significant difference between the mean score index of pre-school learners taught by teachers with favourable and unfavourable attitudes towards CLM and; there is no significant difference between the mean score index of pre-school learners with favourable and unfavourable attitudes towards CLM.

Quantitative data was analysed descriptively (using frequencies, percentages, mean and standard deviation) and inferentially by use of Regression Models and Pearson Correlation Coefficients. Qualitative data was analysed thematically and presented in narrative forms under each objective to triangulate with the quantitative analysis results.

4.2 Presentation and Interpretation of the Data

4.2.1 Response Rate

The study sought to explore the effect of CLM on levels of achievement in the mathematical concepts competence acquisition (MCCA) of pre-school learners. Indicators of CLM were identified as including teacher facilitation of CLM, teacher attitude to CLM, and learner attitude to CLM. Learners' MCCA was measured through their achievement in test items related to specific mathematical concepts.

Response rates were calculated in percentages from the actual usable responses against the total eligible desired sample. According to Fincham (2018), such a calculation is critical in determining the success of a survey in inducing respondents to participate, as it establishes the potential for sample selection bias during administration of the research instrument.

Following compliance with the ethics identified for the study, including obtaining permits and completed consent forms for participation, 20 pre-primary school two (PP2) classes and their teacher respondents formed the sample group, out of the target population of 197 public pre-schools in Kirinyaga County. As none of the pre-school teachers taking part withdrew from the study, the study sample achieved 100% participation on the part of the teachers. The study sample also included 639 pre-primary school two (PP2) learners aged from five to six years old, who accounted for 94% of the total responses. The 40 learner non-respondents (6%) consisted of absentees or pre-school learners who were transferred during the period when data collection was taking place.

The data was analysed and presented in Table 3, where the percentage distribution of the sample across the respondents is shown.

Table 3: Response Rate

Respondent Category	Total Population	Participated Population	Participation Rate
Pre-school learners	679	639	94%
Pre-school teachers	20	20	100%
Total respondents	**699**	**659**	**94%**

Table 3 shows the study participation rate in relation to the anticipated sample size. The 100% response portion consisted of 3% pre-school teachers (100% of the targeted pre-school teachers) and 97% pre-school learners (which was 94% of the targeted pre-school learners).

This study registered a response rate of 94.3%. Draugalis, Coons and Plaza (2008) maintain that a response rate of at least 80% is acceptable. From a different perspective, Cook et al. (2000) posit that in a meta-analysis study, survey research highlights representativeness more than response rate. However, academics appreciate that response rate has a significant influence on how representative a study sample is; a small non-response rate implies a more profound non-response bias, which has diminishing negative effects, whereas a high response rate of 80% and above is more likely to indicate a true representation of the diverse characteristics of the population as a whole.

4.2.2 Demographics of the Respondents

In order to obtain a wide overview of the characterisation of the pre-school teachers involved, the study noted their age, gender, educational levels, and teaching experience. However, learner characterisation was limited to age, gender, and MCCAT achievement only. Demographic data of the pre-primary school learners provided details of their numbers and their percentages in terms of gender.

4.2.2.1 Pre-school Teachers Demographics

The pre-school teachers were asked to indicate their gender, educational levels (in training), and age bracket in the administered questionnaire. The teachers' age (in years) and gender cross-tabulation are presented in Table 4.

Table 4: Demographic Variables of the Teacher Respondents

Qualifications	Gender	Age				Total
		Under 20	21 - 30	31 - 40	41 - 50	
Certificate	Female	10% (n=2)	-	15% (n=3)	20% (n=4)	45% (n=9)
	Male	-	-	-	-	-
Diploma	Female	-	-	10% (n=2)	25% (n=5)	35% (n=7)
	Male	-	-	10% (n=2)	5% (n=1)	15% (n=3)

Bachelor	Female	-	5% (n=1)	-	-	5% (n=1)
	Male	-	-	-	-	-
Total		**10% (n=2)**	**5% (n=1)**	**35% (n=7)**	**50% (n=10)**	**100% (N=20)**

As Table 4 shows, in the Under 20 and 21 – 30 categories, there were 2 female pre-school teachers who were under 20 years of age and 1 female pre-school teacher in the age group 21 to 30. Of the pre-school teachers aged between 31 to 40 years there were 5 females and 2 males, whereas there was 1 male compared to 9 female pre-school teachers in the 41-50 age bracket.

All the male teachers (a total of 3) had a diploma as their qualification; none of them held either a certificate or a degree qualification. In contrast, all the 9 certificate qualification holders were females (45%). Of the diploma holders, 6 (30%) were female and 3 (15%) were male. There was only one (5%) degree holder, who was female.

This implies that every pre-school teacher met the minimum qualifications to handle pre-school learners. the age, qualifications. Kanyoro (2015) established that the academic level of teachers greatly influences the students' performance in science subjects, where a mathematical activity is one. Majority of teachers being between age 41 – 50 would mean that the pre-school learners were being handled by mature pre-school teachers who would professionally address their needs appropriately. The Higher the experience is expected to correspond with a higher level of learning concepts' acquisition (Henderson, 2014). The same case applies to the fact that the female teachers (who were the majority) are expected to provide a mother figure in their approach and care to the learners during learning. This may partially agree with Dewey (1966) who feels that female teachers are the best option for teaching pre-primary school children. There is still a need to see pre-school teachers' gender

balance in order to have gender social skills modelling significantly balanced among pre-primary school children Mohammed (2017).

4.2.2.2 Pre-School Learner Demographics

Overall data analysis of the participating pre-primary school learners indicates a total of 639 children, as presented in Figure 2.

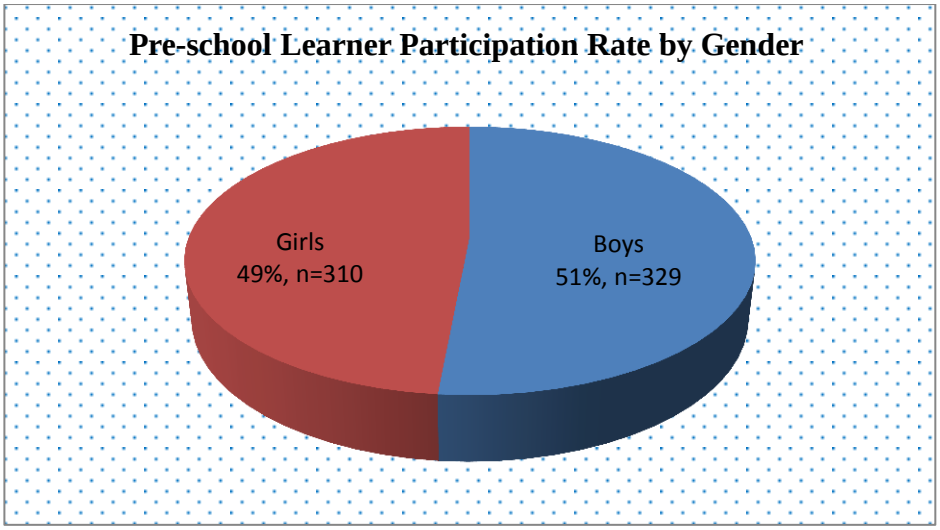

Figure 2: Pre-school Learner Participation Rate by Gender

Figure 2 shows that from the total of 20 pre-schools involved there was a combined total of 639 learners, of which there were 329 boys (51.5%) and 310 girls (48.5%) respectively. This distribution among the learner participants indicated that there was slightly more boys than girls in the study sample. This also informs the study that the study area has a slightly higher proportion of boys compared to girls in pre-schools; nonetheless, that difference in gender representation was insignificant to influence the study findings. Even though, Yüksel-Şahin, F. (2008) maintains that there is no noteworthy variance in learners' gender-stereotypes about success in the acquisition of Mathematical concepts.

4.3 Teacher Facilitation of CLM and Learners' MCCA

This objective sought to address the hypothesis regarding the extent to which there is a difference between the mean score index of learners taught by a teacher who facilitates CLM and those taught by a teacher who does not. Similar to any other instructional methodology in a classroom, teachers have an important role in CLM.

To address this research question, data was collected on various CLM aspects including: levels of MCCA of learners taught by teachers who facilitate CLM and those taught by teachers who do not; availability of CLM groupings during lesson delivery; level of teachers' coordination of CLM activities during learning; level of provision of learning resources during learning; time taken in CLM activities and level of interaction during learning.

4.3.1 Availability of Learning Groups and Learners' MCCA

Availability of learning groups is a key subject in CLM with regards to the way in which teachers have to set up a CLM classroom learning environment. During the pre-school learning sessions, the researcher recorded the extent to which learners were placed into groups and found that some were organised in small learning groups, whereas others were not. The collected data was analysed in Table 5 though cross-tabulation.

Table 5: Availability of Learning Groups and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA			
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation
	N=20	n=4	n=40	n=171	n=424
Whether the teacher established CLM groups					
Established	85%	0%	9%	18%	73%
Not established	15%	2%	5%	33%	63%
	N=20	n=7	n=73	n=217	n=342
Groups working in an organised, sequential way					
Yes	100%	1%	11%	34%	54%
No	0%	0%	0%	0%	0%

According to Table 5, learner achievement increases consecutively, starting from Below Expectation, Approaching Expectation, Meeting Expectation, right up to Exceeding Expectation at 0%, 9%, 18% and 73%. This trend is similar for learners who were not organised in learning groups at 2%, 5%, 33% and 63% consecutively.

Linked to these findings, Table 5, which presents information gathered through the questionnaire about teachers' views on the frequency of CLM group formation and learners' MCCA, reveals that the learners organised in groups always achieved scores at the higher end of the grading system. This appears to confirm the assertion that the use of group work is fundamental in enhancing pre-school learners' educational achievement in basic numeracy concepts (Huber, 2006).

From the evidence, all of the learning groups were working in an organised way during the learning session, with just over half of the learners (54%) Exceeding Expectation. It would appear from this those members of cooperative groups use higher level reasoning strategies more frequently than when individuals work by themselves.

Using the documentary analysis guide, data was gathered from teachers' professional records, more specifically, their schemes of work and lesson plans, about how they documented evidence of their use of CLM groups as the means to organise learning (one of the key aspects of CLM) in teaching mathematical concepts competences. Levels of organisation for learning were determined by what was documented in the schemes of work and lesson plans. The data collected related to how often pre-school teachers used CLM and was used to identify how the use of CLM or otherwise had an impact on learner achievement. This information is presented in Table 6.

Table 6: Documentary Evidence of Learning Group Formation and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Rating of teacher's frequency of forming learning groups						
Never/not indicated	70%	1%	10%	24%	65%	53%
Rarely	0%	0%	27%	73%	0%	3%
Often	25%	1%	9%	45%	46%	26%
Very often	5%	4%	17%	39%	40%	18%

Table 6 indicates that the majority of learners (65%) who were never organised in CLM groups (or whose teachers never indicated that they did) Exceeded Expectation; 73% of those rarely taught in CLM groups just Met Expectation; 46% of those often taught in CLM groups Exceeded Expectation and 40% of those very often taught in CLM Exceeded Expectation. For learner grouping, Table 6 illustrates that just over half of the learners (53%) were either never taught in CLM groups or their teachers did not indicate whether they were ever organised in CLM groups during learning. According to the information obtained, teachers of a quarter of the learners (26%) indicated that they often used CLM groups, 18% stated that they used CLM groups very often and 3% said that they rarely used CLM groups.

Although the expectation is that learners whose teachers established CLM groups very often would achieve the highest level of performance, from the evidence, they were actually below the mean average across the grades. This implies that some teachers may be more efficient in their documentation for planning and preparation, but not necessarily able to implement it in practice. The reasons for this are likely to vary, although it may be due to the demanding nature of the CLM lesson implementation process or failure to comprehend exactly what they are required to do in order to complete all documentation successfully. With regard to the

cognitive theory, the classroom environment becomes critical for the effective implementation of any form of cooperative learning.

Data was also collected on teachers' understanding of CLM, whether they used it and how often they had their learners form CLM groups to make learning of mathematical concepts competences easier and enjoyable, as presented in Table 7.

Table 7: Teachers' Views on CLM Group Formation Frequency and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Understanding of CLM						
Yes	95%	1%	11%	33%	55%	97%
No	5%	0%	27%	72%	0%	3%
Use of CLM						
Yes	90%	1%	12%	36%	50%	90%
No	10%	0%	3%	13%	84%	10%
Frequency in the use of CLM						
Never	35%	0%	0%	0%	0%	0%
Rarely	60%	0%	0%	0%	0%	0%
Often	5%	0%	10%	20%	70%	5%
Very Often	0%	1%	12%	34%	53%	95%
Forming of CLM groups						
Never	30%	0%	0%	0%	0%	0%
Rarely	55%	0%	0%	0%	0%	0%
Often	10%	0%	13%	30%	57%	9%
Very Often	5%	1%	11%	34%	53%	91%
Forming CLM groups makes teaching easier and enjoyable						
Strongly Disagree	5%	0%	0%	0%	0%	0%
Disagree	10%	0%	15%	34%	51%	6%
Undecided	10%	0%	0%	0%	0%	0%
Agree	20%	2%	13%	40%	45%	51%
Strongly Agree	60%	1%	9%	27%	64%	43%

As shown in Table 7, the vast majority of learners (97%) were said to have been taught by teachers who understand CLM as an instructional method for MCCA and 90% were said to

have been taught using CLM. A total of 95% of learners were indicated to have been taught using CLM at a frequency classed as very often, whereas 91% of them were said to be taught in CLM organised groups.

Nevertheless, there was a significant disparity between these figures and what the researcher witnessed during observations, which would then partially concur with the notion that, despite a theoretical interest in team learning and many teachers' generally in high appreciation of CLM as a didactic method, cooperative learning is a rare event in the average classroom (Rotering-Steinberg, 2000). It is possible that this may result from an unfavourable view which some teachers may have of CLM.

However, whereas the majority of learners (55%) taught by teachers who said that they understood CLM Exceeded Expectation, of those learners taught by teachers who did not understand CLM, 72% only Met Expectation; interestingly, none of these learners achieved either below Expectation or Exceeded Expectation.

It was just over half (50%) of the learners indicated as being taught using CLM Exceeded Expectation, which was actually a level of achievement below those learners indicated as not taught using CLM (84%). This would be attributable to the small population of learners in that category who were indicated not to have been taught using CLM.

Nevertheless, other forms of learning group organisation were observed in the classroom, including:

> *A whole class group organisation, learners working in pairs, learners working in groups of three, learners working individually. In other cases, the group element featured only when responding to the teacher's questions orally during learning. There were cases where the whole class group of learners would crowd around the teacher at*

the blackboard for the whole lesson. This demonstrates some teachers' unwillingness to practise CLM facilitation and a tendency to stick to traditional methods of teaching.

Therefore, there is also the possibility that some teachers did not indicate the true position and that they may not be using CLM in their facilitation of mathematical concepts competences, or they may assume that they know what CLM entails, but do not have the necessary support to put it into practice.

From the above, it would appear that teachers are likely to benefit from being provided with additional time for planning and consulting others regarding the most effective ways to enable their learners to increase their acquisition of competence in mathematical concepts, with appropriate support and guidance to be able to practise CLM.

Learners taught by teachers who use CLM often and very often Exceeded Expectation at 70% and 53% respectively. Those taught by teachers who form CLM groups often and very often achieved at 57% and 53% respectively. One would have expected the reverse to be the case, especially with the fact that there were more learners who were below Expectation and Approaching Expectation among the learners taught by teachers who gave the impression that they use CLM as an instructional method very often and also form CLM groups very often.

In a statement on whether teachers helped their learners to form CLM groups to make the learning of mathematical concepts easier and enjoyable, 51% of teachers agreed, 43% strongly agreed and 6% disagreed. The highest percentage of learners who Exceeded Expectation were those who were taught by teachers who strongly agreed that they helped their learners to form CLM groups. 51% of learners who Exceeded Expectation were taught

by those who strongly disagreed and 45% by those who agreed. This information did not match what a number of teachers had indicated in the previous question.

According to the responses given, none of the learners were taught by teachers who never formed CLM groups. In contrast, 6% of the learners were taught by teachers who disagreed that they helped learners to form CLM groups. This implies that although some teachers never apply CLM in their teaching, they know it is a better method of instruction than the traditional ones. The teachers may be resisting a change from using traditional teaching methods to using CLM as a means to facilitate acquisition of competence in mathematical concepts.

This concurs with the affirmation of Cohen, Brody and Sapon-Shevin (2004) that despite the well-documented benefits of cooperative learning, and indeed a structured peer-mediation arrangement, implementing this pedagogical practice in classrooms is a challenge that many teachers seem to find difficult to accomplish.

Difficulties in implementation may occur where teachers do not have a clear understanding about how to establish effective cooperative groups, as indicated by one teacher in the following comments:

> *'What is this Cooperative Learning Method? Is it not where children work together in a group as we have always had it during our teaching? Does it have anything special? How should I answer some of the question items in this questionnaire? Okay, I will answer then you will tell me whether I have answered them correctly.'*

It was surprising that every teacher indicated that they felt that they knew what CLM was. Others said that they employed it very often. Nevertheless, they did not appear to understand some question items with regards to the elements of CLM.

From the sessions observed, it would appear that everyday learning in many Kenyan schools is mainly influenced by individualistic and competitive orientations. A possible reason for this could be the lack of opportunity for teachers to engage in professional development, either through constraints on time or because of a lack of adequate training to improve their delivery of mathematical concepts competences instruction. If this is the case, then this would need to be addressed not just at the level of individual schools, but also at county and maybe even national level. Otherwise, the Zone of Proximal Development (ZPD) sees the need for assistance from an individual pre-school learner with a higher set of skills than the subject in the learning process.

4.3.2 Teachers' Coordination Level, Traditional Methods and Learners' MCCA

Teacher coordination of CLM activities entails both a considerable amount of preparation by teachers in order to have CLM work most effectively and also effective classroom management during facilitation of learning about mathematical concepts.

4.3.2.1 Teacher Preparedness in Facilitating CLM and Learners' MCCA

Observation of teacher preparedness in compiling professional records to facilitate CLM was carried out during the observed lesson and the data is presented in Table 8.

Table 8: Teachers' Preparation Level and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=61	n=190	n=381	N=639
Teachers' Preparedness in Relation to Mean Score Index						
Low level	45%	2%	12%	36%	50%	46%
Mid-level	25%	1%	9%	28%	62%	26%
High level	30%	0%	6%	22%	72%	28%
	N=20	n=7	n=73	n=217	n=342	N=639
Provision of learning aids as planned in the scheme of work						
Done	20%	0%	5%	31%	64%	19%
Not Done	25%	0%	12%	32%	56%	24%
Not Applicable	55%	2%	13%	37%	49%	57%
Provision of learning aids as planned in the lesson plan						
Done	25%	0%	5%	21%	73%	24%
Not Done	25%	0%	13%	34%	53%	24%
Not Applicable	50%	2%	14%	40%	44%	52%

Table 8 illustrates that the level of teachers' preparation had a direct relationship with their learners' MCCA in that the higher the level of teachers' preparedness, the higher their learners' mathematical achievement. Although the majority of the learners were graded the highest (Exceeding Expectation) in all the three levels of teacher preparedness, the highest portion (72%) of the learners were taught by teachers who had high level preparedness, 62% by teachers who had mid-level preparedness, while only 50% were taught by teachers with low level preparedness.

In the lower-level grades, indeed, learners' achievement decreased as the grades lower, but the fewest learners in the lowest categories are those learners taught by teachers who had a high level of preparation. In other words, this means that the higher the teachers' level of preparedness, the fewer the learners who scored the lower grades (below Expectation and Approaching Expectation). Through their preparation and professional development, teachers are able to develop their ability to use CLM to accomplish their lesson goals (Gillies, 2010).

Table 8 reveals that only a small portion of learners were taught by teachers who used learning resources as they had planned in their schemes of work and lesson plans (19%) and 24%) respectively. A slightly higher percentage of learners used learning resources, despite the fact that their teachers had not planned for them; either the scheme of work or the lesson plan, a figure of 24% of learners for both types of teaching document. The biggest percentages of learners were taught by teachers who had no schemes of work (57%) and / or no lesson plans (52%).

The highest achievers (those who Exceeded Expectation) were learners taught by teachers who had planned for their learning resources in the scheme of work and lesson plans (64% and 73% respectively). Among those learners who Exceeded Expectation, the smallest percentage was for those learners who were taught by teachers who had neither scheme of work (49%) nor lesson plans (44%).

Nevertheless, it is important to note that more than half of the learners taught by teachers who provided them with learning aids, despite not having planned for these resources in the scheme of work (56%) and lesson plans (53%) were able to Exceed Expectation. It is also worth noting that there were a slightly higher percentage of teachers who used learning aids in their teaching who had planned for this in their lesson plan (24%) more than those who had done their planning for the lesson in the scheme of work (19%).

Furthermore, it must be borne in mind that without knowing the specific reasons why these teachers used resources that they did not plan for or chose not to use resources that they had planned for, it is very difficult to make a judgement about this based on a single lesson observation. Again, at national and at county level, the key element is to ensure that teachers

receive adequate training in all aspects of their subject and teaching practice to ensure that they are able to deliver learning in a competent manner.

An analysis of schemes of work and lesson plans for a whole term was undertaken, where the data was informed by the previous term's archival records of schemes of work and lesson plans, in order to provide to the researcher with evidence of the trend in teachers' planning for CLM in their on-going weekly instruction of mathematical concepts. The rating was done by weighting the frequency of the teacher's preparation of both sets of documents for each of the 60 mathematical concept lessons for the previous term; frequencies ranging between; 41 - 60 were weighted at high level preparation, 21 - 40 at mid-level preparation and 1 - 20 at low level preparation. This data is presented in Table 9.

Table 9: Teacher's Preparedness and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA			
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation
	N=20	n=7	n=73	n=217	n=342
Scheme of work preparation in line with CLM					
Low level preparation	65%	0%	12%	33%	55%
Mid-level preparation	5%	0%	14%	36%	50%
High level preparation	30%	2%	11%	34%	53%
Lesson plan of work preparation in line with CLM					
Low level preparation	80%	1%	13%	32%	54%
Mid-level preparation	20%	1%	6%	42%	51%
High level preparation	0%	0%	0%	0%	0%

Table 9 shows that all the three categories of learners: with teachers with high level, mid-level and low-level preparation had more than half of learners Exceeding Expectation (53%,

50% and 55% consecutively). There appeared to be quite a small margin between category performances across the grades, despite the varied levels of preparation. This would indicate that there may be other contributory factors beyond teacher preparation that contribute to learners' MCCA and emphasises the fact that teachers need to carry out fully all the aspects of CLM in lessons in order to realise maximum benefits in their learners' achievement of competence in mathematical concepts.

In the sample studied, none of the learners were taught by teachers who had a high level of preparation for their lesson plans. On the other hand, learners taught by teachers with low-level preparation of both scheme of work and lesson plan had the highest level of achievement 55% and 54% at Exceeding Expectation compared with the low and mid-level preparation categories. This finding may have been realized as a result of some of the teachers who never indicated in their planning whether they used CLM teaching organisation whereas they could have been using it (CLM organisation) in their teaching.

The implication is that high level preparation by teachers appears to guarantee a higher level of achievement in competence in mathematical concepts by their learners. This is because successful implementation of CLM requires detailed planning and organisation by the teacher as the facilitator, making their role absolutely critical. In addition, lesson preparation needs to be done effectively and on a regular basis; therefore, each teacher must know their learners well in order to plan appropriately for them (Gocer, 2010).

Table 9 highlights that from the teaching documents sampled, schemes of work appeared to have been done more consistently than lesson plans. In contrast to the lesson plans, it was notable that the schemes of work had verification signatures and stamps of the school head

teacher which had been done early in the term. This process of needing to obtain stamps and signatures would have compelled the teachers to be more conscientious in preparing their schemes of work in order to present them to the school authority.

It may have not been a requirement for lesson plans to be signed and stamped and therefore, their absence. Lesson planning documentation in order to prepare for lessons that occur several times daily requires a significant amount of time and places a huge demand on the part of the teachers. In many cases, the lack of lesson plans may be due to the heavy workload shouldered by teachers by virtue of the large-sized classes in most Kenyan schools.

Of greater concern was the fact that a large number of those teachers who had no schemes of work or lesson plans did not even realise that they ought to have prepared them. They believed that it was already done for them by virtue of having the Competency-Based Curriculum Design document. One teacher commented:

> *'The Competency-Based Curriculum (CBC) document has every lesson's breakdown that one would need to do for the scheme of work. If anything, if a teacher would still be expected to prepare a scheme of work, there is no adequate training that pre-school teachers have been given on the same. Pre-school teachers are never included when lower primary school teachers are attending CBC trainings facilitated by the local Curriculum Support Officers (CSOs) at the educational zone venues. We are told that pre-school teachers' training should be organised by the county government. Nonetheless, the content provided in the CBC is even much cheaper than what we have always handled before.'*

Another said:

> *'There is a new way of lesson planning as recommended and outlined in the CBC but it is quite complex and most of us have not been trained on the same. I just use the CBC design for the purposes of scheme of work and lesson plans and it works. My school administration has no issue with that fact, provided I as the teacher delivers.'*

This would appear to demonstrate that some teachers are completely unaware of the requirement for them to adequately prepare and plan for their lessons through documentation.

Consequently, through their lack of preparation and documentation, these teachers are less able to pay attention to the areas in which their learners may have deficits in mastering knowledge, and it is therefore difficult or almost impossible for them to know at what point they need to be putting remedial measures in place.

4.3.2.2 Classroom Management in Facilitation of CLM and Learners' MCCA

Roles in CLM are designed to be assigned to various learners in the same group to enhance their active involvement with regards to their individual accountability and group responsibility. Assigning roles to group members is more likely to encourage them to work cooperatively, to participate fully in the learning tasks, and ultimately to lead to effective learning. Slavin (2009) posits that when group members are assigned roles in cooperative learning, it creates in them a feeling of positive interdependence and challenges them to encourage and help one another to achieve their group's goal.

The observation of roles assigned to learners in the group and the class learning environment is presented in Table 10.

Table 10: Roles' Assignment to the CLM Group Members and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
A group member assigned the role of a reader						
Done	0%	0%	0%	0%	0%	0%
Not Done	100%	1%	11%	54%	54%	100%
A group member assigned the role of a recorder						
Done	0%	0%	0%	0%	0%	0%
Not Done	100%	1%	11%	54%	54%	100%
A group member assigned the role of a checker/quizzer						
Done	0%	0%	0%	0%	0%	0%
Not Done	100%	1%	11%	34%	54%	100%
A group member assigned the role of an encourager/police						
Done	0%	0%	0%	0%	0%	0%
Not Done	100%	1%	11%	34%	54%	100%
Any other roles assigned to learners other than the above CLM roles						
Done	60%	1%	11%	33%	55%	58%
Not Done	40%	1%	12%	36%	51%	42%

According to Table 10, none of the learners were assigned the role of eader, recorder, checker/quizzer or encourager/police. However, more than half (58%) of the learners were taught by teachers who assigned various roles to their learners, even though these were not CLM-oriented roles, whereas the rest (42%) were taught by teachers who did not assign any type of role.

The majority of achievers (55%) among learners whose teachers assigned various roles to learners Met Expectation above the grade mean. On the other hand, 51% of learners where teachers did not assign roles to them also Met or Exceeded Expectation; however, this was below the grade average mean.

Some of the role assigning observed was:

> *Teachers were appointing learners to respond to their oral questions and prompts during learning, calling upon them to act as counters, appointing some to solve some sums on the blackboard. At other times every one of them was to do the various tasks as*

they were being directed by the teacher as colleagues and or partners were confirming correctness of the same. Some learners were assigned the role of arranging the counters as per the teacher's prompts as the rest of the members counted. In other classes, learners were assigned the role of checking on their partners' learning tasks.

Whereas the assigning of roles to learners by teachers is an integral aspect of CLM, the role assignments observed were not in line with those recommended by CLM. Instead, they reflected the traditional methods of assigning roles, which simply maintains the status quo and does nothing to enable learners to experience more effective learning. The observed scenario is the most common classroom situation in most Kenyan schools. As such, improvement of MCCA by pre-school learners is not guaranteed. This limits the expected change of the focus of classrooms from being teacher-centred, where teachers impart knowledge to learners, to learner-centred where learners are expected to play a more active part in the process of their own knowledge construction. Consequently, making the most of the returns of peer-to-peer teaching in the small groups suppressed.

As CLM is a significant educational innovation that has enabled teachers in recent times to improve their learners' acquisition of competence in different areas, it would be of much greater benefit if teachers assigned roles in line with CLM guidelines in order to enhance acceptance of responsibilities within each learning group, which is a crucial aspect in the achievement of group goals (Cohen, et al., 2004)

4.3.3 Teachers' Provision of Learning Aids and Learners' MCCA

The use of appropriate educational materials is as equally important as the use of effective teaching methods when presenting Mathematics lessons. Effective instruction depends on both the skill of the teacher and the quality of the resources that they use for teaching and learning (Gauther and Lawson, 2004). The study sought to assess the provision and use of

learning aids in the facilitation of MCCA by teachers. The researcher observed the forms of learning aids used by the teachers in the delivery of mathematical concepts, their adequacy and whether they had been planned for in the professional documents for use in the learning process. The collected data is presented in Table 11.

Table 11: Teachers' Provision of Learning Resources and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Availability of learning resources during the lesson						
Done	95%	1%	12%	33%	55%	93%
Not Done	5%	2%	7%	52%	39%	7%
Adequacy of the available learning resources						
Done	95%	1%	12%	33%	55%	93%
Not Done	5%	2%	7%	52%	39%	7%

Table 11 shows that almost every learner (93%) was provided with learning resources and only a small minority of them (7%) were not. While more than half (55%) of learners who were provided with learning resources Exceeded Expectation, more than half (52%) of the learners who were not provided with learning resources were graded lower - at Meeting Expectation. This appears to substantiate the notion that availability of learning resources influences utilisation of any hands-on method of learning (Muriithi, 2013), CLM being a good example.

With regard to the adequacy of resources, the study found that the available learning materials were adequate for almost all the learners (93%). In the majority of cases, teachers shared most of the learning resources from the classroom learning corners. Making use of these resources was a guaranteed way of ensuring availability of learning materials whenever

needed for learning in lessons. The need for adequate learning materials for particular class sizes is essential (Caven, 2009), which was demonstrated during the study, as classes on average varied in size between 20 and 30 learners. This is a favourable aspect to CLM given that a learner gets a chance to share personal experiences of others in addition to those of the individual learner.

From the researcher's observation, teachers employed a variety of learning aids, including some who employed more than one type of learning aid, as shown in Table 12. The types of learning materials provided in the classes observed included: sketches, bottle tops, letter cards, seeds, action songs, realia, and learners themselves were used as counters.

Table 12: Forms of Learning Resources Applied in the Lesson and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Visual learning aids applied						
Done	60%	2%	17%	40%	42%	55%
Not Done	40%	1%	5%	27%	68%	45%
Audio learning aids applied						
Done	0%	0%	0%	0%	0%	0%
Not Done	100%	1%	11%	34%	54%	100%
Audio visual learning aids applied						
Done	0%	0%	0%	0%	0%	0%
Not Done	100%	1%	11%	34%	54%	100%
Tactile learning aids applied						
Done	65%	0%	8%	27%	65%	65%
Not Done	35%	3%	18%	47%	32%	35%

From Table 12 it is evident that more than half (55%) of the learners were provided with visual learning aids, while almost two thirds (65%) were provided with tactile learning aids. No audio or audio-visual learning aids were provided. The data in Table 12 shows that tactile learning aids are favoured over audio ones for learner achievement. For optimal results, use

of these materials should not be limited to teacher demonstration, but rather learners must be given the opportunity to make use of them in meaningful ways.

Less than half (42%) of learners who had access to visual resources Exceeded Expectation, whereas 68% learners who used another type of learning resource (specifically tactile resources) Exceeded Expectation. The majority of learners, 65%, who used tactile learning resources Exceeded Expectation, whereas only 32% of those who used an alternative (visual learning aids) Exceeded Expectation.

Table 13 shows the documentary analysis regarding frequency of learning materials provided.

Table 13: Documentary Analysis of Learning Material Provision and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Teacher frequency of provision of learning materials to the learning groups						
Never/not indicated	60%	2%	12%	47%	42%	33%
Rarely	0%	0%	0%	0%	0%	0%
Often	0%	0%	0%	0%	0%	0%
Very Often	40%	1%	11%	26%	64%	67%

Table 13 indicates that the majority of learners (67%) were provided with learning materials very often and the majority of them (64%) Exceeded Expectation. However, it was striking to note that for 60% of learners there was no evidence of their teachers ever providing them with learning materials; however, this may have been due to their teachers not indicating that they provide materials even though they actually do so. This saw the highest achieved grade to be Meeting Expectation (47%). None of the teachers were noted as either rarely providing or often providing learning resources to their learners. This is probably because most of them

sourced the learning resources from their classes' learning corners, where they were readily available.

It is worth noting that Njoroge and Githua (2013) found when they were researching the causes of poor performance in Murang'a County that lack of available learning materials was a major factor that hampered learners' understanding of mathematical concepts.

The teachers' opinion about the extent of their provision of learning materials for their learners was elicited by the use of a questionnaire, as presented in Table 14.

Table 14: Teachers' Provision of Learning Aids to Learners and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Teachers' providing learning materials						
Never/not indicated	55%	0%	0%	0%	0%	0%
Rarely	40%	0%	0%	0%	0%	0%
Often	5%	0%	15%	34%	51%	6%
Very Often	0%	1%	11%	32%	50%	94%

Table 14 indicates that the vast majority of learners (94%) were said to be provided very often with adequate learning materials. Teacher opinion was almost the same as that about the extent of the provision of learning materials. This appears to indicate the difference between the ideal and the reality: teachers understand the necessity for learning aids in the learning process, however, it is not always possible to provide them, which may be due to unavailability or inadequacy of materials, as well as teacher failure to make use of resources. Using learning aids, particularly tactile ones, is beneficial because this gives learners the opportunity to manipulate them, thereby developing finger muscle dexterity and fine

psychomotor skills. Furthermore, these aids foster observational skills, as well as raising learning interest in learners (Mohammad, 2004). Going by Skinner (1938) learning resources reinforces acquisition of the concepts being learnt.

4.3.4 Time Taken in CLM Activities and Learners' MCCA

Table 15 presents the data collected using the observation schedule during the learning session of the actual observation of teachers' time taken in CLM activities.

Table 15: Observed Teachers' Time Taken in CLM Activities and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Teacher setting rules to be followed the CLM groups						
Done	15%	2%	11%	34%	54%	89%
Not Done	85%	0%	16%	38%	46%	11 %
Teacher designing tasks to be undertaken by each CLM group						
Done	25%	1%	11%	34%	54%	100%
Not Done	75%	0%	0%	0%	0%	0%
Teacher observing learners' individual work by random checking						
Done	0%	1%	11%	34%	54%	18%
Not Done	100%	1%	12%	34%	53%	82%
Teacher observing learners' individual work by asking them to explain their answers						
Done	20%	1%	7%	35%	57%	51%
Not Done	80%	2%	16%	36%	47%	49%
Teacher observing learners' individual work by assigning them various roles						
Done	0%	2%	12%	32%	54%	57%
Not Done	100%	0%	10%	37%	52%	43%
Teacher specifying time for CLM groups' task completion						
Done	0%	0%	9%	18%	73%	37%
Not done	100%	2%	14%	45%	40%	63%

Table 15 highlights the impact of the variation in teacher activities, but with a similar trend: the lower the grade, the lower the percentage was of learners who achieved, whereas the higher the grade, the higher the number of learner achievers rose. There is a consistency in the achievement of learners whose teachers undertook CLM activities and those who scored

the highest grade (Exceeding Expectation) in greater numbers compared to their peers, whose teachers never took time in undertaking CLM activities.

Organising learning in small groups does not necessarily imply that students will work together and support each other in mastering their learning tasks. Occasionally, in the highest category (Exceeding Expectation), there were learners who were taught by teachers who took time in undertaking CLM activities but who did not achieve 50%. These were in situations where teachers did not undertake the CLM requirements of setting rules to be followed by the CLM groups (46%), observing learners' individual work by asking them to explain their answers (47%) or specifying time for the completion of the CLM group tasks (40%). If these activities are not undertaken successfully, cooperative learning is less likely to be very effective.

Every teacher (100%) designed learning tasks to be undertaken by each one of their CLM groups. There was no unduly significant disparity in the achievement of competence in mathematical concepts in many of the CLM activities undertaken by teachers, except where teachers specified time for the completion of a CLM group task. There was a relatively large disparity between the 73% of learners whose teachers specified time for their CLM group tasks completion and the 40% of those whose teachers did not do this.

In every grade category, the achievement of learners whose teachers took time to undertake CLM activities was always above the average mean score for each grade (54%). Teachers who set rules to be followed in the CLM groups, who specified time for the completion of CLM group tasks, who designed tasks for each CLM group, and who observed individuals'

work by random checking, asking them to explain their answers and by assigning them various roles achieved 54%, 54%, 73%, 57%, 54% and 54% consecutively.

Notably, although teachers never used all of the measures specified by CLM when undertaking the lesson, they used at least one or two of them alternately. Other observations made indicated that:

> *When setting rules, some classes only received general instructions from the teacher, where both learning groups and whole class group organisation was applied.*
>
> *When designing of tasks to be undertaken by learners, some teachers gave direction to the groups by prompting them on what to do.*
>
> *When teachers observed learners' individual work, some individual learners were appointed to act on the teacher's prompts as other learners were following. In other cases, some teachers just went round marking the learners' individual work around the class. If anything, in some cases, learners were working individually and not in a group setting. In some other cases, learning groups were rotated to assess completed learning work/tasks by other groups. Most often, specifying time for CLM group task completion was done at the end of the task where the teacher called the class to order when the lesson came to an end.*

Implementing learning in small groups needs careful consideration. Not only must learning tasks be carefully structured, but consideration must also be given to how the teacher takes time to set conditions and processes that enhance social interaction between team mates.

A documentary analysis of the time taken by teachers in carrying out CLM activities was undertaken, as presented in Table 16.

Table 16: Documented Teachers' Time Taken in CLM Activities and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Frequency of setting rules to be followed by learning groups						
Never/ not indicated	60%	1%	10%	26%	64%	57%
Rarely	0%	2%	13%	45%	40%	43%
Often	0%	0%	0%	0%	0%	0%
Very often	40%	0%	0%	0%	0%	0%
Frequency of designing tasks for learning groups						
Never/ not indicated	100%	1%	11%	27%	62%	56%
Often	0%	0%	0%	0%	0%	0%
Very often	0%	0%	0%	0%	0%	0%
Very often	0%	2%	12%	42%	43%	44%
Frequency of specifying time for completion of tasks by learning groups						
Never/ not indicated	65%	0%	11%	29%	60%	60%
Rarely	0%	2%	12%	42%	44%	40%
Often	0%	0%	0%	0%	0%	0%
Very often	35%	0%	0%	0%	0%	0%

Table 16 presents data collected using the documentary analysis guide. None of the learners were taught by teachers who rarely or often set rules to be followed by learning groups and none of them were taught by teachers who rarely or often took time specifying the time limit for the completion of tasks. The majority of the teachers either never undertook the setting of rules to be followed (57%), designing tasks (56%) or specifying time for completion of tasks (60%) or did not indicate it in the documents seen and analysed.

Interestingly, the majority of learners taught by teachers who either never took time undertaking CLM activities or where it was not indicated Exceeded Expectation at 60%, 62% and 64% consecutively. It is therefore possible that the details indicating the implementation of CLM activities were never included in the documentation. This would most likely be due to the fact that most of the lesson plans made available to the researcher were extremely brief and the reality is that establishing cooperative learning in a classroom requires teacher

commitment to embedding the procedures into the pre-school curriculum and in implementing, monitoring, and evaluating it (Gillies & Boyle, 2010).

Teacher opinion on their frequency of carrying out various CLM activities, collected through the questionnaire, is presented in Table 17.

Table 17: Teachers' Opinion on Time Taken in CLM Activities and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Teachers' setting rules						
Never or not indicated	35%	0%	0%	0%	0%	0%
Rarely	60%	0%	0%	0%	0%	0%
Often	0%	0%	0%	11%	89%	7%
Very Often	5%	1%	11%	36%	51%	93%
Teachers' designing tasks						
Never or not indicated	55%	0%	0%	0%	0%	0%
Rarely	40%	0%	0%	0%	0%	0%
Often	5%	0%	15%	34%	51%	6%
Very Often	0%	1%	14%	40%	63%	94%
Teachers' specifying time for the task completion						
Never or not indicated	45%	0%	0%	0%	0%	0%
Rarely	50%	0%	0%	0%	0%	0%
Often	5%	0%	0%	3%	97%	5%
Very Often	0%	1%	14%	42%	62%	96%

Table 17 shows teachers' responses on their perceived level of time taken in CLM activities (as per the questionnaire completed by teachers) that reflected a variation from what was observed in the learning session. Although the majority of teachers did not apply all three of the CLM coordination activities, none indicated that they never did it. Almost every teacher indicated that they set rules (93%), designed tasks (94%) and specified time for task completion (96%). Where teachers set rules, almost every learner Exceeded Expectation

(89%), compared with teachers who indicated that they did it very often, who only had about half (51%) of their learners Exceeding Expectation.

Even though the majority of learners taught by teachers who designed learning tasks Met and Exceeded Expectation, a larger percentage of learners Below Expectation or Approaching Expectation had teachers who said that they did it very often. There were no learners Below Expectation or Approaching Expectation among learners taught by teachers who specified time for task completion often, compared to those who said that they did it very often.

Teachers' reluctance to embrace CLM may also be due to the lack of time to learn about peer-mediated methods, because of the challenge they perceive it might pose to their control of the learning process, the demands it places on classroom organisational changes, or the professional commitments required to sustain their efforts (Cohen et al., 2004). This perception may cause teachers to prefer traditional teaching methods over CLM, where they learners spend more time listening to what the instructor has to say (Kamau, 2010). This diminishes learners' chances of benefiting from the concept of CLM as an instructional method in which they work together with the aim of maximising their own and each other's learning in the pursuit of a common objective. This observation goes against the basics of human learning and the disposition of pre-school children to imitate behaviour observed in others, through modelling Bandura (1999).

4.3.5 Teacher Interaction Level in CLM Facilitation and Learners' MCCA

There is a great need for social interaction between group members, as well as support at individual level, to avoid adverse experiences when learners face challenges in their learning teams, such as controversial suggestions, ideas and strategies. Teachers can support by

maintaining discipline, assessing completed tasks, providing feedback on performance and monitoring learner contributions.

4.3.5.1 Teacher Monitoring of Learner Contribution and Learners' MCCA

Monitoring learning groups creates individual accountability in the sense that whenever a teacher observes a group; members tend to feel accountable to be constructive members. In small group learning, such as CLM, a problem may occur if learners with greater social skills are enabled to participate more frequently in group activities and, thus, have more opportunities to learn. Neglecting the members of the group who have poorer social skills may curb not only their achievement but also the achievement of all members, because even potentially important contributions by members who interact less can be lost (Cohen, 1994).

In pre-school settings, social skill status is determined by how well individual children interact with others and how much they are able to mix and work together with their peers. Consequently, this affects the way in which each learner is recognised by his or her peers. For this reason, Cohen et al. (1994) emphasise the need to monitor the contribution of all group members in order to gain maximum benefit from the learning task being undertaken. Cohen et al. demonstrate that learners of both high and low social skill status show comparable amounts of participation with monitoring intervention, although learners with higher status, and therefore greater social skills, still offer more help.

Teacher monitoring of learners' contributions during learning activities was observed and the data is presented in Table 18.

Table 18: Teacher Monitoring of Learner Contribution and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Monitoring every learner's contribution in the CLM groups						
Done	15%	1%	14%	18%	67%	94%
Not Done	85%	0%	3%	13%	84%	6%
Monitoring every learner's contribution during learning by directing their group work						
Done	15%	1%	11%	34%	54%	100%
Not Done	85%	0%	0%	0%	0%	0%
Monitoring every learner's contribution during learning by paraphrasing						
Done	15%	1%	11%	34%	54%	100%
Not Done	85%	0%	0%	0%	0%	0%
Monitoring every learner's contribution during learning by energising the group						
Done	15%	1%	11%	34%	54%	96%
Not Done	85%	0%	18%	43%	39%	4%
Monitoring every learner's contribution during learning by describing learners' feelings						
Done	15%	1%	11%	34%	54%	96%
Not Done	85%	0%	18%	43%	39%	4%

Table 18 shows that almost every learner (96%) was taught by teachers who were keen to monitor their contribution while carrying out learning activities, using a variety of ways to do so. Only a very small portion of learners (4%) did not have a teacher who was keen to monitor their contribution during learning.

Surprisingly, the data appears to indicate that learners who were never monitored in their contribution during learning were among the higher percentage of learners who Exceeded Expectation (84%) compared to those who were monitored (67%). This can be attributed to the extremely small percentage of learners who were never monitored in the carrying out of learning tasks (6%) in comparison to those who were monitored (94%).

Every teacher (100%) monitored learner contributions in lessons, either by directing group work and/or by paraphrasing. In both cases, the majority of learners Met and Exceeded

Expectation (34% and 54% respectively). Monitoring every learner's contribution during learning by energising the group was done for 96% of the learners, whereas for 4% it was not. The same percentage was registered for monitoring learner contributions by describing learners' feelings. In both cases, a greater percentage of learners Exceeding Expectation (54%) were monitored using the two ways compared to those who were not (39%).

Other means that some teachers employed to assess learner contributions during lessons were:

> *Teachers appointed various learners to carry out certain learning tasks. These tasks involved solving specific sums on the blackboard as the whole class observed and followed. In other cases, the teachers went round assessing every learning group's or individual's performance on the given learning tasks.*

Teachers' opinion on their assessment of their learners' contribution is presented in Table 19.

Table 19: Assessment of Learner Contribution and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Non-assessment of learners' contribution in learning groups during learning						
Strongly disagree	65%	2%	16%	37%	45%	60%
Disagree	35%	1%	5%	29%	66%	40%
Reversal of non-assessing of learner contribution in learning groups during learning						
Agree	35%	1%	5%	29%	66%	40%
Strongly Agree	65%	2%	16%	37%	45%	60%

Rating themselves on the same statement aspect of CLM but negated (assessment of learners' contribution in their learning groups), 60% of learners had teachers who strongly agreed and 41% disagreed. The same statement was reversed on the SPSS worksheet and yielded the

same results, where 41% agreed and 60% strongly disagreed that they did not assess learners' contribution in their learning groups during learning.

Interestingly, those who disagreed (as opposed to strongly disagreeing) that they did not assess their learners' contribution during learning had their learners performing better in the highest grade of Exceeding Expectation (66%) than those who strongly disagreed (45%). They also registered the least percentages of low achievers (Below Expectation and Approaching Expectation).

Despite the variation in teachers' indicated frequencies of their extent of assessing learners' contribution in learning groups, during classroom observations every one of them was seen on a regular basis to be checking that every learner was actively participating in the learning. This is an absolutely essential aspect of successful pedagogy, as it is through regular checking that teachers receive diagnostic information about their learners' learning processes, difficulties, and outcomes, which they are able to apply and use again in their teaching (Uerdingen, 2002). This agrees with the dyadic exchange proposed by Homans (1961), Thibaut and Kelley (1978) where the balance of rewards and costs in social exchanges determines the learning process in a group of learners.

This is good teaching practice and should be maintained, because it can also be used to provide feedback to parents and other stakeholders about learner progress.

4.3.5.2: Teacher Assessment of Completed Tasks and Learners' MCCA

The researcher personally observed teachers' assessment of learners' completed tasks and the data is as shown in Table 20.

Table 20: Teachers' Assessment of Learners' Completed Tasks and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Status of assessment of the learners' completed tasks during the lesson						
Done	85%	1%	11%	34%	54%	100%
Not done	15%	0%	0%	0%	0%	0%
By individual tests						
Done	15%	1%	11%	34%	54%	100%
Not Done	85%	0%	0%	0%	0%	0%
By random tests to one group member orally						
Done	10%	1%	8%	45%	46%	34%
Not done	90%	1%	13%	28%	57%	66%
By random tests to one group member written						
Done	0%	2%	8%	32%	59%	8%
Not done	100%	1%	12%	34%	53%	92%

Every learner was taught by a teacher who assessed completion of tasks well during the lesson, as shown in Table 20. All learners had the opportunity to be assessed by individual tests, where they responded individually to mathematical problems posed to them by their teacher. This is very much in order, given that assessment of learners' achievement highlights individual and group accountability, by reflecting how well each learner performs and also indicates whether the learning group achieved its goals.

Less than half (34%) of the learners were assessed by random tests to one group member orally; in such cases their achievement was almost equal among the learners who Met Expectation (45%) and Exceeded Expectation (46%). This form of random assessment was done by learners being appointed to respond to the teachers' prompts on a learning task being carried out by the teacher on the blackboard while others watched.

Only a very small portion of the learners (8%) were assessed by random written tests for one group member. Assessment was undertaken by the teacher appointing a learner to solve a

given sum on the blackboard as the rest of the class watched. At times, the other class members would respond to this learner and at times correct them where they went wrong. In these instances, the majority of achievers Met Expectation (32%) or Exceeded Expectation (59%).

It is evident that about 90% of learners taught by teachers who carried out assessment of learning completed tasks in any of the three ways and in doing so Met and Exceeded Expectation in their achievement. This is seen where achievement was 88% for those assessed by individual tests, 91% for those assessed by random tests to one group member orally and 91% for those assessed by random tests to one group member written. CLM provides a voice for every learner and a contribution during learning to fulfil their potential within a pro-social and caring learning environment (Aronson 2000; Kohn 2000). As such, learners would uphold confidence that enhances their mutual learning for effective numeracy achievement. It is therefore, in agreement with the social interdependence theory whereby learning success happens when individual learners share common goals and that each one's success is affected by the actions of the others.

4.3.5.3: Teacher Provision of Feedback on Performance and Learners' MCCA

Teacher feedback on learner performance is extremely critical for learner motivation, as well as for taking any other necessary decision-making with regards to individual group activities during learning. The teacher does this by providing comments to every group's performance in the specified learning tasks in the lesson.

CLM has three specific forms of providing feedback to learners: providing results to a group, individuals or having learners edit each other's work. The data observed on this is as shown in the Table 21.

Table 21: Teacher's Provision of Feedback on Performance and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=0	n=49	n=179	n=411	n=639
Status of teacher's provision of feedback on the groups' performance						
Done	10%	0%	8%	28%	64%	100%
Not done	90%	0%	0%	0%	0%	0%
Teacher's provision of results to a group						
	N=20	n=7	n=73	n=217	n=342	n=639
Done	5%	0%	11%	32%	57%	22%
Not done	95%	1%	12%	35%	52%	78%
Teacher's provision of results to individuals						
Done	10%	1%	11%	34%	54%	96%
Not done	90%	0%	14%	36%	50%	4%
Teacher's provision of results by having learners edit each other's work in CLM						
Done	0%	0%	2%	8%	91%	10%
Not done	100%	1%	13%	37%	50%	90%

According to Table 21, every learner (100%) received feedback from their teacher in one or more ways. A relatively small portion of learners (22%) received their results in their groups. None of these learners scored Below Expectation, whereas the majority Met and Exceeded Expectation (32% and 57% respectively). The majority of those learners who did not get their results in groups had Met and Exceeded Expectation at 35% and 52% respectively. This would be because the teachers may have used another way or ways of providing feedback to the learners. The vast majority of learners (96%) received their results individually, but their level of mastery and achievement, Meeting and Exceeding Expectation (34% and 54%), was low compared with those learners who did not receive results individually (36% and 50%

respectively). This would be attributed to the small number of those learners whose results were not provided individually.

It was encouraging to see that there were teachers who provided results to individual learners within their learning groups and where they also took extra time to comment on certain learners' performance, especially those who seemed to have specific difficulties. They did this as they went around the class marking individual learners' completed work. This provided considerable assurance to the learners, who responded to the positive feedback received from their teachers.

The smallest group of learners (10%) received feedback through editing each other's work in their CLM groups. The vast majority of this category Exceeded Expectation (91%) and none of them were Below Expectation. This result is in agreement with the findings of Chianson, Kurumeh and Obida, (2010) and Adebowale and Ojo (2012) from the use of cooperative strategies in teaching Mathematics in senior classes, which indicated a high level of interest and retention by students, and concluded that CLM is an ideal instructional method for facilitating the acquisition of competence in mathematical concepts for pre-school learners. Providing feedback to learners gives individual accountability for mastery of the learning content, as well as group responsibility for the same and so it encourages all learners to support one another.

Individual and group feedback provision activities are intended for both the learners and the teacher (Duplass, 2006 and Schul, 2012). This is more often implemented through marking and/or commenting on learners' learning completed tasks. Table 22 presents data collected

through the questionnaire on teacher provision of feedback and their marking of learners' learning tasks.

Table 22: Frequency of Teacher Provision of Feedback, Marking and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Provision of feedback						
Never	0%	0%	0%	0%	0%	0%
Rarely	0%	0%	15%	34%	51%	6%
Often	30%	0%	0%	0%	0%	0%
Very Often	70%	1%	11%	34%	54%	94%
Marking of learners' tasks						
Never	0%	0%	0%	0%	0%	0%
Rarely	0%	0%	0%	0%	0%	0%
Often	30%	0%	0%	0%	0%	0%
Very Often	60%	1%	11%	34%	54%	100%

Teachers' views about whether and how frequently they provide feedback to their learners, as shown in Table 22, gives the impression that almost every teacher (94%) does it very often, with only a very small portion considering that they rarely do it. Nevertheless, their learners' achievement was almost equal across the grades. All teachers were positive about their marking of their learners' completed work. This coincided with what was observed in the classroom. This would imply that marking, as an indication of the teacher's checking the extent to which the learner understands mathematical concepts may have been effectively carried out by every teacher irrespective of the frequency. Another possibility is that the teachers who indicated that they did the marking rarely may not have been keen in their response to the particular research question item; they may have been doing it very often too.

4.3.5.4: Teacher Maintenance of Discipline and Learners' MCCA

Due to their short concentration spans, self-restraint does not come automatically to pre-school learners. Consequently, they have a tendency to be distracted by things in the classroom unrelated to the lesson, causing them to abandon what they are supposed to be doing for the purpose of learning in the lesson. For this reason, it is really important that teachers maintain discipline in the classroom. Teachers' method to ensuring the maintenance of discipline during learning was observed and the data is presented in Table 23.

Table 23: Teachers' Ensuring Discipline Maintenance and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Ensuring discipline maintenance in the CLM groups						
Done	15%	1%	11%	34%	54%	100%
Not done	85%	0%	0%	0%	0%	0%
Using quiet voice						
Done	5%	1%	11%	34%	54%	100%
Not done	95%	0%	0%	0%	0%	0%
Using voice monitor						
Done	0%	0%	0%	0%	0%	0%
Not done	100%	1%	11%	34%	54%	100%
Using participation monitor						
Done	0%	2%	7%	52%	39%	7%
Not done	100%	1%	13%	35%	51%	93%
Using voice monitoring						
Done	0%	2%	7%	52%	39%	7%
Not done	100%	1%	13%	35%	51%	93%
Using turn-taking monitoring						
Done	0%	0%	0%	0%	0%	0%
Not done	100%	1%	11%	34%	54%	100%

As shown in Table 23, the observational data highlights that all teachers (100%) maintained discipline in their classes by using one or more ways to do so, in line with CLM. In this area, the greater majority of the learners either Met (34%) or Exceeded Expectation (54%). All

learners had teachers who ensured discipline with a quiet voice, with the learners Meeting Expectation (34%) and Exceeding Expectation (54%). None of the learners had teachers ensuring discipline in their learning groups by either using voice monitoring or by using turn-taking monitoring. A very small portion of learners (7%) had teachers who ensured discipline by using participation monitor and/or using voice monitoring. These registered more than half of the learners (52%) only Meeting Expectation, while just over a third of them (39%) Exceeded Expectation.

An observation made about how the maintenance of discipline in learning groups was ensured was:

> *In most of the classes' teachers controlled the learners by establishing keen eye-contact with them, and at times warning them against inattention and even punishing them when they misbehaved. Some teachers silenced noise makers and threatened them that the 'visitor' (the researcher) was noting those who were misbehaving down. This would silence the noise makers but make them suspicious of the researcher; they could be seen whispering to one another when the teacher was not facing them. To capture the attention of every leaner, some teachers would ask the class members to confirm whether the various appointed problem solvers got it right on the sums they were solving on the board or in groups. Inattentive learners were also called upon to do some tasks in front of others in order to occupy them while the distracted ones were reprimanded and redirected into the lesson by the teacher.*

Table 24 shows teachers' view of their success in ensuring discipline in learning groups.

Table 24: Teachers' Frequency of Ensuring Discipline and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Teacher's ensuring discipline						
Never	65%	0%	0%	0%	0%	0%
Rarely	20%	0%	0%	0%	0%	0%
Often	5%	0%	15%	34%	51%	6%
Very Often	10%	1%	11%	34%	54%	94%
Non-assurance of discipline of CLM groups						
Strongly disagree	10%	2%	17%	39%	42%	55%
Disagree	5%	1%	6%	29%	65%	28%
Agree	25%	0%	3%	13%	84%	6%
Strongly Agree	60%	0%	3%	31%	66%	11%
Reversal: Non-assurance of discipline of CLM groups						
Strongly disagree	60%	0%	3%	31%	66%	11%
Disagree	25%	0%	3%	13%	84%	6%
Agree	5%	1%	6%	29%	65%	28%
Strongly Agree	10%	2%	17%	39%	42%	55%

Table 24 illustrates that almost every teacher (94%) considered that they ensured discipline in learning groups very often, with only 6% saying often. Learners whose discipline was assured very often outperformed across all the grades those whose discipline was often assured. In fact, only 1% of learners whose discipline was said to be very often assured by their teachers performed Below Expectation, whereas no learner who performed Below Expectation had a teacher who considered that they ensured discipline often. This appeared to correspond more or less to the responses registered by the same teachers on the same question when it was reversed. As previously noted, reversing the statements was a means of verifying whether teachers had understood the previous question. The corresponding of the responses proved that the teachers had understood and had responded appropriately. This agrees with (Donham, 2009) finding that ensuring discipline guarantees maintenance of order

in the learning environment and this enables the teacher to address the needs of learners with learning difficulties. It is explained by Deutsch (1962) that positive interdependence tends to result in promotive interaction; that must have guaranteed improved achievement of the mathematical concepts' competences.

4.3.5.5 Regression Model on Teacher Facilitation of CLM and Learners' MCCA

To determine the contribution made by the teacher's facilitation of CLM to MCCA, the data was subjected to a regression model procedure. This is presented in Table 25.

Table 25: Regression Model on Teacher Facilitation of CLM and Learners' MCCA

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	0.392[a]	0.154	0.461	0.676

ANOVA on Teachers' CLM Facilitation and Learners' MCCA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	52.457	5	8.743	19.134	.000[b]
Residual	288.782	633	0.457		
Total	341.239	638			

Coefficients of Teachers' CLM Facilitation and Learners' MCCA

Model	Unstandardized Coefficients		Standardised Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.221	0.194		16.626	0.000
Availability of Groupings	0.472	0.057	0.323	8.240	0.000
Teacher preparedness	0.092	0.060	0.106	1.538	0.125
Level of Coordination	0.132	0.061	0.150	2.172	0.030
Level of Provision of Learning Resources	0.173	0.069	0.130	2.486	0.013
Time taken in CLM Activities	0.207	0.046	0.217	4.533	0.000
Level of Interaction	0.149	0.039	0.186	3.769	0.000

a. Dependent Variable: Mathematical Concepts Competences Acquisition

b. Predictors: (Constant), Availability of Groupings and Teacher preparedness, Level of Provision of Learning Resources, Level of Coordination, Level of Interaction, Time taken in CLM Activities

Table 25 shows Regression analysis of the relationship between the identified predictor variables: availability of groupings and teacher preparedness, level of provision of learning resources, level of coordination, level of interaction, time taken in CLM activities and the

dependent variable (mathematical concepts competences acquisition (MCCA)). The analysis showed that R = 0.392, R Square = 0.154 and adjusted R Square = 0.461 with a standard error of the estimate at 0.676. This means that for pre-school learners in Kirinyaga County, 46.1% (0.461×100) of the MCCAT achievement would be attributed to the use of CLM as an instructional method. This confirms the finding by Gubbad (2010) that CLM changes classroom learning dynamics where groups of learners, even at pre-school level, share classroom learning facilitation collectively. As a result, it is no longer the exclusive duty of the instructor to impart mathematical concepts to the learners but they too actively construct their own knowledge, hence improving their learning performance.

ANOVA also produced the statistics ($F(5,633=19.134$, $p<0.05$, $p<0.000$) and the coefficients are: $\beta=0.323$, 0.106, 0.150, 0.130, 0.217 and 0.186; $t=8.240$, 1.538, 2.172. 2.486, 4.533 and 3.769; and $p=0.000$, 0.125, 0.030, 0.013, 0.000 and 0.000 consecutively.

The findings indicate that the regression model is a significant predictor of MCCA. It therefore means that teacher facilitation of mathematical concepts competences using CLM is a significant predictor of MCCA in Kirinyaga County. However, teacher preparedness, as a variable in teacher facilitation of CLM, was found to be an insignificant predictor of MCCA in pre-school learners in Kirinyaga County. This finding seems to partially agree with research studies by Edwards et al., (2000) and Ukpokodu (2002) where it was difficult to identify specific mode of preparedness related to teacher effectiveness.

The Correlation coefficients show that a unit increase in the availability of groupings, level of provision of learning resources, level of coordination, level of interaction and time taken in CLM activities would increase the MCCA of pre-school learners in Kirinyaga County by

1.212 units (0.323+0.106+ 0.150+ 0.130+ 0.217+ 0.186). This is because CLM positively correlates with mathematical concepts acquisition of the learners in Kirinyaga County.

4.4 Teacher Attitude towards CLM and Learners' MCCA

This analysis was undertaken as part of the second hypothesis of the study questioning the extent to which there may be a difference between the mean score index of pre-school learners taught by teachers with favourable and unfavourable attitudes towards CLM. Teachers' attitude to instructional methods for acquiring competence in mathematical concepts has a key role to play in determining their desire to apply the instructional methods, given that this may perhaps influence their willingness to use them to teach and ensure that learners are successful in MCCA (Gillies and Boyle, 2010).

Teacher attitude to CLM and the competences that pre-school learners had in mathematical concepts were analysed under five themes: level of preparation, level of involvement, level of provision of resources, amount of time taken in CLM activities and level of monitoring. The analysis is presented under these subheadings in the order of teachers' attitude description, regression and coefficients on teacher attitude and the MCCA of their learners.

4.4.1 Teacher Attitude to CLM and Learners' MCCA

Teachers' own opinion on the status of their attitude to CLM was obtained by weighing their extent of using CLM, their preference for CLM as the best instructional method, their dislike of using CLM, their view of CLM as not a waste of time, their interest in using CLM and motivation in using CLM. A reversal of the statement regarding teachers' dislike of using CLM was given in order to verify their consistency in their response to the statement.

This information was collected through a questionnaire as presented in Table 26.

Table 26: Teachers' Views on Their Attitude to CLM and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Teachers' extent of using CLM						
Not At All	0%	0%	0%	0%	0%	0%
Moderate Extent	0%	0%	0%	0%	0%	0%
Great extent	30%	0%	18%	48%	34%	23%
Very great extent	70%	1%	10%	30%	59%	77%
Teacher preference of CLM as the best method						
Strongly disagree	5%	5%	4%	12%	79%	3%
Disagree	15%	15%	7%	34%	44%	17%
Undecided	10%	10%	19%	48%	23%	7%
Agree	20%	20%	8%	21%	51%	17%
Strongly Agree	50%	50%	13%	38%	44%	56%
Teachers' dislike of using CLM						
Strongly disagree	50%	0%	15%	34%	51%	51%
Disagree	30%	0%	8%	35%	57%	29%
Undecided	5%	5%	27%	73%	0%	4%
Agree	10%	10%	3%	29%	58%	13%
Strongly Agree	5%	5%	4%	12%	79%	4%
Reversal of teachers' dislike of using CLM						
Strongly disagree	5%	5%	4%	12%	79%	4%
Disagree	10%	10%	3%	29%	58%	13%
Undecided	5%	5%	27%	73%	0%	3%
Agree	30%	0%	8%	35%	57%	29%
Strongly Agree	50%	0%	15%	34%	51%	51%
Teachers viewing CLM as not a waste of time						
Strongly disagree	0%	0%	0%	0%	0%	0%
Disagree	0%	0%	0%	0%	0%	0%
Undecided	15%	5%	12%	46%	37%	16%
Agree	50%	0%	11%	37%	52%	49%
Strongly Agree	35%	5%	11%	24%	60%	34%
Teacher interest in using CLM						
Strongly disagree	0%	0%	0%	0%	0%	0%
Disagree	5%	5%	10%	20%	65%	3%
Undecided	5%	5%	27%	68%	0%	3%
Agree	40%	0%	10%	27%	63%	38%
Strongly Agree	50%	0%	11%	37%	52%	56%
Teacher motivation in using CLM						
Strongly disagree	0%	0%	0%	0%	0%	0%
Disagree	5%	5%	10%	20%	65%	3%
Undecided	0%	0%	0%	0%	0%	0%
Agree	75%	5%	12%	37%	46%	78%
Strongly Agree	20%	0%	10%	23%	67%	19%

Table 26 shows teachers' opinion of their attitude to using CLM for facilitating their learners' acquisition of mathematical concepts. On the Likert scale, the majority of teachers (77%) considered that they used CLM to a very great extent, whereas 23% said they used it to great extent. In response to the statement that using CLM was their best preference, 56% strongly agreed, 17% agreed, 7% were undecided, 17% disagreed and 3% strongly disagreed. The statement that teachers disliked using CLM while teaching mathematical concepts competences had 51% strongly disagreeing, 29% disagreeing, while 3% were undecided. However, 13% agreed and 4% strongly agreed that they disliked using CLM for teaching mathematical concepts.

Coincidentally, the information corresponded to the responses registered on the reversal of the item on the same questionnaire. A relatively higher percentage of learners were taught by teachers who viewed CLM as not a waste of time, 34% of their teachers strongly agreed, 49% agreed, while 16% were undecided. None of the respondents neither disagreed nor strongly disagreed that CLM was not a waste of time for teaching mathematical concepts.

The statement that teachers had an interest in CLM was widely held, with 56% strongly agreeing, 38% agreeing and 3% undecided. However, 3% disagreed with the statement. The same applied to teacher motivation for using CLM for teaching competence in mathematical concepts, where 19% strongly agreed that they were motivated to use CLM, 78% agreed, none were undecided, but 3% disagreed.

Subsequently, the majority (55%) of learners taught by teachers who used CLM to a very great extent Exceeded Expectation, whereas 34% of those whose teachers used it to a great extent Met Expectation. The majority (85%) of learners whose teachers strongly agreed that

they disliked using CLM in their facilitation of mathematical concepts competences Exceeded Expectation, while 69% were taught by teachers who agreed, 56% had teachers who disagreed and 49% had teachers who strongly disagreed that their learners were taught by teachers who disagreed that they disliked using CLM, and they Met and Exceeded Expectation, compared to learners taught by teachers who disliked CLM. The fact that the responses of both the negative–oriented statement corresponded with the reversal of the same showed that teachers understood the question but also that they may have over-rated themselves.

Furthermore, 65% of learners who Exceeded Expectation were taught by teachers who strongly agreed that CLM is not a waste of time. Also Exceeding Expectation were 50% of learners who were taught by teachers who agreed that CLM is not a waste of time. 42% of learners who Exceeded Expectation had teachers who remained undecided about whether CLM is not a waste of time.

The statement on teachers' interest in using CLM had the majority of learners Exceeding Expectation: 50% of learners were taught by teachers who strongly agreed, 62% agreed and 70% disagreed that they had an interest in CLM. No learner Exceeded Expectation among those taught by teachers who felt undecided about their level of interest in using CLM. The highest achievement in this category was 73% who had Met Expectation.

The researcher sought to know how much achievement by the learners was in line with their teachers' opinion of their motivation in using CLM. Those who Exceeded Expectation were 68% of those whose teachers indicated that they strongly agreed with the statement, 49% for those whose teachers agreed, and 70% for those whose teachers disagreed. The above

findings are in agreement with the conclusion reached by Ahmad and Mahmood (2010) that CLM enhances learners' academic achievement as compared to traditional instruction. However, it is really important that teachers should also be in agreement with that conclusion.

4.4.1 Extent of Teacher Documentation and Learners' MCCA

Adequate planning and organisation is critical in ensuring the role of the teacher is successful in carrying out cooperative learning instruction (Gocer, 2010). The adequacy of teaching documentation in accordance with CLM, i.e. the preparation of a scheme of work (SoW) and a lesson plan (LP), was determined by examining the level of each teacher's compliance in articulating the elements of the five aspects of CLM: interdependence, face-to-face interaction, individual and group accountability, group behaviours, and group processing.

Interdependence expresses the concept that learners will work together to overcome challenges and complete the lesson activities successfully. This is referred to as positive interdependence. Face-to-face interaction refers to the way in which teachers present the collaborative learning tasks that they want the learners to participate in and carry out during the leaning session. The individual and group accountability aspect requires the teacher to strategize how each learning group as well as all the individual members of the group will master the learning content material. Group behaviours are a component of CLM, where the teacher makes use of collaborative social skills needed for successful group work. Finally, group processing requires the teacher to indicate how they will monitor learners' behaviour, as well as the other tasks, such as giving feedback to learners, and learners' discussion of their group activities.

Adapting these CLM concepts in the teacher's professional documents accounted for one point (20%). Therefore, inclusion of all the five aspects of CLM amounted to 100% (5 × 20). This rating system is what determined teacher's level of preparation and documentation in accordance with CLM. The data was collected using the observation schedule and the documentary analysis guide. The analysed results are presented in Table 27.

Table 27: Teacher's Level of Documentation and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Teacher documentation in accordance with CLM – a) scheme of work						
N/A	10%	1%	10%	32%	57%	57%
40%<	15%	0%	0%	0%	0%	0%
40%-80%	35%	0%	10%	25%	55%	8%
>80%	40%	0%	6%	31%	63%	35%
Teacher documentation in accordance with CLM – b) lesson plans						
N/A	55%	2%	12%	37%	49%	52%
40%-80%	5%	0%	0%	30%	70%	6%
>80%	40%	0%	6%	20%	73%	43%

The adequacy of pre-school teachers' documentation in line with CLM is laid out in Table 27. It is evident that the majority of learners were taught by teachers who had no scheme of work (57%) and no lesson plan (52%) while carrying out learning activities. Teachers who had done schemes of work had organised them in groups or in pairs, where learners were expected to carry out learning tasks.

A group of teachers considered the CBC document to be a ready to use scheme of work which did not require any further additions. Some teachers delivered mathematical concepts competences lessons that were not in their actual scheme of work. When the researcher asked some teachers about it, one commented:

> *'The CBC document is organised in such a way that one doesn't need to do a scheme of work. It is very easy to follow when teaching, unlike the ECDE Syllabus (2008) document. The number of lessons to be taught in every strand and sub-strand is very clearly stated and tabled, as well as their corresponding learning outcomes. It offers a very easy way to approach teaching to a teacher.'*

Another teacher said:

> *'With the CBC document a teacher doesn't even need to do a lesson plan, let alone the scheme of work. If anything, if a teacher follows it to the letter it would lag learners behind because its content is very much simplified. Imagine a PP2 learner, for example, should not be exposed to solving mathematical concepts' problems exceeding digit nine!'*

Nevertheless, teachers must spend sufficient time to prepare and document the lesson for cooperative learning in order to ensure that it responds to their learners' needs (Gillies and Boyle, 2011).

Less than half of the learners (35%) and (43%) were taught by teachers who did their preparation of scheme of work and lesson plan at 80% and above respectively. From the data, learners taught by teachers who had adequate documentation (above 80%) in both scheme of work and lesson plan had 63% and 73% of their learners Exceeding Expectation respectively. This was the highest majority of achievement of the statuses represented. This implies that the lesson plan was found to be a relatively more effective tool while teaching mathematical concepts competences in accordance with CLM. In his longitudinal study done in New York, Kane et al., (2006) indicated that a teacher who is prepared with a lesson plan and have a full mastery of a teaching method is competent in their delivery has the greatest impact on learner's achievement.

4.4.2 Teacher Participation Behaviour in the Learning Process and Learners' MCCA

Enhanced academic results are always realised in pre-schools where teachers have the requisite subject knowledge and teach the learners by participating in classroom management activities as they apply instructional methodology (Awiti, 2006).

Teacher's participation behaviour in the learners' learning process was evaluated in various aspects relating to: giving direction to group work, encouraging everyone to participate in the group work, expressions of support and acceptance of the learners, offering to explain and clarify ideas to learners and energising each of the learning groups to work.

The data collected was analysed and presented in Table 28.

Table 28: Teacher Participation Behaviour in the Learning Process and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Teachers giving direction to group work						
Done	85%	1%	2%	24%	73%	92%
Not done	15%	0%	8%	33%	59%	8%
Teachers encouraging everyone to participate in group work						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	0%	0%	0%	0%	0%
Teachers expressing support and acceptance of learners						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	0%	0%	0%	0%	0%
Teachers offering to explain and clarify ideas to learners						
Done	100%	1%	4%	22%	74%	15%
Not done	0%	0%	13%	36%	50%	85%
Teachers energising the group to work						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	0%	0%	0%	0%	0%

The data presented in Table 28 about teachers' participation behaviour in CLM activities shows that the majority of learners had teachers who carried out most of the CLM activities. This is the essence of every effective learning facilitator to ensure that learners have all the requisite underpinning knowledge and resources in order to be able to carry out activities successfully (Gillies and Haynes, 2011; Jalilifar, 2010).

Learners who were given direction to group work by teachers had the highest percentage (92%) compared to those who were not directed (8%). Every teacher (100%) encouraged every learner to participate, expressed support and acceptance of learners in their CLM group work and energised the learning groups to work. Where these are observed, it stands out as the main feature of the CLM that distinguishes it from other instructional methods by giving the opportunity for interaction between learners (Mercendetti, 2010). This enables cooperative learning groups to realise their learning objectives guided by their small group activities.

Table 28 illustrates that there was a considerable disparity between learners whose teachers offered to explain and clarify ideas and those who did not: 15% and 85% respectively. Learners whose teachers gave direction to CLM group work, encouraged everyone to participate in CLM group work, expressed support and acceptance of learners, explained and clarified ideas to learners and energised groups to work were 92%, 100%, 100% (n=639), 85% and 100% consecutively. Every teacher (100%) indicated that they gave results to individual learners.

It is very noticeable that the learners' mean score indices progressed in all instances from the lowest score to the highest (Below Expectation 1%; Approaching Expectation 11%, Meeting

Expectation 34%; and Exceeding Expectation 54%). The majority of the learners' MCCA Exceeded Expectation in the various CLM activities: 73% for learners who were given direction for their group work, 54% for learners who were encouraged to participate in group work, 54% for those who were given support and acceptance, 74% for those who were offered explanation and clarity of ideas and 54% for those who were energised to work in groups consecutively.

The impact of such levels of performance is worth noting, especially as it reflects the findings of other studies; for example, learners' in-class participation has been found to increase following the introduction of cooperative learning in tutorials. This confirms Herrmann's (2013) findings in his study on the impact of cooperative learning on learner engagement in Aarhus University, Denmark that the CLM technique results in more in-class participation from learners. This is explained by the fact that when learners are comfortable and familiar with discussion and peer interaction, they are motivated to participate. The learners are relaxed and inspired to think and find ways to put their understanding into practice in their cooperative group learning.

However, not all classrooms in Kirinyaga County have yet made the transition to effective cooperative learning. When the research for this study was undertaken, some teachers facilitated their teaching with individuals and whole class group organisation. In these classes, learners would be seen working out mathematical concepts' competences learning tasks alone while the teacher would go round marking, commenting on their individual work, and would at times refer some individuals to a colleague to learn from them. In other cases, the teacher would appoint someone to do the sums on the blackboard while the others watched and followed.

In other instances, the teacher would have the whole class in front and demonstrate as they followed from there. The learners would crowd around the teacher as they responded in chorus as the teacher prompted.

On asking one teacher about it, the researcher received this response:

> *'When they (learners) are near me (at the blackboard) they are easily controlled and they tend to be more attentive. While they are seated, some tend to make noise, while others get distracted elsewhere. You see like now that you are here, some would be following who the visitor is and what you are doing/writing. By the way, due to that the class would have been so much interrupted by continuous reporting amongst themselves about those not following our learning.'*

This would be explained by the reasoning put forward by Gillies and Boyle (2010) that if pre-school teachers perceive CLM as neither rewarding to their needs nor the needs of their learners, it is possible that they will not adopt the method when they are instructing mathematical concepts. This would be explained by the emotional dispositions that impact on a teacher's behaviour, since teachers are most likely to adopt the method of teaching which they prefer, which is generally the one that they find helpful and that they feel confident in delivering (Abrami et al., 2014). Much mentoring on the use of CLM as an instructional method should be effected on teachers in order to promote their self-efficacy on the use of the same.

4.4.3 Teachers Supporting Learners with Learning Provisions and Learners' MCCA

The use of appropriate educational materials is equally as important as the use of effective teaching methods in mathematical concepts competences lessons. Mehra and Thakur (2008) consider the use of learning aids is a key component for teachers in developing learners' attitude to mathematical concepts competences learning.

The way in which teachers supported learners providing suitable learning resources was analysed by the extent and variety of the resources provided: only one type of learning aid, two types of learning aids, three types of learning aids and more than three types of learning aids. This is presented in Table 29.

Table 29: Teacher Support of Learners with Learning Resources and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Teachers applying learning resources						
Done	90%	1%	10%	60%	30%	93%
Not done	10%	3%	15%	36%	45%	7%
Teachers applying no learning resources at all						
Done	10%	3.4%	15.4%	45%	36%	7%
Not done	90%	0%	10%	30%	60%	93%
Teachers applying only one type of learning resource						
Done	10%	0%	4%	10%	85%	8%
Not done	90%	1%	12%	36%	51%	93%
Teachers applying two types of learning resources						
Done	45%	0%	8%	29%	63%	45%
Not done	55%	2%	14%	38%	6%	55%
Teachers applying three types of learning resources						
Done	15%	0%	17%	37%	46%	22%
Not done	85%	1%	11%	34%	55%	78%
Teachers applying more than three types of learning resources						
Done	20%	0%	10%	29%	61%	30%
Not done	80%	1%	12%	35%	52%	70%

Table 29 indicates that the majority of learners were supported by teachers who supplied them with a variety of learning aids (93%), and only a very small proportion was not (7%). The lowest percentage of learners (8%) were taught by teachers who provided only one type of learning aid, 45% were provided with two, 22% were provided with three and 30% were provided with more than three types of learning aids. This is not the only study to have shown that the use of concrete materials can produce meaningful use of notational systems and increase learners' achievement in competence in mathematical concepts.

The researcher observed a variety of learning supplies provided during learning, which included:

> *Bottle tops and blackboard sketches drawn by the teachers that served as counters, whereas in some classes learners counted their jumps. Numbers written on the blackboards were also used as counters, as well as rulers, pencils, shoes, learners themselves, water jerry cans, thermos flasks, exercise and textbooks, food dishes, and so on. A variety of songs that were oriented in the basic mathematical operations (like addition and subtraction) were appropriately applied in the learning tasks. They would be sung alongside learning tasks involving bottle tops and skittles. Other available learning resources utilised were tubers, sticks, seeds, beads, maize cobs, and pebbles.*

The majority (over 80%) of all the categories of learners who were supplied with learning aids Met and Exceeded Expectation in their achievement. This attested to the fact that the availability of a variety of learning aids influences the utilisation of CLM and consequently increases learners' performance. This concurs with Douglass and Kristin (2000), who conducted a comprehensive review of activity based on learning in mathematical concepts competences from kindergarten all the way to grade eight and concluded that using a variety of materials (especially those that are easy to handle and manipulate) produces greater achievement gains than not using them.

Where no learning aid was supplied at all, the score was low (36%) for learners who Exceeded Expectation, while where learning aids were supplied, the score increased to 60%. It was also found that the majority of learners whose teachers did not supply any learning aid at all (45%) only achieved at Meeting Expectation, whereas among their counterparts who had learning aids only 30% of them scored that same grade.

Learning aids should include a multisensory nature in order to enable pre-school learners to develop their ability to represent mathematical concepts in the real world. This practice should see learners being supplied with a variety of learning resources, as well as being given

multiple opportunities to practise representing different mathematical concepts in order to carry out and understand the expected operations competently. Eshiwani as cited by Kamau (2007) noted that sustainable use of concrete instructional materials by teachers who are knowledgeable in their use improves learners' MCCA and consequently their attitude to learning. Manipulation of learning resources by learners stimulates their imagination and innovation, and encouragement of what they are doing. This motivates their cooperative group learning accomplishments, leading to improved mathematical concepts skills acquisition.

4.4.4 Teacher's Engagement Behaviour in CLM Activities and Learners' MCCA

Performing the role of teacher well is essential to learners' educational achievement; this is based on the assumption that teachers prompt learners to understand a mathematical concept personally and are competent in it before explaining it to peers in a CLM setting **(**Andreas and Seth, 2013).

For the purpose of this study, the engagement behaviour of the teacher in CLM activities in the learning process was analysed against teachers performing a number of different activities: taking time to share ideas and opinions with learners; paraphrasing to learners; describing learners' feelings; integrating learners' ideas; having learners justify their responses; extending learners' responses; setting aside time for learners to reflect on their experience while working in a CLM group; providing procedures for learners to use in discussing group effectiveness; including group-processing questions in the assignment sheet; providing constructive feedback; criticising flawed aspects of learners' ideas without criticising the learners; differentiating between the ideas and reasoning of group members;

providing results to CLM groups; providing results to individual learners; having learners editing each other's work and keeping groups small.

The information found about teacher engagement behaviour is presented in Table 30.

Table 30: Teachers' Engagement Behaviour in CLM Activities and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Taking time to share ideas and opinions with learners						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	0%	0%	0%	0%	0%
Taking time to paraphrase to learners						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	0%	0%	0%	0%	0%
Taking time to describe learners' feelings						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	0%	0%	0%	0%	0%
Taking time to integrate learners' ideas						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	0%	0%	0%	0%	0%
Taking time to have learners justify their responses						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	0%	0%	0%	0%	0%
Taking time to extend learners' responses						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	0%	0%	0%	0%	0%
Setting aside time for learners to reflect on their experience working in a CLM group						
Done	85%	1%	11%	36%	50%	89%
Not done	15%	0%	0%	17%	83%	11%
Providing procedures for learners to use in discussing group's effectiveness						
Done	5%	4%	17%	67%	13%	4%
Not done	95%	0%	0%	17%	83%	96%
Group-processing questions included in the assignment sheet						
Done	5%	4%	17%	67%	13%	4%
Not done	95%	1%	11%	33%	55%	96%
Providing constructive feedback						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	0%	0%	0%	0%	0%
Criticising ideas without criticising people						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	0%	0%	0%	0%	0%

Differentiating between ideas and reasoning of group members						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	1%	13%	36%	50%	0%
Giving results to CLM groups						
Done	30%	0%	10%	36%	53%	28%
Not done	70%	2%	12%	36%	33%	72%
Giving results to individuals						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	0%	0%	0%	0%	0%
Letting learners edit each other's work						
Done	25%	0%	5%	24%	71%	27%
Not done	75%	2%	14%	38%	38%	73%
Keeping groups small						
Done	75%	0%	10%	28%	62%	69%
Not done	25%	4%	17%	51%	29%	31%

From Table 30 it can be seen that there was a relatively large disparity between learners whose teachers set time aside for them to reflect on their experience of working in a CLM group (89%) and those who did not (11%). Teachers who provided learners with procedures to use in discussing group effectiveness, including group processing questions in the assignment sheet, all had learners who achieved (4%), against those who did not provide any procedures for their learners (96%).

Every teacher (100%) took time to provide constructive feedback to learners, criticise ideas without criticising learners and differentiated between ideas and reasoning of group members. In this instance and in accordance with the findings, all the teachers were teaching in agreement with teaching theory. Theoretically, feedback conditions learners to be highly motivated to care about each other's learning and achievement by asking freely for assistance, giving detailed explanations, testing for understanding, and monitoring each member's learning progress (Wigfield and Eccles, 2000).

Group celebration is a form of reward for interdependence; the feedback received during group processing is aimed at improving the use of social skills and is a form of individual accountability (Gillies, 2014). When teachers do not initiate this kind of interaction they risk letting learners interact on a somewhat superficial level (Cohen 1994; Renkl 1997).

The researcher observed the following scenarios:

> *Some learning environments were 'unique' from the known conventional learning standard environment. The researcher observed that learning in these classes would happen when all the learners were crowding around the teacher and standing for the entire lesson. The teacher 'sung' the learning content material as the whole class group chanted back. Some learners were not even attentive to what the teacher was presenting on the blackboard; they shouted as the teacher prompted the class to do things but had a complete lack of contact with the lesson. The lesson would continue without the teacher noticing that these learners were not hands-on in the lesson but doing their own things behind others. Since there were no exercises or lesson tasks for the learners from the teacher, the lesson would just end 'unceremoniously' for some learners.*

Less than a third of teachers (28%) gave results to their CLM groups, as opposed to those who did not (72%). The exchange of knowledge and skills in CLM must be supported by group processes, and feedback or reward for the learning of the group members (Huber et al., 2001). That is why results on the cooperative learning groups' performance are extremely critical for their motivation, as well as for taking any other necessary decision-making with regards to individual group activities during learning.

The data presented in Table 30 shows that every teacher (100%) took time to carry out one or more of the CLM activities listed. Noticeably the scores were progressive in all instances from the lowest to the highest mean score index. The mean score indices achieved by the learners were Below Expectation (1%); Approaching Expectation (11%); Meeting Expectation (34%); and Exceeding Expectation (54%).

This grading achievement was for learners whose teachers were taking time in sharing ideas and opinions with learners; paraphrasing to learners; describing learners' feelings; integrating learners' ideas; having learners justify their responses; extending learners' responses; providing results to individual learners; providing constructive feedback by the teacher; criticising ideas without criticising the learners; and differentiating between ideas and reasoning of group members. However, learners taught by teachers who provided procedures for learners to use in discussing the group's effectiveness and carried out group-processing with questions included in the assignment sheet did not achieve the would-be expected highest score of Exceeding Expectation, in actual fact only 13% Exceeded Expectation.

> *It is worth noting that some of the observed teachers gave feedback to the learners as the learners participated on the blackboard. This was done through general comments to the class by the teacher. If anything, during the learning session the learners were more concerned with their individual work than the group set activities.*
>
> *A significantly large proportion of teachers would like to employ the CLM learning organisation in their mathematical concepts' classes. Nonetheless, there could be challenges or impediments facing the use of the method despite the high desire and even positive attitude towards them. This conforms to the findings of Farrow as cited by Muthusi (2019) that successful adoption of CLM in teaching basic arithmetic skills is all about teacher attitude and beliefs.*

It is important to note that the proactive role of the pre-school teacher must be seen to involve the creation of a zone of proximal development, where the teacher provides scaffolding for mathematical concepts competences learning. This helps the learner to understand from their own perspective (Idowu & Bukunola, 2012). Abrami et al. (2014) also explain that teachers with an attitude towards a certain phenomenon in class develop emotional dispositions that influence their choice of a method of teaching that they enjoy, feel confident in using or find helpful.

A similar progression pattern was seen where the majority of learners who were taught by teachers who set aside time for them to reflect on their experience working in a CLM group Exceeded Expectation (50%) or Met Expectation (36%).

There were very few learners (4%) whose teachers provided procedures for them to use in discussing group effectiveness. The figure was also 4% for those learners whose teachers included group-processing questions in the assignment sheet. The majority of these learners Met Expectation (67%). The number of learners who were Approaching Expectation (17%) was greater than the number of learners who Exceeded Expectation (13%). In fact, the highest percentage of learners was Approaching Expectation across all CLM activities.

It was also in the two aspects of providing procedures for learners to use in discussing group effectiveness and including group-processing questions in the assignment sheet where there was the highest percentage of learners scoring Below Expectation (4%). There were no learners Below Expectation among those whose teachers got them to edit each other's work and who kept the learning groups small. The majority of these learners Exceeded Expectation: 71% for learners who edited each other's work and 62% for learners whose teachers kept the learning groups small.

For grading, the learners who were given results as groups and as individuals had the majority Exceeded Expectation (53% and 54% respectively). The findings showed that the method of giving out results either individually or in a CLM group did not influence learners' performance.

The percentage of learners where they edited each other's work is quite low at 27%, whereas where the CLM groups were kept small, the percentage was 69%. The grading increased

when groups were kept small, with no learner (0%) scoring Below Expectation, 10% Approached Expectation, 28% Met Expectation and 62% Exceeded Expectation. This implies that the amount of time taken by teachers in CLM activities influences learners' performance and that there is a correlation between the two.

Furthermore, there is an implication that when teachers commit themselves to carrying out these CLM activities, learners construct their own knowledge through dialogical pedagogy by argumentation and discussion in their cooperative learning groups. This promotes effective conceptual learning and the ability for teachers to act accordingly (Corcoran, 2012). Teachers should be urged to adopt pedagogical methods that are more suited to the characteristics of young children. Teacher's engagement enhances the learners' interdependence where they connect new ideas and experiences to their existing understanding and experiences to produce novel or improved perception (Johnson and Johnson, 2003).

These would allow the learners to develop sufficient ability to construct knowledge through play and participation in mathematical concepts activities.

4.4.5 Teacher Monitoring Behaviour of the Learning Process and Learners' MCCA

While conducting a mathematical concepts competences lesson, the teacher monitors each cooperative learning group and intervenes whenever needed to improve on the task work and teamwork. Furthermore, the teacher gathers specific facts about promotive interaction, the use of targeted social skills, and engagement in the desired interaction patterns. This data is used to intervene in groups and to guide group processing.

Teachers' monitoring behaviour of the learning process was weighed against how they assessed learners by asking in-depth questions, teachers' generation of further answers and testing reality by checking CLM group work. This information is presented in Table 31.

Table 31: Teacher Monitoring Behaviour of the Learning Process and Learners' MCCA

Status	No of Teachers	Pre-School Learners' MCCA				
		Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	N=20	n=7	n=73	n=217	n=342	N=639
Probing learners by asking in-depth questions						
Done	100%	1%	11%	34%	54%	100%
Not done	0%	0%	0%	0%	0%	0%
Generation of further answers						
Done	95%	1 %	11%	33%	55%	96%
Not done	5%	4%	17%	67%	13%	4%
Testing reality by checking CLM groups' work						
Done	90%	1%	11%	34%	56%	92%
Not done	10%	2%	17%	54%	27%	8%

Table 31 illustrates that every learner (100%) had a teacher who monitored their learning process. This was done by assessing learners and asking in-depth questions. 96% of learners were taught by teachers who sought to generate further answers, whereas 92% had teachers who tested reality by checking their CLM group work. In essence, as a method of pedagogy, CLM is based on the recognition that human beings are helpful and social individuals who are driven by cooperation and pro-social and humanistic motives (Deutsch, 1973). However, the researcher observed that this aspect was neglected where no groups were formed during the learning session. This would confirm the finding by Muriithi (2013) that a considerable number of teachers have a negative attitude towards hands-on teaching methods, of which CLM is one. This is an indication of unfavourable attitude towards CLM as an instructional

method; that would eventually affect learners' attitude towards it and the cycle would negatively affect mathematical concepts competence acquisition.

In the three aspects of teacher monitoring behaviour of the learning process, the majority of learners Exceeded Expectation or Met Expectation. Firstly, for teachers probing learners by asking in-depth questions, 54% Exceeded Expectation and 34% Met Expectation; secondly, for teachers who generated further answers, 55% Exceeded Expectation and 33% Met Expectation; lastly, for those teachers who tested reality by checking CLM group work, 56% Exceeded Expectation and 34% Met Expectation.

This is attributable to the fact that teacher monitoring behaviour of learners' learning and intervening as necessary enables learners to complete learning tasks successfully and use the set interpersonal and group skills effectively (Oner, 2013). Monitoring is a key component of CLM. According to Moore (2008), learners' academic achievement is based on the effectiveness of the instructional method adopted by the teacher. Organising learning in small groups does not necessarily imply that learners work together and support each other in mastering their learning tasks. As an essential part of teachers' role, they are required to harmonise and set up the class as a suitable learning environment that enables learners to cooperate in their group learning. The interdependence theory has it that success of any learning group goes to the extent that as a group they become a dynamic whole, such that an alteration in the condition of any group member consequently changes the condition of any other member (Kurt, 1935).

The teacher should keenly observe to know mathematical concepts activities to be given to each learner (Hewett, 2001). Through observation a teacher will be able to offer meaningful

mathematical activities that promote learning through stimulation of imagination, enhanced communication, problem solving and co-operating skills.

4.4.6 Regression Model and Coefficients of Determination on Teacher Attitude to CLM and Learners' MCCA

The hypothesis to test the extent to which there is a difference between the mean score index of pre-school learners taught by teachers with favourable and unfavourable attitudes towards CLM was used to verify the relationship and the nature of relationship between teacher attitude to CLM and the MCCA of pre-school learners in Kirinyaga County.

The hypothesis was tested using a statistical process that involved establishing whether there was any significant association between teacher attitude to CLM and MCCA in pre-school learners. Regression model analysis was run in order to establish whether there was a predictive association between teacher attitude to CLM and the MCCA of pre-school learners. Table 32 presents the regression model data on teacher attitude to CLM and its predictive relationship with its indicators.

Table 32: Teacher Attitude to CLM and Learners' MCCA

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.107[a]	0.110	0.100	0.728

ANOVA					
Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	3.871	1	3.871	7.309	0.007[b]
Residual	337.368	637	0.530		
Total	341.239	638			

Coefficients					
Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.179	0.086		36.799	0.000
Teacher attitude status	0.164	0.061	0.107	2.704	0.007

a. Dependent Variable: Mathematical Concepts Competences Acquisition
b. Predictors: (Constant), Teachers' Attitude

From Table 32, it can be seen that adjusted R Square = 0.100, equivalent to 10% (0.100×100). The implication is that teachers' attitude to CLM accounts for a 10% variation in MCCA across pre-schools in Kirinyaga County. This means that there are other factors, which account for 90%, that have an impact in influencing MCCA, besides teacher attitude to CLM. Furthermore, the results indicate that ($F(1, 637 = 7.309$, $P<0.05$, $p=0.007$), demonstrating that teacher attitude to CLM is a significant predictor of MCCA in pre-school learners at a significance of $P<0.007$. Coefficients of determination results are as outlined: $\beta=0.107$, $t=2.704$ and $p<007$. A unit increase in teacher attitude to CLM leads to a variation of 0.107 units. This is an indication that teacher attitude to CLM influences MCCA in pre-schools learners in Kirinyaga County. Positive teacher's disposition towards CLM should be cultivated at all costs because it seems to correlate with positive achievement of mathematical concepts competences among pre-schools learners in Kirinyaga County.

In addition, a regression model procedure was carried out in order to identify the strength of the effect of teacher attitude on pre-school learners' MCCA. Table 33 presents the regression model data on teacher attitude to CLM and its predictive relationship with its indicators.

Table 33: Teacher Attitude to CLM and Learners' MCCA

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.305[a]	0.093	0.085	0.700

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	31.848	6	5.308	10.843	0.000[b]
	Residual	309.392	632	0.490		
	Total	341.239	638			

Coefficients					
Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	4.672	0.295		15.839	0.000
Teacher's level of preparation	0.023	0.075	0.015	0.308	0.758
Teacher's level of involvement	0.023	0.115	0.009	0.197	0.844
Teacher's level of learning resource provision	0.450	0.069	0.274	6.510	0.000
Teacher's amount of time taken in CLM activities	0.131	0.061	0.087	2.141	0.033
Teacher's level of monitoring	0.510	0.105	0.191	4.833	0.000

a. Dependent Variable: Mathematical Concepts Competences Acquisition

b. Predictors: (Constant), Teacher's level of monitoring, Teacher's amount of time taken in CLM activities, Teacher's level of involvement , Level of learning resource provision, Level of Interaction, Teacher's level of preparation

Table 33 indicates that the level at which pre-school teachers provide learning resources to their learners had a correlation coefficient of r=0.274, t=6.510, p<0.05, p=0.000, whereas teachers' level of monitoring had a correlation coefficient of r=0.191, t=4.833, p<0.05, p=0.000. This is an indication that teachers' level of provision of learning resources and their level of monitoring of pre-school learners' cooperative group learning activities are significant predictors of improved MCCA for learners in Kirinyaga County.

Nevertheless, the result of teachers' level of preparation of their professional documents was: β=0.015, t=0.308, p<.0.05, p=0.758; teachers' level of involvement in CLM activities was β=0.009, t=0.197, p<0.05, p=0.844; and the amount of teachers' time taken in CLM activities was: r=0.087, t=2.141, p<0, 05, p=0.033. This would imply that the level of preparation of professional documents and the level of involvement in CLM activities by teachers are not predictors of improved MCCA in pre-school learners in Kirinyaga County. This appears to demonstrate inefficacy on the part of teachers in the comprehensive execution of CLM activities. This would hamper their ability to create an active learning environment in which their learners can solve problems, answer questions, formulate questions of their own, discuss, explain, debate, or brainstorm during class (Coppola, 2007).

It is absolutely imperative to note that the proactive role of the teacher must be seen to involve the creation of a zone of proximal development, the provision of scaffolding for learning and the co-construction of meaning with learners based on the teacher's awareness and understanding of the learners' perspective (Idowu & Bukunola, 2012). This is what makes teachers' level of preparation of CLM lesson, teachers' level of interaction with learners in learning activities, teachers' level of involvement in the learning groups and the amount of teachers' time taken in CLM activities vital in order for them to enable each of their learners to develop and achieve their greatest potential.

The finding in this study is consistent with the findings of Bernero (2000) that teacher attitude leads to an increase in their efforts to encourage their learners to discuss the learning content material at the heart of the lesson that will enable each learner to understand and internalise it, with the result that learners encourage each other to work hard for improved academic achievement. Johnson et al. (2014) identified that CLM is a tested means for

enabling learners to improve in both their academic attainment and in the quality of their interpersonal relationships. This is rooted in team-based learning, which distinguishes CLM from the competitive and/or individualistic instruction of the traditional classroom.

4.4.7 Pearson's Correlation Coefficient on Teacher Attitude to CLM and Learners' MCCA

Further analysis of the research hypothesis involved establishing the strength of association between the variables for teachers' attitude to CLM with regards to the MCCA of their learners. The Pearson's correlation coefficient data is presented in Table 34.

Table 34: Pearson Correlation Coefficient on Teacher Attitude to CLM and Learners' MCCA

Correlations			
		MCCAT mean score index	Teachers' attitude status
Mathematical Concepts Competences Acquisition	Pearson Correlation	1	0.107**
	Sig. (2-tailed)		0.007
	N	639	639
Teacher Attitude	Pearson Correlation	0.107**	1
	Sig. (2-tailed)	0.007	
	N	639	639

***. Correlation is significant at the 0.01 level (2-tailed).*

Table 34 indicates that there is a relatively low positive correlation between teacher attitude to CLM and MCCA by pre-school learners at r=0.107. The correlation between teachers' attitude to CLM and MCCA by pre-school learners was significant at p=0.007, which is less than 0.01. This is likely to mean that learners' mathematical concepts learning achievement would be as a result of both their intrinsic motivation to learn out of natural curiosity, or as a result of anxiety at being unsuccessful or reprimanded by the teacher.

Correlation coefficients between the indicators of teachers' attitude to CLM included: teachers' level of preparation for teaching, level of involvement in the teaching activities, level of learning resource provision for learners during the learning session, amount of time taken in CLM activities, level of monitoring against MCCA. All of these were tested and Table 35 presents this information.

Table 35: Pearson's Correlation Coefficient on Teacher Attitude to CLM and Learners' MCCA

Mathematical Concepts Competences Acquisition	Pearson Correlation	1
	Sig. (2-tailed)	
	N	639
Teacher's level of preparation	Pearson Correlation	0.047**
	Sig. (2-tailed)	0.024
	N	639
Teacher's level of involvement	Pearson Correlation	0.049**
	Sig. (2-tailed)	0.022
	N	639
Teacher's level of learning resources' provision	Pearson Correlation	0.022**
	Sig. (2-tailed)	0.000
	N	639
Amount of teacher's time taken in CLM activities	Pearson Correlation	0.003**
	Sig. (2-tailed)	0.408
	N	639
Teacher's level of monitoring	Pearson Correlation	0.014**
	Sig. (2-tailed)	0.000
	N	639

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

The results in Table 35 show that although all the indicators generated significant levels of MCCA among pre-school learners, there only exists a low positive correlation between all of them. Teachers' level of preparation registered a correlation coefficient of r=0.047, teachers' level of involvement was r=0.049, their learning resources provision was r=0.022, the amount of their time taken in CLM activities was r=0.003 and their level of monitoring was

r=0.014. Therefore, as they all have $p<0.05$, the conclusion can be drawn that these indicators are predictors of improved pre-school learners' MCCA.

This agrees with the view of Biggs (2007) that effective teaching does not simply involve applying general principles of teaching, rather it should aim to engage students in learning-related activities that enable them to theorise, generate new ideas, reflect and solve problems in the target content area. Provision of learning resources by teachers stimulates learners' imagination and innovation, and monitoring of learning activities assures learners of their teacher's assessment and encouragement of what they are doing. This motivates their cooperative group learning activities, leading to improved mathematical concepts problem-solving skills.

Although, as Lafi (2001) notes, some teachers may only have limited experience and knowledge of how to teach groups cooperatively and how to benefit from this strategy in teaching, this should not discourage them from undertaking CLM activities. This is due to the fact that, as a method of learning together, CLM has a strong focus on interpersonal skills. Each lesson is expected to have a social skills objective as well as an academic objective. This is justified by the evidence that pre-school learners' ability to work cooperatively on the various mathematical concepts tasks and solve the problems as a team gives them practice in developing respect for others' viewpoints, methods to problem solving and other learning styles. The teacher as instructor is no longer the sole custodian of knowledge in the classroom environment while the learners are passive knowledge receivers.

4.5 Learners' Attitude towards CLM and Resulting MCCA

As part of the research, the study sought to investigate: 'To what extent is there a difference between the mean score index of pre-school learners with favourable and unfavourable attitudes towards CLM?' based on the hypothesis that pre-school children who have a favourable attitude to CLM would be more likely to achieve a higher mean score index in mathematical concepts competencies than those whose attitude is unfavourable. This assumes that a favourable attitude to CLM would allow promotive interaction, and adoption of promotive interaction behaviours among group members tends to heighten the effort of the co-operative group (Johnson and Johnson, 2009).

4.5.1 Learner Attitude to CLM and Learners' MCCA

Teachers' opinion about learners' attitude to CLM was collected using the following question items: the extent to which learners like CLM, learners' preference for using CLM, learners viewing CLM as a waste of time, learners not interested in CLM participation and learners feeling less motivated in participating in CLM. In order to ascertain the consistence of the given responses, the negatively stated statements were reversed. This information is presented in Table 36.

Table 36: Rating of Learner Attitude to CLM and Learners' MCCA

Status	Pre-School Learners' MCCA				
	Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	n=7	n=73	n=217	n=342	N=639
Extent to which learners like CLM					
Not At All	0%	0%	0%	0%	0%
Less Extent	0%	0%	0%	0%	0%
Moderate Extent	0%	0%	0%	0%	0%
Great Extent	1%	17%	46%	36%	21%
Very Great Extent	2%	10%	30%	58%	79%
Learners' preference of using CLM					
Strongly disagree	0%	3%	31%	66%	11%
Disagree	0%	27%	73%	0%	3%
Undecided	0%	10%	20%	70%	3%
Agree	1%	9%	33%	58%	36%
Strongly Agree	2%	14%	34%	50%	47%
Learners viewing CLM as a waste of time					
Strongly disagree	1%	13%	35%	50%	65%
Disagree	1%	9%	34%	57%	31%
Undecided	0%	0%	0%	0%	0%
Agree	0%	5%	9%	86%	3%
Strongly Agree	0%	0%	0%	0%	0%
Reversal of learners viewing CLM as a waste of time					
Strongly disagree	0%	0%	0%	0%	0%
Disagree	0%	5%	9%	86%	3%
Undecided	0%	0%	0%	0%	0%
Agree	1%	11%	37%	51%	80%
Strongly Agree	0%	15%	25%	61%	17%
Learners not interested in CLM participation					
Strongly disagree	2%	15%	37%	46%	47%
Disagree	0%	9%	31%	61%	46%
Undecided	0%	0%	0%	0%	0%
Agree	0%	0%	0%	0%	0%
Strongly Agree	0%	15%	34%	51%	7%
Reversal of learners not interested in CLM participation					
Strongly disagree	0%	0%	0%	0%	0%
Disagree	0%	0%	0%	0%	0%
Undecided	0%	0%	0%	0%	0%
Agree	0%	10%	32%	58%	59%
Strongly Agree	2%	14%	37%	47%	41%
Learners feeling less motivated in participating in CLM					
Strongly disagree	2%	16%	37%	46%	39%
Disagree	1%	9%	31%	59%	34%
Undecided	0%	27%	73%	0%	3%
Agree	0%	3%	25%	73%	17%

Strongly Agree	0%	15%	34%	51%	6%
Reversal of Learners feeling less motivated in participating in CLM					
Strongly disagree	0%	15%	34%	51%	6%
Disagree	0%	3%	25%	73%	17%
Undecided	0%	27%	73%	0%	3%
Agree	1%	9%	31%	59%	34%
Strongly Agree	2%	16%	37%	46%	39%

Table 36 presents teacher opinion on the extent to which their learners like CLM. From the data compiled, it can be seen that for the majority of learners (79%), their teachers indicated that they like CLM to a very great extent, while for the remaining 21%, their teachers indicated that they liked it to a great extent. The majority of learners (58%) rated by their teachers as liking CLM to a very great extent Exceeded Expectation, whereas the 46% of learners who were rated as liking CLM to a great extent just Met Expectation. Learners' attitude to CLM as an instructional method would appear to positively influence their teachers' adoption of CLM effectively in their delivery to their pre-school learners of teaching and learning for competence in mathematical concepts, in line with the findings of Rudhumbu (2014).

The teachers of the majority of learners (47%) strongly agreed with the statement that their learners preferred using CLM, while 36% agreed. These two categories of learners had half or more of them Exceeding Expectation: for those who strongly agreed, the figure was 50%, and for those who agreed, it was 58%. The 70% of those who were undecided but who Exceeded Expectation can be attributed to the small number of the learners in that category. This finding that CLM is the preference of the learners is in agreement with the affirmation by Farooq and Shah (2008) that a positive learner attitude to CLM will translate into higher academic achievement by learners.

A vast majority of learners (65%) had teachers who strongly disagreed with the statement that learners viewed CLM as a waste of time. This implied that for these 65%, CLM is not a waste of time. On the same statement, 31% had their teachers disagreeing, meaning that they agreed that CLM is not a waste of time. This is an indication that even teachers admit that CLM is an effective instructional method. However, in 3% of cases, there were learners whose teachers agreed that CLM is a waste of time for their learners. This may be as a result of these teachers encountering difficulties in implementing CLM, either due to issues in putting it into practice or through finding it more cumbersome than other instructional methods (Broussard and Garrison, 2011).

Interestingly, learner achievement that Exceeded Expectation was 86% for those learners taught by teachers who agreed that CLM was a waste of time, 57% for learners taught by teachers who disagreed that CLM was a waste of time, and 50% for learners taught by teachers who strongly disagreed that CLM was a waste of time. The high figure of 86% of learners taught by teachers who agreed that CLM was a waste of time is most likely as a result of the small number of learners in that category.

The reversal of learners viewing CLM as a waste of time posted different results, in that only 17% of teachers strongly disagreed that CLM is not a waste of time. This means that they strongly agreed that it is a waste of time. The same statement had 80% disagreeing, meaning that they agreed that CLM is a waste of time. In addition, there was correlation of the data where 3% of the learners were taught by teachers who disagreed that CLM is not a waste of time. Learners who Exceeded Expectation were 86% from teachers who disagreed, 51% from teachers who agreed and 61% from teachers who strongly agreed that CLM was a waste of time for their learners.

The incoherence observed from responses in this statement would indicate that there is a possibility that teachers may have just responded without reading the statement carefully to understand it, and may therefore have indicated a response which did not match their actual belief. Any prior knowledge which learners had may have also resulted in a higher level of performance, even where a traditional instructional method may have been used. Furthermore, this finding can be explained with reference to the assertion by Wigfield and Eccles (2000) that learners' choice, persistence, and performance can be as a result of their beliefs about how well they are determined to do on a learning task and the extent to which they value the learning task.

The highest numbers of learners were taught by teachers who considered that their learners were interested in participating in CLM. 47% of learners who were taught by teachers who strongly disagreed with the statement that learners were not interested in participating in CLM, 46% disagreed and 6% strongly agreed that learners were not interested in participating in CLM. This portion (6%) implied that they strongly agreed with the fact that their learners viewed CLM as a waste of time.

On the reversal of the statement that learners were not interested in participating in CLM, there were 59% of the learners taught by teachers who felt that they agreed that their learners were interested in participating in CLM. The rest (41%) of the learners were the ones whose teachers strongly agreed that their learners were interested in CLM participation. This means that the entire cohort of learners was taught by teachers who indicated their learners' positive inclination to participating in CLM.

In spite of the fact that over 80% of the learners in these two responses Met and Exceeded Expectation, there was a variation in the figures of responses for those learners who were said to be interested and those whose teachers stated that they were not interested in participating in CLM. Nevertheless, the learners' positive attitude to participating in CLM corresponded with their expected achievement, since CLM is a hands-on teaching method that is designed to enhance learning competence in learners.

The statement that learners felt less motivated to participating in CLM yielded exactly the same number of respondents with that of its reversal. This correspondence was also seen in the results, where 51% of the learners whose teachers strongly disagreed, 73% whose teachers disagreed, 59% whose teachers agreed and 46% whose teachers strongly agreed that learners did not feel less motivated in participating in CLM Exceeded Expectation.

A reversal of the statement that learners felt less motivated in participating in CLM yielded exactly the same number of respondents with that of the original question. This correspondence was also realised in the results, where: 39% of the learners had their teachers strongly disagreeing, 34% disagreeing, 3% undecided, 17% agreeing and 6% strongly disagreeing with the statement that learners didn't feel less motivated in participating in CLM Exceeded Expectation.

There was a clear tallying of these figures with their responses on the reversal of the same statement. This means that the teachers understood the question and responded to it in the light of their reflection on the subject. Evidently, over 90% of learners who were said to be motivated in participating in CLM Exceeded Expectation, whereas none of them achieved Below Expectation.

4.5.1.1 Level of Collaboration and Achievement of Learners' MCCA

Interaction between learners, in other words, the process by which group participants interrelate while engaging in the learning task, challenges learners' thinking and scaffolds their understanding (Gillies and Haynes, 2011). In the case of the acquisition of competence in mathematical concepts, this process involves learners helping each other to understand the content of the given mathematical concepts, sharing ideas with each other on problem solving, encouraging other group members' efforts to learn, explaining their ideas, teaching what they know to classmates and discussing their workings out and answers with others. Table 37 presents the interactional behaviours by learners which the researcher observed during the learning session.

Table 37: Learners' Level of Interaction and Learners' MCCA

Status	Pre-School Learners' MCCA				
	Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	n=7	n=73	n=217	n=342	N=639
Learners helping each other understand the content					
Done	0%	6%	25%	70%	45%
Not Done	2%	16%	42%	40%	55%
Learners sharing ideas with each other on problem solving					
Done	0%	6%	25%	70%	45%
Not Done	2%	16%	42%	40%	55%
Learners encouraging other group members' efforts to learn					
Done	0%	6%	25%	70%	45%
Not Done	2%	16%	42%	40%	55%
Learners explaining their ideas					
Done	0%	6%	25%	70%	45%
Not Done	2%	16%	42%	40%	55%
Learners discussing with others					
Done	0%	6%	25%	70%	45%
Not Done	2%	16%	42%	40%	55%
Learners teaching what they know to classmates					
Done	0%	7%	28%	65%	49%
Not Done	2%	16%	40%	42%	51%

Table 37 indicates that the majority (70%) of learners who helped each other to understand the mathematical concepts, those who shared ideas with each other about problem solving in the learning session, those who encouraged other group members' efforts to learn, those who explained their ideas during learning and those who discussed with others Exceeded Expectation compared to 40%, who Exceeded Expectation, but who did not engage in these behaviours.

In fact, the majority (42%) of the learners among those who did not help each other to understand concepts, share ideas on problem solving in the session, encourage others' efforts to learn, explain ideas during learning or discuss with others achieved a score of Meeting Expectation.

None of the learners who helped each other to understand concepts, shared ideas on problem solving, encouraged efforts to learn, explained ideas and discussed with others achieved Below Expectation. This supports the idea that social interaction greatly enhances learners' acquisition and retention of mathematical concepts' competences as they learn from the more knowledgeable members of their groups (Vygotsky, 1978). During the learning interaction offered by CLM a learner receives assistance from colleagues with higher set of skills and that learner is able to gradually develop the ability to do certain mathematical problem-solving tasks; thus inspiring and evolving their individual learning.

Learners who taught what they knew to their classmates had a majority (65%) registering the highest achievement (Exceeding Expectation) and 0% of them achieved Below Expectation. In contrast, only 42% of learners who did not teach what they knew to their classmates Exceeded Expectation and 2% of those who did not teach their peers achieved Below

Expectation. This would mean that these learners never had the opportunity to practise what they learnt with others and were therefore denied the possibility of perfecting the knowledge they have acquired, as well as restricting the increase in retention of the same knowledge and experiences (Rousseau, 1712-1778). Rousseau's emphasis on the importance of expression to produce a well-balanced and freethinking cannot be under-estimated in the 21st century.

In their research on CLM among middle school students, Johnson, Johnson, and Roseth (2010) stated that the basic premise of CLM is that how goals are structured determines how individual group members interact, which will consequently determine their results. The established roles and norms have a significant impact on the interactions and output of all the members of the group. The educational advantage provided by CLM is that it incorporates and uses the experiences of others in addition to focussing on the personal experience of the learner (Felder and Brent, 2012) in order for the achievement of everyone in the group to exceed what it would be if each learner were learning individually.

4.5.1.2 Level of Eye Contact and Learners' MCCA

Learners' level of eye contact was observed in a variety of aspects, namely whether learners asked for facts and reasoning to help them to understand each other's work, if they were able to disagree without criticising, whether they offered to explain and clarify their ideas, whether learners encouraged every member of their learning group to participate in their group activities, as well as whether they expressed support for and acceptance of others in their groups. The findings are presented in Table 38.

Table 38: Level of Eye Contact Establishment and Learners' MCCA

Status	Pre-School Learners' MCCA				
	Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	n=7	n=73	n=217	n=342	N=639
Learners express support and acceptance to others					
Done	1%	7%	30%	62%	60%
Not Done	2%	18%	39%	41%	40%
Learners disagree without criticising					
Done	0%	7%	28%	65%	33%
Not Done	1%	14%	37%	48%	67%
Learners offering to explain and clarify their ideas					
Done	1%	7%	31%	61%	52%
Not Done	2%	16%	37%	45%	48%
Learners encourage everyone in their group to participate					
Done	1%	6%	30%	63%	55%
Not Done	2%	18%	39%	42%	45%
Learners ask for facts and reasoning to aid understanding of each other's work					
Done	2%	9%	34%	55%	64%
Not Done	0%	1%	35%	49%	36%

From Table 38, which shows learners' level of eye contact when they engaged in thoughtful discussion and examined diverse perspectives, it can be seen that the majority of learners who expressed support and accepted others' support, who disagreed without criticising, who offered to explain their learning contribution and clarify their ideas, who encouraged everyone in their group to participate, and who asked for facts and reasoning to help understand each other's ideas Exceeded Expectation by over 60% across all of those aspects. The exact figures were 62% for those who expressed support and accepted others' support, 65% for those who disagreed without criticising, 61% for those who offered to explain their contribution and clarify ideas, 63% for those who encouraged everyone to participate, and 55% for those who asked for facts and reasoning to help them to understand others' ideas.

This same category of learners had less than 1% of learners achieving Below Expectation in the same aspects (2%, 1%, 1%, 1%, and 1% respectively). Cooperative learning activities

equip pre-school learners for learning the necessary skills to work effectively in collaboration with others (Shimazoe and Aldrich, 2010), and this is demonstrated by the improved performance results produced in this study.

None of the learners achieved half of the mean score index (50%) when they did not express support and acceptance to others during learning, when they did not disagree without criticising, when they did not offer to explain and clarify their ideas, when they did not encourage everyone to participate in their groups, or when they did not asked for facts and reasoning to understand other's work. The exact figures were 41% for those who did not express support or accepted others' support, 48% for those who did not disagree without criticising, 45% for those who did not offer to explain their contribution and clarify ideas, 42% for those who did not encourage everyone to participate, and 49% for those who asked for facts and reasoning to help them to understand others' ideas.

1% or more of these same learners achieved Below Expectation, except in the category of asking for facts and reasoning to help understand each other's work (2%, 1%, 2%, 2%, and 0%, consecutively). It is possible that the teacher may have avoided implementing CLM in the face of challenges, such as a reluctance to release the management of learning to the learners, difficulties in controlling learners' noise levels, resolving conflicts amongst learners and difficulty in assessing their pre-school learners' learning.

4.5.1.3 Level of Individual Contribution and Learners' MCCA

The level of individual contribution was observed against how learners resolved conflict constructively, took turns, used quiet voices, communicated accurately, accepted the support of others and shared ideas and opinions. Successful CLM work is reliant on the contributions

of every group member rather than just the contributions of one individual. This involves equal contributions by each group member, as CLM goal accomplishment depends on the performance of every single individual (Johnson and Johnson, 2009). Information on the level of individual contribution in the learning process is shown in Table 39.

Table 39: Level of Individual Learners' Contribution and Learners' MCCA

Status	Pre-School Learners' MCCA				
	Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	n=7	n=73	n=217	n=342	N=639
Learners sharing ideas and opinions					
Done	1%	10%	32%	57%	76%
Not Done	0%	16%	39%	45%	24%
Learners taking turns					
Done	0%	8%	28%	64%	59%
Not Done	2%	17%	42%	39%	41%
Learners using quiet voices					
Done	1%	9%	32%	58%	78%
Not Done	0%	19%	40%	41%	22%
Learners communicating accurately					
Done	1%	8%	33%	58%	73%
Not Done	3%	20%	38%	39%	27%
Learners accepting the support of others					
Done	1%	8%	31%	60%	66%
Not Done	2%	19%	40%	39%	34%
Learners resolving conflict constructively					
Done	2%	12%	34%	52%	62%
Not Done	0%	11%	33%	56%	38%

Table 39 illustrates that there is a very wide margin in the highest achievement between the learners who did and who did not share ideas and opinions (57% compared to 45%), took turns (64% compared to 39%), used quiet voices (58% with 41% against), communicated accurately (58% with 39% against), accepted the support of others (60% compared to 39%), and resolved conflict constructively (52% compared to 56%).

It is immediately apparent that the achievement that Exceeded Expectation was more likely to be by learners who shared ideas and opinions, took turns, used quiet voices, communicated accurately, and accepted the support of others. The only exception was for resolving of conflict constructively. This same pattern was also demonstrated at the Approaching Expectation level of achievement across the two categories of learners. This can be explained by the learners' increased motivation, greater time on task and active learner involvement as a result of learning using CLM. This confirms the assertion by Abdulwahab et al. (2016) that when pre-school learners realise the value of their input and effort in their learning groups, they believe in their ability as well as having social and working skills embedded. This promotes the learners' efficacy of what they know, think as well as their interest and needs.

4.5.1.4 Persistence in Groupings and Learners' MCCA

In order to assess time taken in the CLM learning process, the researcher observed learners as they were carrying out specific tasks in the learning process, including an individual group member taking a random test written by the teacher, a learner teaching what they knew to someone else, one group member assigned as checker of understanding for the group, an individual group member responding to a random test given orally by the teacher, and learners' ability to handle individual tests.

The time taken in the learning groups during instruction, determining the maximization of learners' learning opportunities, is presented in Table 40.

Table 40: Time Taken in the Groupings and Learners' MCCA

Status	Pre-School Learners' MCCA				
	Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	n=7	n=73	n=217	n=342	N=639
Learners handling individual tests					
Done	1%	12%	36%	51%	89%
Not Done	0%	6%	18%	76%	11%
Learners teach what they know to someone else					
Done	0%	9%	32%	59%	51%
Not Done	2%	14%	36%	48%	49%
One group member is assigned checker of understanding for the group					
Done	1%	16%	49%	33%	11%
Not Done	1%	11%	32%	56%	89%
Random tests to one group member orally by the teacher					
Done	0%	10%	37%	52%	33%
Not Done	1%	12%	32%	54%	67%
Random tests to one group member written by the teacher					
Done	0%	13%	39%	48%	11%
Not Done	1%	11%	33%	5%	89%

As evidenced by Table 40, it is only for learners who taught what they knew to others where the majority (59%) Exceeded Expectation. There are those who did not handle individual tests (76%); who did not have one group member assigned as a checker of understanding for the group (56%); those who did not have random tests given to one group member orally by the teacher (54%); and those who did not have a random written test given to one group member by the teacher (54%) Exceeding Expectation.

Nevertheless, unexpectedly, there are relatively more learners who achieved Below Expectation among those who had individual tests (1%) or who had one group member assigned as a checker of understanding for the group (1%). However, there were no learners who achieved Below Expectation among learners where a random written test was given to a group member by the teacher. This should never be a surprise, given that appropriate utilisation of collaborative skills depends on the teacher modelling positive interpersonal

skills, practising the skills, and encourage their pre-school learners to reflect on how effectively they are performing the skills (Shimazoe and Aldrich, 2010).

4.5.1.5 Level of Group Self-Analysis and Learners' MCCA

The level of group self-analysis involves group processing, which entails the acceptance and understanding of each group member's roles and responsibilities within the group (Gillies, 2014). Regular reflection to evaluate the group members' actions in relation to group goals determined each CLM group's self-analysis level. It is in these groups that behaviours which need to change or continue and the continuous improvement of group effectiveness in the learning process are resolved.

The observed criteria aspects included: learners celebrating collectively as a whole class, learners making decisions about which actions the group will continue or change, learners congratulating each other on their hard work, learners celebrating within their small group and learners describing which members' actions were helpful and which were not helpful in CLM group reaching goals. Table 41 shows learners' level of self-group analysis.

Table 41: Level of Group Self-Analysis and Learners' MCCA

Status	Pre-School Learners' MCCA				
	Below Expectation	Approaching Expectation	Meeting Expectation	Exceeding Expectation	Status %
	n=7	n=73	n=342	n=342	N=639
Describing what members' actions were helpful and not helpful in group reaching goals					
Done	0%	2%	43%	55%	7%
Not Done	1%	12%	33%	53%	93%
Making decisions about which actions the group will continue or change					
Done	0%	2%	43%	55%	7%
Not Done	1%	12%	33%	53%	93%
Congratulating each other on their hard work					
Done	0%	2%	43%	55%	7%
Not Done	1%	12%	33%	53%	93%
Small group celebrating					
Done	0%	2%	43%	55%	7%
Not Done	1%	12%	33%	53%	93%
Whole-class celebrating					
Done	1%	5%	48%	47%	20%
Not Done	1%	13%	32%	55%	80%

Table 41 demonstrates that the majority of learners who Exceeded Expectation were in cases where learners described which members' actions were helpful and which were not helpful in their CLM group reaching their goals (55%), those who made decisions about which actions the group would continue or change (55%), those who congratulated each other on their hard work (55%) and those whose small group celebrated (55%). There were fewer learners who Exceeded Expectation among those who had a whole-class celebration (47%) against those who did not (55%).

This is finding is supported by the assertion by Altun (2015) that when learners work together in their CLM groups, they are able to maximise their own and each other's learning in the pursuit of a common objective. When children interact, they give and receive help, express their point of view, learn about others' perspectives, look for new ways to clarify differences, solve problems, and formulate renewed understanding and knowledge. These are

reflections that are extremely essential in the Kenyan classroom scenario, where the strengths and weaknesses of the learning group are identified as the reason for informing future pedagogical planning. Teachers should ensure that a mathematical concepts classroom is a community of learners where members of cooperative groups are able to use higher level reasoning strategies more frequently as opposed to individuals working individualistically or competitively.

4.5.1.6 Regression Model Analysis of Learner Attitude to CLM and Learners' MCCA

Inferential statistics were analysed in order to verify whether there is a difference between the mean score index of learners with favourable and unfavourable attitudes towards CLM. This was done by using a statistical process that sought to establish whether there was a predictive association between learners' attitude and MCCA in pre-school learners, using a regression model, as shown in Table 42.

Table 42: Learner Attitude to CLM and Learners' MCCA

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.202	0.041	0.035	0.718

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	11.043	1	11.043	21.304	0.000[b]
Residual	330.196	637	0.518		
Total	341.239	638			

Coefficients

Model	Unstandardized Coefficients		Standardised Coefficients	t	Sig.
	B	Standard Error	Beta		
(Constant)	2.956	0.100		29.501	0.000
Rank of learner attitude aggregate scores	0.272	0.059	0.180	4.616	0.000

a. Dependent Variable: Mathematical Concepts Competences Acquisition
b. Predictors: (Constant), Learners' Attitude

Table 42 shows a correlation coefficient of Adjusted R Square r=0.035 being equivalent to a 3.5% variation. This implies that learner attitude to CLM accounts for a 3.5% effect on MCCA across the pre-school learners in Kirinyaga County. This leads to the conclusion that in Kirinyaga County there are other factors that determine pre-school learners' MCCA, other than learners' attitude to CLM.

A linear regression established that learner attitude to CLM could statistically significantly predict pre-school learners' MCCA, ($F(1, 637 = 21.304$, $p<0.05$, $p=0.000$). This points to the fact that learner attitude to CLM is a significant predictor of the MCCA of pre-school learners, given the significant value of $P<0.000$. Coefficients of determination results were: $\beta=0.180$, $t=4.616$ and $p<000$. This is an indication that learners' attitude to CLM contributes significantly statistically in influencing MCCA in pre-school learners in Kirinyaga County.

All of the above findings lead the researcher to conclude that learner attitude to CLM has an impact on the MCCA of pre-school learners in Kirinyaga County. This finding agrees with Stipek et al. (2013) that pre-school learners may show a keen interest in CLM, leading them to record high grades in MCCA. The interdependence theory supports this whereby the group members are rendered mutually dependent by their common goals (Johnson and Johnson, 2003) and as they identify their common aims, they become motivated to move towards the achievement of their learning goals.

However, despite pre-school learners' positive beliefs and interests, their teacher's teaching ability must be sufficient in order to deliver the results required as studies to date indicate that pre-school learners cannot effectively be taught mathematical concepts competences without their teacher taking great interest in how and what their learners are taught and delivering this using an appropriate teaching method. This makes it essential for teachers to implement CLM appropriately in their delivery of lessons intended to teach mathematical concepts competences.

The three primary purposes of using cooperative instructional strategy are to develop learners' social and communication skills, increase tolerance and acceptance of diversity, and improve academic accomplishment (Lin & Zhang, 2006). In contrast, traditional teaching methods are teacher-centred with teachers as the source of the knowledge, while learners are passive receivers who must memorise information that they are given (Mahira and Azamat, 2013). The traditional teaching method emphasises learning by listening, which is a disadvantage for learners who prefer other learning styles (Guido and Amelie, 2010).

In accordance with the findings of the study, the researcher established that, in contrast with traditional instructional methods, where the learners are compelled to sit and observe the teacher in most cases, the use of cooperative instructional strategies in the teaching of mathematical concepts competences greatly enhances pre-school learners' achievement and definitely creates interest in Mathematics as a subject, due to the fact that these methods actively engage every learner during learning, leaving no room for observers.

The positive effect of CLM on pre-school learners' acquisition of competences in mathematical concepts realized from indicators of CLM implies that the theoretical perspectives that underpinned this study were practicable. The components feature of the teacher facilitation contributed 15.4%; while teacher's attitude towards CLM was found to be 9.3%; and learners' attitude 4.1 % to the pre-schoolers' mathematical concepts competences achievement. The theories follow a constructivist method, and this study sought to make use of them in order to establish whether there is a link between CLM and the acquisition of competence in key mathematical concepts during learning. This is because although CLM overlaps constructivist learning theory, as both emphasise the importance of interactivity, Felder and Brent (2012) note that while constructivism focuses on the personal experience of the learner to grasp new knowledge, CLM not only focuses on and uses the individual learner's personal experience, but also the experiences of others.

Generally, the findings on the extent that CLM contributed to MCCA for pre-school learners in Kirinyaga County give adequate proof that CLM is an effective intervention measure for boosting MCCA for pre-school learners in Kirinyaga County.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary, conclusions and recommendations of the study. First of all, a highlight on the summary of the findings is presented, followed by the conclusions from these findings, and finally recommendations for future studies are proposed.

5.2 Summary of the study

The study focused on assessing the effect of the cooperative learning method (CLM) on the achievement of pre-schoolers' competences in mathematical concepts in Kirinyaga County. The intention was to achieve this, using three objectives and four data collection instruments that facilitated the collection of both qualitative and quantitative data. Consequently, both qualitative and quantitative techniques were utilised in data analysis for presentations and discussions. The objectives of the study were to:

Establish the difference between the mean score index of pre-school learners taught by a teacher who facilitates learning using the Cooperative Learning Method (CLM) and those taught by a teacher who does not; establish the difference between the mean score index of pre-school learners taught by teachers with favourable and unfavourable attitudes towards CLM and; assess the difference between the mean score index of learners with favourable and unfavourable attitudes towards CLM.

The review of related literature focused on past studies in this subject area by other academics in order to undertake a critical analysis of the concept of CLM, the effect of the

teacher's facilitation role in CLM, and teacher and learner attitudes towards CLM which affect pre-school learners' acquisition of competence in mathematical concepts.

This study was carried out in a representative sample of 20 Pre-Primary 2 classes out of the 197 public pre-schools in Kirinyaga County in Kenya. The research tools employed enabled the gathering of the required data for the set of themes specified in the research objectives. Qualitative data was analysed thematically, based on research objectives and presented in narrative form, whereas quantitative data was analysed descriptively (using frequencies, percentages through cross tabulation) and inferentially by use of Regression model procedures and Pearson Correlation Coefficients in order to establish the contribution of the independent variables on the dependent variable (pre-school learners' mathematical concepts competences acquisition or MCCA).

5.2.1 CLM Facilitation on Pre-School Learners' Mathematical Concepts Competences Acquisition (MCCA) in Kirinyaga County

The study found that there was a significant difference in mathematical concepts competences acquisition (MCCA) between pre-school learners taught using CLM and those who were not. Those who were taught using CLM achieved higher mean score indices than those who were not. The implication here is that the use of CLM improves pre-school learners' levels of achievement, indicating that it is a more effective method of teaching. The mean score index of learners taught using CLM was found to be statistically significant in comparison with those who were taught using traditional learning methods. This indicates a wide margin in the achievement of those learners exposed to CLM compared to those who were not.

Teachers' facilitation of CLM seemed to have a significant positive influence on the learners' MCCA. The components feature of the teacher facilitation contributed 15.4% in the learners' performance. These features were availability of groupings and teacher preparedness, level of provision of learning resources, level of coordination, level of interaction, time taken in CLM activities.

CLM offers a learner-centred experience where learners develop their psychomotor skills as they manipulate learning resources during their activities. These physical activities are scaffolded to stimulate intellectual achievement as they utilise the learning resources, activities which include solving mathematical concepts competences problems, as well as discoveries of new ideas. Teachers' facilitation of CLM enables learners to make the best use of the given opportunities for enquiry and discovery learning. This cultivates a great deal of interest in learners that becomes a springboard for their involvement in the learning tasks, skills and the subject matter.

5.2.2 Teachers' Attitude towards CLM on Pre-School Learners' Mathematical Concepts Competences Acquisition in Kirinyaga County

The study also found that there is a positive relationship between teachers' attitude towards the use of CLM and pre-school learners' mathematical concepts competences acquisition (MCCA). The learners whose teachers were favourable towards CLM registered higher mean score indices than those who were unfavourable towards CLM. However, teachers across the range of teaching qualifications were able to apply CLM effectively.

A unit increase in a teacher's attitude towards CLM leads to a 0.107 increase in MCCA. Although teacher attitude was found to be a significant factor in learners' acquisition of

mathematical concepts competences, it only contributed 9.3% to its improvement. This would be explained by some indicators of teachers' attitude registering a negative correlation, e.g., teacher's level of interaction, teacher's level of involvement and teacher's amount of time taken in CLM activities. Teacher ineffectiveness in implementing CLM effectively may be the cause of this. It is therefore not surprising that an increase in teachers' attitude in the learning process will contribute such a small (0.107) increase in their learners' mathematical concepts competences performance.

5.2.3 Learners' Attitude towards CLM on Pre-School Learners Mathematical Concepts Competences Acquisition (MCCA) in Kirinyaga County

The study found that there is a positive relationship between learners' attitude towards CLM and their mathematical concepts competences acquisition. Learners' attitude contributed 4.1 % to their mathematical concepts' competences achievement. Learner attitude indicators included their levels of interaction, eye-contact, individual contribution and the time they took in the groups as well as group self-analysis. All of these were statistically significant for all aspects of learners' performance, except for learners' level of individual contribution.

The learner attitude variable correlated negatively with teacher attitude. This means that teachers are not dependent on whether learners are favourable or unfavourable to CLM when making their decision to facilitate the acquisition of mathematical concepts competences using CLM as the instructional method.

All of the remaining variables correlate positively with each other, including the dependent variable. However, each one of the three independent variables - teacher's facilitation of CLM, teacher attitude and learner attitude - was statistically significant to each other, just as

they were to the dependent variable (pre-school learners' mathematical concepts competences acquisition (MCCA).

It is that despite theoretical interest in team learning and teachers' generally high appreciation of this instructive arrangement, cooperative learning rarely occurs in the average classroom in Kirinyaga County. The majority of classroom instruction across the County appears to be mainly individualistic and competitive in nature rather than collaborative.

It is the researcher's view that teachers' reluctance to embrace cooperative learning may also be due to the lack of time for them to learn about CLM, or the challenge they perceive CLM might pose to their control of the learning process and the demands that it places on classroom organisational changes, which would place significant demands on their part. The professional commitment that is required to sustain teachers' efforts in the implementation of CLM by embedding the CLM procedures into the curricula and in implementing, monitoring, and evaluating it demonstrates the teacher's commitment to CLM as a peer-mediated instructional method.

5.3 Conclusions

The purpose of this study was to assess the effect of CLM on the acquisition of competence in mathematical concepts in pre-school learners; and establish to what extent CLM improves the acquisition of competence in mathematical concepts in pre-school learners in Kirinyaga County, Kenya. The study indicated the following:

5.3.1 CLM Facilitation on Pre-School Learners' Mathematical Concepts Competences Acquisition (MCCA) in Kirinyaga County

The use of CLM by pre-school teachers in facilitating mathematical concepts competences acquisition produced higher mean score indices of the results realised. This is in comparison with the achievement of learners who were not exposed to CLM during their mathematical concepts' competences learning, and is therefore an indication that CLM imparts the required mathematical concepts competences better than traditional instructional methods. Teachers who effectively facilitated CLM enabled their learners to acquire higher mean score indices than their counterparts.

5.3.2 Teachers' Attitude towards CLM on Pre-School Learners' Mathematical Concepts Competences Acquisition (MCCA) in Kirinyaga County

The current research found that teacher attitude is an extremely critical factor in the use of CLM in the facilitation of mathematical concepts competences in pre-school classes. This implies that if pre-school teachers uphold the beliefs and practices of CLM as a favourable and manageable practical instructional method, this can enhance the pre-school learners' mathematical concepts competences acquisition.

5.3.3 Learners' Attitude to CLM on Pre-School Learners' Mathematical Concepts Competences Acquisition (MCCA) in Kirinyaga County

Learners' attitude to CLM can never be overlooked in the sense that how an individual feels in regard to a particular instructional method is likely to dictate their involvement in learning tasks designed to develop achievement in mathematical concepts competences. A key attitudinal dimension in using CLM in pre-school learners is confidence, which has been identified as critical to effective numeracy achievement (Han and Carpenter, 2014). This

points to the finding that if pre-school learners would be accorded the opportunity to express themselves during mathematical concepts' lessons through cooperative learning groups, they would increase their belief in their own ability. This would translate to the pre-school learners getting complemented to CLM as a pedo-centric pedagogical approach, consequently enhancing in their mathematical concepts' competences acquisition.

However, despite theoretical interest in team learning and teachers' generally high appreciation of this didactic arrangement, it must be noted that cooperative learning is a rare event in the average classroom (Rotering-Steinberg 2000). From this study, a lower proportion of learners were found to be taught mathematical concepts competences through the use of CLM than there were who were taught using traditional instructional methods. As noted in 5.1.3, individual or whole group learning appears to be the main form of instruction in an average pre-school class in Kirinyaga County.

5.4 Contribution of the Study to the Body of Knowledge

The review of related literature assessed: pre-school teachers' facilitation of learning mathematical concepts using the Cooperative Learning Method, pre-school teachers' and learners' attitudes towards the Cooperative Learning Method. From the findings of this study, it can be clearly noted that teaching using the Cooperative Learning Method directly influences pre-school learners' mathematical concepts competences acquisition.

The independent variables were tested by collecting empirical data from both pre-school teachers and learners. This study generated information that linked the gaps that previously existed in the available reviewed research studies. Table 43 presents a summary of the contribution to the body of knowledge resulting from the research undertaken for this study.

Table 43: Contribution of the Study to the Body of Knowledge

Study Objectives	Study Findings	Conclusion	Contribution to the Body of Knowledge
To establish the difference between the mean score index of pre-school learners taught by a teacher who facilitates learning using CLM and those taught by a teacher who does not.	Facilitating mathematical concepts competences using CLM positively influences learners' mathematical concepts competences acquisition.	Teachers' facilitation of CLM seemed to have a significant positive influence on the learners' mathematical concepts competences acquisition.	The implication of the findings points to the fact that; Teachers' facilitation of CLM enables learners to make the best use of the given opportunities for enquiry and discovery of mathematical concepts during learning.
To establish the difference between the mean score index of pre-school learners taught by teachers with favourable and unfavourable attitudes towards CLM.	There is a positive relationship between teachers' attitude towards the use of CLM and pre-school learners' mathematical concepts competences acquisition.	Learners whose teachers were favourable towards CLM registered higher mean score indices than those who were unfavourable towards CLM. However, teachers across the range of teaching qualifications were able to apply CLM effectively.	Teacher attitude is an extremely critical factor in the use of CLM in the facilitation of mathematical concepts competences in pre-school classes and it requires teachers to uphold the beliefs and practices of CLM as a favourable and manageable practical instructional method.
To assess the difference between the mean score index of pre-school learners with favourable and unfavourable attitudes towards CLM.	There is a positive relationship between learners' attitude towards CLM and their mathematical concepts competences acquisition. Learners' level of individual contribution was not statistically significant to their mathematical concepts'	The learner attitude variable correlated negatively with teacher attitude. This means that teachers are not dependent on whether learners are favourable or unfavourable to CLM when making their decision to facilitate the acquisition of mathematical concepts competences using CLM as the instructional method.	A key attitudinal dimension in using CLM in pre-school learners is confidence, which has been identified as critical to effective numeracy achievement.

	competences acquisition	The study found that a lower proportion of learners were taught mathematical concepts competences through CLM than those taught by traditional instructional methods.	

5.5 Recommendations

Based on the findings and conclusions of this study the researcher recommended that:

5.5.1 Formulation of Policies

Pre-school teachers' mathematical concepts competences instructional skills should be offered pedagogical refresher courses regularly. This would enhance teachers' facilitation of CLM to make the best use of the given opportunities for enquiry and discovery learning of their learners. There should be developed policies and programmes that seek to refresh pre-school teachers' mathematical concepts competences instructional skills in a bid to encourage them to develop pedagogical practices that stimulate learning for their learners, thereby promoting acquisition of competences in mathematical concepts for all learners. This should be undertaken both as in-service training for current teaching personnel.

Pre-service teacher training should focus on inculcating skills for teacher's effective implementation of CLM. Teacher training programmes should be restructured to ensure that trainee teachers are able to embed an effective implementation of CLM in addition to other mathematical concepts competences instructional methods into their delivery of learning in the classroom. CLM, as a peer-mediated learning method, is learner-centred and it has been found to produce better outcomes in mathematical concepts competences skills achievement. Emphasis should therefore be placed on its use.

School administrators should ensure that they encourage teachers to undertake prior planning and demonstrate the will to implement this. Prior planning will prompt better organisation, which in turn should guarantee efficiency and efficacy of mathematical concepts competences delivery.

5.2.2 Pre-school teachers' classroom practice

Pre-school teachers should routinely turn to cooperative learning groups work to make the most of the returns of peer-to-peer teaching while facilitating mathematical concepts' competences. This would allow the making use of the pre-school learner's personal experiences of others in addition to those of the individual learner.

This will go a long way in boosting the pre-schoolers' understanding of mathematical concepts' competences learning content as well as constructing careful transferable skills. This would only be possible when the pre-school children would be bestowed opportunities to do Mathematics by themselves, speak their thoughts, offer and receive explanations, introduce several procedures for solving mathematical problems.

5.5.3 Theoretical viewpoint

Pre-school teachers should ensure that pre-school learners understand the learning tasks' objectives, instructional activities, and criteria for success during the lesson. The teacher should, therefore, review and assign roles to learners in order to facilitate a smooth transition to CLM groups.

5.6 Recommendations for Further Research

The following proposals for further research were recommended:

i) The undertaking of a longitudinal study on the effect of the Cooperative Learning Method (CLM) on the achievement of learners' competences in mathematical concepts across the entire pre-school and lower primary level. This would give more time to the study to establish more in-depth effect of Cooperative Learning Method (CLM) on achievement of pre-schoolers' competences in mathematical concepts.

ii) A study of the relationship between teachers' facilitation of CLM and learners' attitude towards CLM as well as the relationship between teachers' facilitation of CLM and learners' gender factor in mathematical concepts competences acquisition.

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APPENDIX I

INTRODUCTION LETTER TO NACOSTI

UNIVERSITY OF NAIROBI
COLLEGE OF EDUCATION & EXTERNAL STUDIES
SCHOOL OF EDUCATION

Telephone: 0724692079

P.O. BOX 30197, 00100 NAIROBI

P.O. BOX 92, 00902 KIKUYU

20 July 2019

National Commission for Science, Technology and Innovation (NACOSTI)
P. O. Box 30623, 00100
Nairobi, KENYA

Dear Sir/Madam

RE: APPLICATION FOR AUTHORITY TO CONDUCT RESEACH IN KENYA: KAMAU BONFACE E87/50700/2016

This is to certify that **KAMAU BONFACE Reg. Number E87/50700/2016** is a student at the University of Nairobi, Department of Educational Communication and Technology pursuing PhD in Early Childhood Education. He is seeking authorization to conduct research titled **"Effect of Cooperative learning method on preschoolers' competences in mathematical concepts in Kirinyaga County Kenya."**

Kindly assist him to acquire research permit to enable him continue towards completion of his work.

Yours faithfully,

Dept. of Ed. Communication & Technology Chairman 20 JUN 2019 P.O. Box 92 Kikuyu University of Nairobi

PROF. JANE C. GATUMU
CHAIRMAN,
DEPARTMENT OF EDUCATIONAL COMMUNICATION AND TECHNOLOGY

APPENDIX II

RESEARCH CERTIFICATE BY THE NACOSTI

THIS IS TO CERTIFY THAT:
MR. KAMAU BONFACE
of UNIVERSITY OF NAIROBI, 0-1000
THIKA,has been permitted to conduct
research in *Kirinyaga County*

on the topic: *EFFECT OF COOPERATIVE LEARNING METHOD ON PRESCHOOLERS' COMPETENCES IN MATHEMATICAL CONCEPTS IN KIRINYAGA COUNTY*

for the period ending:
24th July,2020

Permit No : NACOSTI/P/19/22836/31752
Date Of Issue : 25th July,2019
Fee Recieved :Ksh 2000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014.

CONDITIONS

1. The License is valid for the proposed research, location and specified period.
2. The License and any rights thereunder are non-transferable.
3. The Licensee shall inform the County Governor before commencement of the research.
4. Excavation, filming and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
5. The License does not give authority to transfer research materials.
6. NACOSTI may monitor and evaluate the licensed research project.
7. The Licensee shall submit one hard copy and upload a soft copy of their final report within one year of completion of the research.
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice.

National Commission for Science, Technology and innovation
P.O. Box 30623 - 00100, Nairobi, Kenya
TEL: 020 400 7000, 0713 788787, 0735 404245
Email: dg@nacosti.go.ke, registry@nacosti.go.ke
Website: www.nacosti.go.ke

REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH LICENSE

Serial No.A 26053

CONDITIONS: see back page

APPENDIX III

RESEARCH AUTHORIZATION LICENSE BY THE NACOSTI

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471,
2241349,3310571,2219420
Fax:+254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/19/22836/31752** Date: **25th July, 2019**

Kamau Bonface
University of Nairobi
P.O. Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Effect of cooperative learning method on preschoolers' competences in mathematical concepts in Kirinyaga County"*** I am pleased to inform you that you have been authorized to undertake research in **Kirinyaga County** for the period ending **24th July, 2020.**

You are advised to report to **the County Commissioner and the County Director of Education, Kirinyaga County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Kirinyaga County.

The County Director of Education
Kirinyaga County.

APPENDIX IV

RESEARCH AUTHORIZATION BY THE COUNTY COMMISSIONER

THE PRESIDENCY
MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT

Telegrams "*COMMISSIONER*" Kerugoya
Telephone. 21053 Kerugoya

countycommissionerkirinyaga@gmail.com

COUNTY COMMISSIONER
KIRINYAGA COUNTY
P.O. BOX 1
KERUGOYA

ADM 1/23 VOL.II/143 **31ST JULY, 2019**

KAMAU BONFACE
UNIVERSITY OF NAIROBI
P.O. Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your request to conduct research on "***Effect of cooperative learning method on preschoolers in mathematical concepts in Kirinyaga County, Kenya***", I am pleased to inform you that you have been authorized to undertake research for a period ending **24th July, 2020**.

By a copy of this letter, the Deputy County Commissioners, Kirinyaga County and County Director of Education are requested to accord you necessary action.

ISSAC MUJESIA
FOR: COUNTY COMMISSIONER
KIRINYAGA COUNTY

c.c.

All Deputy County Commissioners
Kirinyaga County

County Director of Education
Kirinyaga County

APPENDIX V

RESEARCH AUTHORIZATION BY COUNTY DIRECTOR OF EDUCATION

MINISTRY OF EDUCATION
STATE DEPARTMENT OF EARLY LEARNING & BASIC EDUCATION

Telephone: 060-21835/0202641217
Email kirinyagacde1@gmail.com
When replying please quote
Ref. No. and date

COUNTY DIRECTOR OF EDUCATION
KIRINYAGA COUNTY
P. O. BOX 96
KERUGOYA

REF.NO.MOE/CDE/KRG/GEN/09/85/215

31st July, 2019

KAMAU BONFACE
UNIVERSITY OF NAIROBI
P.O BOX 30197-00100
NAIROBI

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on, ***Effect of cooperative learning method on preschoolers' competences in mathematical concepts in Kirinyaga County."***

I am pleased to inform you that you have been authorized to undertake research in Kirinyaga County for a period of one year.

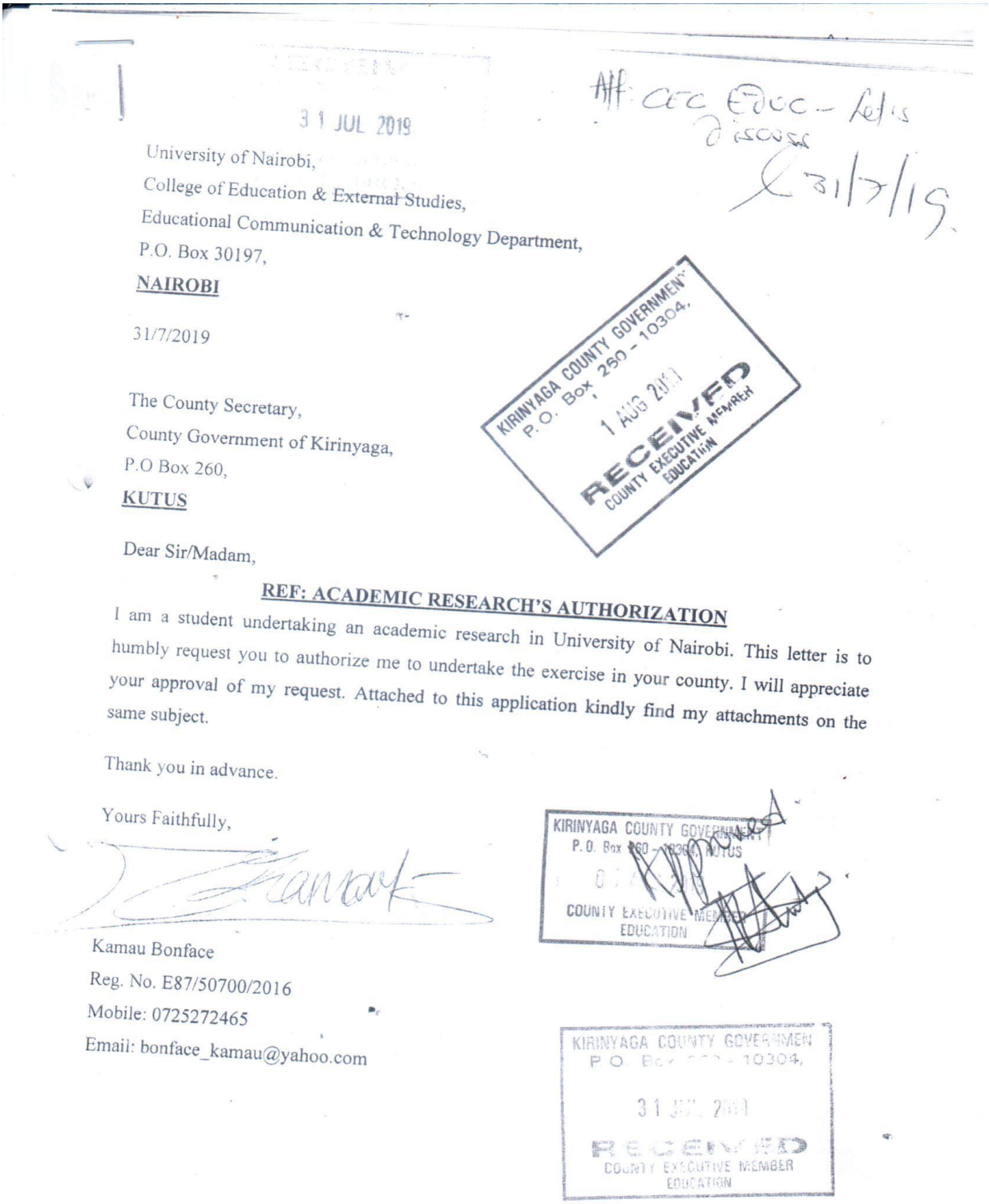
PP

MARGARET MWIRIGI
COUNTY DIRECTOR OF EDUCATION
KIRINYAGA

CC: PS MOE
REGIONAL COORDINATOR – CENTRAL
COUNTY COMMISSIONER

APPENDIX VI

RESEARCH AUTHORIZATION BY THE OFFICE OF THE COUNTY GOVERNMENT SECRETARY



31 JUL 2019

Aff: acc Educ - Kefis
2 issues
31/7/19

University of Nairobi,
College of Education & External Studies,
Educational Communication & Technology Department,
P.O. Box 30197,
NAIROBI

31/7/2019

KIRINYAGA COUNTY GOVERNMENT
P.O. Box 260 - 10304,
1 AUG 2019
RECEIVED
COUNTY EXECUTIVE MEMBER
EDUCATION

The County Secretary,
County Government of Kirinyaga,
P.O Box 260,
KUTUS

Dear Sir/Madam,

REF: ACADEMIC RESEARCH'S AUTHORIZATION

I am a student undertaking an academic research in University of Nairobi. This letter is to humbly request you to authorize me to undertake the exercise in your county. I will appreciate your approval of my request. Attached to this application kindly find my attachments on the same subject.

Thank you in advance.

Yours Faithfully,

KIRINYAGA COUNTY GOVERNMENT
P.O. Box 260 - 10304, KUTUS
COUNTY EXECUTIVE MEMBER
EDUCATION

Kamau Bonface
Reg. No. E87/50700/2016
Mobile: 0725272465
Email: bonface_kamau@yahoo.com

KIRINYAGA COUNTY GOVERNMENT
P.O. Box 260 - 10304,
31 JUL 2019
RECEIVED
COUNTY EXECUTIVE MEMBER
EDUCATION

APPENDIX VII

LETTER OF INTRODUCTION TO THE HEAD TEACHER

The Head Teacher,

…… Primary School,

P.O. Box ……,

……

Dear Sir/Madam,

RE: PERMISSION TO CONDUCT RESEARCH IN YOUR PRE-SCHOOL

I am a student taking a course in Doctor of Philosophy in Early Childhood Education at the University of Nairobi. I am required to submit as parts of my research work assessment, a research thesis on ***'Effect of Cooperative Learning Method on Development of Pre-schoolers' Competences in Mathematical concepts competences in Kirinyaga County, Kenya'***. To achieve this, your pre-school has been selected to participate in the study. This information would be used purely for academic purpose and your name will not be mentioned in the report. Findings of the study, shall upon request, be availed to you.

Your assistance and cooperation will be highly appreciated.

Thank you in advance.

Yours Faithfully,

KamauBonface

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APPENDIX VIII

INFORMED CONSENT FORM FOR PRE-SCHOOL TEACHERS

Dear respondent,

The researcher is a student undertaking a degree course in Doctor of Philosophy in Early Childhood Education of the University of Nairobi carrying out a research on the ***'Effect of Cooperative Learning Method on Development of Pre-schoolers' Competences in Mathematical concepts competences in Kirinyaga County, Kenya'.*** For this study, I will request you to give me some time as you will be asked some questions. I will maintain your privacy and confidentiality about your information. Your name will not be written on any of the materials, and only the researcher will have access to your information. Your participation is totally voluntary, and you may change your mind and withdraw at any time before and during the study. The researcher will not pay or give any facilitation for this participation. If you agree to take part to participate in this research, please sign the form below.

Participant:

09	SWH	14/10/2020
Code of Participant	Signature	Date

Researcher:

KAMAU BONFACE		14/10/20
Name of Researcher	Signature	Date

APPENDIX IX

A SAMPLE OF A MCCAT MARKED SCRIPT

APPENDIX V

MATHEMATICAL CONCEPTS ACHIEVEMENT TEST

Name: Y Gender: F

School: Duration: 1 Hour

Instructions: Attempt all the Questions.

1. Identify the following numbers and write in words;

i. 1 one

ii. 8 eight 4

iii. 7 seven

iv. 5 five

2. Fill in the missing number

i) 7. 8 9.

ii) 4. 4 6.

iii) 12. 4 14.

iv). 17. 5 19. 1

3. Count the objects and write their correct number values

i) = 5

ii) = 3 4

iii) =

iv) = 3

4. Work out the sums below.

i) 5 + 3 = 8

ii) 3 2 + 3 = 5

iii) 4 + 3 = 5

iv) 4 + 2 = 2

5. i) 6 – 2 = 5

ii) 9 – 4 = 5

iii) 5 - 4 =

iv) 8 - 2 = 3

APPENDIX X

ORIGINALITY REPORT

EFFECT OF COOPERATIVE LEARNING METHOD ON DEVELOPMENT OF PRE-SCHOOLERS' COMPETENCES IN MATHEMATICAL CONCEPTS IN KIRINYAGA COUNTY

ORIGINALITY REPORT

11%	10%	4%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	mafiadoc.com Internet Source	1%
2	repository.usfca.edu Internet Source	1%
3	Submitted to Kenyatta University Student Paper	1%
4	ir-library.ku.ac.ke Internet Source	<1%
5	www.nap.edu Internet Source	<1%
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150	Günter L. Huber, Anne A. Huber. "Chapter 6 Structuring Group Interaction to Promote Thinking and Learning During Small Group Learning in High School Settings", Springer Science and Business Media LLC, 2008 Publication	<1 %

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		

APPENDIX XI

OBSERVATION SCHEDULE

Pre-school ……..... Sub-County….....

Lesson ……..…. Topic .....……. Date…….. Time ….....……

Section A: Pre-school Teacher's Facilitation Role in Cooperative Learning Method and Competences in Mathematical concepts competences among Pre-school Learners

1. Does the teacher appear prepared in terms of preparation of the following records?

a) Schemes of work	Done [1]	Not done [0]
b) Lesson plan	Done [1]	Not done [0]
c) Lesson notes	Done [1]	Not done [0]

d) Any other record.....

2. How the teacher appears prepared to facilitate learning:

i) Status of teaching aids used in the lesson:

Available [1] Not available [0]

ii) The teaching aids provider (if available):

Learners [1] Teacher [2]

Any other.....

iii) Forms of teaching aids provided;

a) Visual aids:	Done [1]	Not done [0]
b) Audio aids:	Done [1]	Not done [0]
c) Audio-visual aids:	Done [1]	Not done [0]
d) Tactile aids:	Done [1]	Not done [0]

Any other.....

v) Adequacy of the learning aids in every group;

Done [1] Not done [0]

vi) Learning aids provided as they were indicated in the scheme of work and lesson plan;

Done [1] b) Not done [0]

Any other observation ……...

3. Classroom learning organization:

i) Teacher's establishment of cooperative learning groups;

Established [1] Not established [0]

Any other observation …….

ii) Number of learners put in one group (is available);

4 learners [1] 5 learners [2] 6 learners [3]

Any other number……...…….…….

iii) Roles assignment to group members (if available);

Done [1] Not done [0]

Any other observation ……..…

iv) Types of roles assigned to the group members;

a) Reader; Done [1] Not done [0]

b) Recorder; Done [1] Not done [0]

c) Checker/Quizzer; Done [1] Not done [0]

d) Encourager/participation police; Done [1] Not done [0]

Other…….....

v) Groups working in an organized sequential way;

Done [1] Not done [0]

4. Teacher's setting of rules to be followed by the groups;

Done [1] Not done [0]

c) Any other observation ……..……

5. Teacher's designing of tasks to be undertaken by each group;

i) Status of the teacher's designing of tasks to be undertaken by each group

Done [1] Not done [0]

c) Any other observation ……...……

ii) Mode of teacher's observing learners' individual work;

a) Random checking; Done [1] Not done [0]

b) Have them explain answers; Done [1] Not done [0]

c) Assigning roles; Done [1] Not done [0]

d) Any other observation ……..……

6. Teacher's specifying time for learning groups' task completion;

Done [1] Not done [0]

7. Teacher's monitoring every learner's contribution during learning;

i) Status of monitoring every learner's contribution during learning;

Done [1] Not done [0]

ii) If done, how it is done;

Give direction to group work; Done [1] Not done [0]

Paraphrase; Done [1] Not done [0]

Energize the group; Done [1] Not done [0]

Describe feelings; Done [1] Not done [0]

Any other observation; …..……

8. Teacher's assessment of the performance of the completed tasks;

i) Status of the teacher's assessment of the performance of the completed tasks;

Done [1] Not done [0]

ii) If done, how it is done;

Individual tests; Done [1] Not done [0]

Random tests to one group member orally; Done [1] Not done [0]

Random tests to one group member written; Done [1] Not done [0]

Any other observation.....

9. Teacher's provision of feedback on the groups' performance;

i) Status of teacher's provision of feedback on the groups' performance;

Done [1] Not done [0]

ii) If done, how;

Results are given to group; Done [1] Not done [0]

Results are given to individuals; Done [1] Not done [0]

Students edit each other's work; Done [1] Not done [0]

d) Any other observation.....

10. Teacher's ensuring discipline maintenance in the groups;

i) Status of teacher's ensuring discipline maintenance in the groups

Done [1] Not done [0]

ii) If done, how it is done;

a) Using quiet voices; Done [1] Not done [0]

b) Noise monitor; Done [1] Not done [0]

c) Participation monitor; Done [1] Not done [0]

d) Voice monitor; Done [1] Not done [0]

e) Turn-taking monitor; Done [1] Not done [0]

f) Any other observation; …..……

Section B: Pre-school Teacher's Attitude towards Cooperative Learning Method and Competences in Mathematical concepts competences among Pre-school Learners

1. The much the teacher looks motivated to use LCM while teaching Mathematical concepts:

i) Teacher's level of preparation of schemes of work in line with CLM;

Adequate [2] Moderate [1] Inadequate [0]

Any other observation.....

ii) Teacher's level of preparation of lesson plan in line with CLM;

75% and above [1] 50 - 75% [2] Below 50% [3]

Any other observation.....

iii) Teacher's level of involvement in the learners' learning process;

a) Giving direction to group work Done [1] Not done [0]

b) Encouraging everyone to participate Done [1] Not done [0]

c) Expressing support and acceptance Done [1] Not done [0]

d) Offering to explain and clarify Done [1] Not done [0]

e) Energizing the group Done [1] Not done [0]

Any other observation …...……...……

iv) Teacher's Level of resources' provision during learning process;

None at all [0] Only one type [1] Two types [2] Three types [3]

Any other.....

v) Teacher's amount of time taken in CLM activities with learners;

a) Sharing of ideas and opinions Done [1] Not done [0]

b) Paraphrasing Done [1] Not done [0]

c) Describing feelings Done [1] Not done [0]

d) Integrating ideas into a single position Done [1] Not done [0]

e) Asking for justifications Done [1] Not done [0]

f) Extending Answers Done [1] Not done [0]

Any other observation …...……

vi) Teacher's monitoring of learning process;

Probing by asking in-depth questions; Done [1] Not done [0]

Generating further answers; Done [1] Not done [0]

Testing reality by checking group's work; Done [1] Not done [0]

Any other observation; …...……

vii) Group processing;

a) Setting aside time for learners to reflect on their experience working in a group

Done [1] Not done [0]

b) Providing procedures for learners to use in discussing group effectiveness

Done [1] Not done [0]

c) Group-processing questions are included on assignment sheet

Done [1] Not done [0]

Any other observation …..……

vi) Feedback;

a) Providing constructive feedback; Done [1] Not done [0]

b) Criticizing ideas without criticizing people; Done [1] Not done [0]

c) Differentiating between ideas and reasoning of group members;

Done [1] Not done [0]

d) Results are given to group; Done [1] Not done [0]

e) Results are given to individuals; Done [1] Not done [0]

f) Students edit each other's work; Done [1] Not done [0]

g) Groups are kept small; Done [1] Not done [0]

h) Any other observation; …..……

Section C: Pre-school Learner's Attitude towards Cooperative Learning Method and Competences in Mathematical concepts competences among Pre-school Learners

1. Extent to which the learners are willing, ready and enthusiastic to get into the groups and work to undertake CLM procedure/activities:

i) Face-to-face interaction: They are generally discussing and establishing eye contact to each other as in;

a) Helping each other understand the content Done [1] Not done [0]

b) Sharing ideas with each other on problem solving; Done [1] Not done [0]

c) Encouraging other group members' efforts to learn; Done [1] Not done [0]

d) Explaining their ideas; Done [1] Not done [0]

e) Discussing with others; Done [1] Not done [0]

f) Teaching what they know to classmates; Done [1] Not done [0]

Any other observation; …..……

ii) Positive interdependence: They are willingly encouraging and supporting one another in the learning at;

a) Express support and acceptance; Done [1] Not done [0]

b) Disagreeing without criticizing; Done [1] Not done [0]

c) Offer to explain and clarify; Done [1] Not done [0]

d) Encourage everyone to participate; Done [1] Not done [0]

e) Ask for facts and reasoning to help understand each other's work;

Done [1] Not done [0]

Any other observation; …..……

iii) Social skills: learners' display of concentration and collaborative skills needed to work with together;

a) Share ideas and opinions; Done [1] Not done [0]

b) Taking turns; Done [1] Not done [0]

c) Using quiet voices; Done [1] Not done [0]

d) Communicating accurately; Done [1] Not done [0]

e) Accepting the support of others; Done [1] Not done [0]

f) Resolving conflict constructively; Done [1] Not done [0]

Any other observation …..……

iv) Individual accountability: They are responsible for doing each their part during the learning process by;

a) Individual tests; Done [1] Not done [0]

b) Students teach what they know to someone else; Done [1] Not done [0]

c) One group member is assigned checker of understanding for the group; Done [1] Not done [0]

d) Random tests to one group member orally; Done [1] Not done [0]

e) Random tests to one group member written; Done [1] Not done [0]

Any other observation; …..……

v) Group processing: They are analyzing their own and the group's ability to work together as in;

Describing what members' actions were helpful and not helpful in group reaching goals; Done [1] Not done [0]

Making decisions about which actions the group will continue or change; Done [1] Not done [0]

Students congratulating each other on their hard work; Done [1] Not done [0]

a) Small-group celebrating; Done [1] Not done [0]

b) Whole-class celebrating; Done [1] Not done [0]

Any other observation; …..……

APPENDIX XII
QUESTIONNAIRE FOR PRE-SCHOOL TEACHERS

Dear respondent,

The researcher is a student undertaking a course in Doctor of Philosophy in Early Childhood Education of the University of Nairobi carrying out a study on the ***'Effect of Cooperative Learning Method on Achievement of Pre-schoolers' Competences in Mathematical concepts competences in Kirinyaga County, Kenya'.*** The information you provide will be treated with confidentiality and entirely used for purposes of this study.

Section A: Background Information

1. Gender:

Male	[1]	Female	[2]

2. Level of Education

Certificate	[1]	Diploma	[2]
Bachelor	[3]	Masters	[4]
PGDE	[5]	PhD	[6]

3. Duration of teaching (experience)

Below 5 year	[1]
Between 11 - 15 years	[2]
Between 6 - 10 years	[3]
Above 15 years	[4]

4. Age bracket of the teacher

Below 20 years	[1]	21 – 30 years	[2]
31 – 40 years	[3]	41 – 50 years	[4]
Above 50 years	[5]		

Section B: Use of Cooperative Learning Method in Teaching of Mathematical concepts competences in Pre-schools

1. Do you think you understand Cooperative Learning Method as a learning method in mathematical concepts?

Yes [1] No [2]

2. Do you use cooperative learning method in teaching Mathematical concepts competences in your class?

Yes [1] No [2]

3. Please, rate how often you use cooperative learning method in teaching Mathematical concepts competences in your pre-school

Very Often [4]

Often [3]

Rarely [2]

Never [1]

Section C: Pre-school Teacher's Facilitation of Cooperative Learning Method and Competences in Mathematical concepts competences among Pre-school Learners

1. How often do you undertake the following activities while using Cooperative Learning Method in teaching Mathematical concepts competences in your pre-school?

Cooperative learning method activities	**Rating**			
	Very Often (3)	Often (2)	Rarely (1)	Never (0)
Helping learners form groups				
Setting rules to be followed in groups				
Designing tasks to be undertaken in each group				
Ensure learners have adequate materials in every group				
Specifying time for task completion				
Assessing every learner's contribution in solving tasks in Mathematical activities				
Marking of the completed tasks				
Providing feedback on the best group				
Ensuring discipline is maintained in the groups				

2. Rate the extent to which you agree with the following statements on the effectiveness of your facilitation role in cooperative learning method on competences in Mathematical concepts competences among your pre-school learners.

Key: **SA**-Strongly Agree **A**-Agree **U**-Undecided **D**-Disagree **SD**-Strongly Disagree

Question Items	**Rating**				
	SA (5)	A (4)	U (3)	D (2)	SD (1)
I always help my pre-school learners to form groups of four to make learning Mathematical concepts competences easier and enjoyable.					
As I help my pre-school learners form groups, I always set rules to be followed while undertaking Mathematical activities' tasks.					
As I help my pre-school learners form groups, I always design Mathematical activities' tasks to be undertaken by my learners.					
I always set time for completion of tasks for every group to improve their achievement in Mathematical concepts.					
I always give children group work without giving them adequate learning materials.					
I always give children group work without marking their task outcomes.					
I always give children group work without assessing every learner's contribution towards solving Mathematical activities' tasks within their groups					
I always give children group work without ensuring that they maintain discipline within the groups and concentrate in mastering Mathematical concepts competences in the lesson.					

Section D: Pre-school Teacher's Attitude towards Cooperative Learning Method and Competences in Mathematical concepts competences among Pre-school Learners

1. How would you rate the extent to which you prefer using cooperative learning method in teaching Mathematical concepts?

Very Great extent	[5]	Great extent	[4]
Moderate Extent	[3]	Less Extent	[2]
Not at all	[1]		

2. Rate the extent to which you agree with the following statements on the effect of your attitude towards cooperative learning method on competences in Mathematical concepts competences among your pre-school learners

Key: **SA**-Strongly Agree **A**-Agree **U**-Undecided **D**-Disagree **SD**-Strongly Disagree

Question Items	**Rating**				
	SA (5)	A (4)	U (3)	D (2)	SD (1)
Cooperative learning method is the best method which can improve my pre-school learner's competences in Mathematical concepts.					
I do not like using cooperative learning method as a way of improving my pre-school learner's competences in Mathematical concepts.					
Using cooperative learning method to teach Mathematical concepts competences in pre-school is not a waste of time to me.					
I am always interested in using cooperative learning method in teaching Mathematical concepts.					
I always feel motivated to use cooperative learning method while teaching Mathematical concepts.					

Section E: Pre-school Learner's Attitude towards Cooperative Learning Method and Competences in Mathematical concepts competences among Pre-school Learners

1. How would you rate the extent to which your pre-school learners like undertaking cooperative learning method in a Mathematical activities class?

Very Great extent	[5]	Great extent	[4]
Moderate Extent	[3]	Less Extent	[2]
Not at all	[1]		

2. Rate the extent to which you agree with the following statements on the effect of your pre-school learner's attitude towards cooperative learning method on their achievement in Mathematical concepts

Key: **SA**-Strongly Agree **A**-Agree **U**-Undecided **D**-Disagree **SD**-Strongly Disagree

Test Items	**Rating**				
	SA (5)	A (4)	U (3)	D (2)	SD (1)
My learners prefer cooperative learning method to other methods of learning Mathematical concepts.					
My pre-school learners view involvement in group formation as a strategy for learning Mathematical concepts competences as a waste of time.					
My pre-school learners are not interested in participating in group discussion as a method of learning Mathematical concepts competences and improving their competences in Mathematical concepts.					
My pre-school learners feel less motivated to participate in cooperative learning method to improve their competences in Mathematical concepts.					

THANK YOU VERY MUCH FOR YOUR COOPERATION AND TIME

APPENDIX XIII

DOCUMENTARY ANALYSIS GUIDE

Using this guide, the researcher will assess the records with information on levels of pre-school learners' achievement in mathematical concepts competences (through learners' progress records and mark sheets), how often pre-school teachers use cooperative learning method (through schemes of work and lesson plans) and how often teachers undertake cooperative learning method activities.

Section A: Records of pre-school teacher's preparation and use of Cooperative Learning Method in the teaching of Mathematical concepts competency based on: -

i) **Schemes of work per term.**

Frequency of Teacher's Use of Cooperative Learning Method in a Term	**Rating**
0 - 20 times	Low level preparation
21 - 40 times	Mid-level preparation
41 - 60 times	High level preparation

ii) Lesson plans per term.

Frequency of Teacher's Use of Cooperative Learning Method in a Term	**Rating**
0 - 20 times	Low level preparation
21 - 40 times	Mid-level preparation
41 - 60 times	High level preparation

iii) Lesson notes per term.

Frequency of Teacher's Use of Cooperative Learning Method in a Term	**Rating**
0 - 20 times	Low level preparation
21 - 40 times	Mid-level preparation
41 - 60 times	High level preparation

Section B: Records of Pre-school Teacher's Cooperative Learning Method Activities Based on Lessons Plans and Schemes of Work.

Cooperative learning method (Ratings)	**Very Often (3)**	**Often (2)**	**Rarely (1)**	**Never (0)**
Groups form by the pre-school teacher				
Rules are set by the pre-school teacher				
There are tasks designed by the teacher				
Procedures of maintaining group discipline				
Procedures of assessing every learner's contribution in solving tasks outlined				
Pre-school teachers mark learner's completed tasks				
Learning materials are provided for every group				
Time for task completion specified				

APPENDIX XIV

MATHEMATICAL CONCEPTS COMPETENCES ACHIEVEMENT PRE-TEST

Name: (Optional) Gender: ……

School: …… Duration: 1 Hour

Instructions: Attempt all the Questions.

1. Identify the following numbers and write in words;

i) 5 ……

iii) 7 …….

ii) 8 ……...

iii) 3 …….

Above Expectation	**Meets Expectation**	**Approaches Expectation**	**Below Expectation**
4	**3**	**2**	**1**
Able to get the 4 items correctly.	Able to get 3 items correctly.	Able to get 2 items correctly.	Able to get 1 item correctly.

2. Fill in the missing number

i) 7, __, 9. ii) 2, __, 6. iii) 12, __, 14. iv). 16, __, 18.

Above Expectation	**Meets Expectation**	**Approaches Expectation**	**Below Expectation**
4	**3**	**2**	**1**
Able to get the 4 items correctly.	Able to get 3 items correctly.	Able to get 2 items correctly.	Able to get 1 item correctly.

3. Count the objects and write their correct number values

i)  =

ii)  =

iii)  =

iv)  =

Above Expectation	**Meets Expectation**	**Approaches Expectation**	**Below Expectation**
4	**3**	**2**	**1**
Able to get the 4 items correctly.	Able to get 3 items correctly.	Able to get 2 items correctly.	Able to get 1 item correctly.

4. Work out the sums below.

i) 5 + 3 =

ii) 2 + 3 =

iii)
$$\begin{array}{r} 4 \\ +\ 3 \\ \hline \\ \hline \end{array}$$

iv)
$$\begin{array}{r} 4 \\ +\ 2 \\ \hline \\ \hline \end{array}$$

Above Expectation	**Meets Expectation**	**Approaches Expectation**	**Below Expectation**
4	**3**	**2**	**1**
Able to get the 4 items correctly.	Able to get 3 items correctly.	Able to get 2 items correctly.	Able to get 1 item correctly.

5. i) 6 – 2 = ii) 9 – 4 = iii) 5 iv) 8

- 4 - 2

Assessment Rubric

Above Expectation	**Meets Expectation**	**Approaches Expectation**	**Below Expectation**
4	**3**	**2**	**1**
Able to get the 4 items correctly.	Able to get 3 items correctly.	Able to get 2 items correctly.	Able to get 1 item correctly.

APPENDIX XV

MATHEMATICAL CONCEPTS COMPETENCES ACHIEVEMENT POST-TEST

Name (Optional) Gender: ……

School: …… Duration: 1 Hour

Instructions: Attempt all the Questions.

1. Identify the following numbers and write in words:

i. 6 …….

ii. 14 …….

iii. 3 …….

iv. 9 …….

Assessment Rubric

Above Expectation	**Meets Expectation**	**Approaches Expectation**	**Below Expectation**
4	**3**	**2**	**1**
Able to get the 4 items correctly.	Able to get 3 items correctly.	Able to get 2 items correctly.	Able to get 1 item correctly.

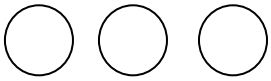
2. Fill in the missing number

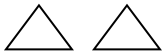
i) 8, __, 10. ii) 4, __, 6. iii) 13, __, 15. iv) 17, __, 19.

Assessment Rubric

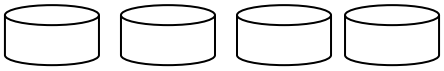
Above Expectation	**Meets Expectation**	**Approaches Expectation**	**Below Expectation**
4	**3**	**2**	**1**
Able to get the 4 items correctly.	Able to get 3 items correctly.	Able to get 2 items correctly.	Able to get 1 item correctly.

3. Count the objects and write their correct number values



i.  =

ii. =



iii. =

iv.  =

Assessment Rubric

Above Expectation	**Meets Expectation**	**Approaches Expectation**	**Below Expectation**
4	**3**	**2**	**1**
Able to get the 4 items correctly.	Able to get 3 items correctly.	Able to get 2 items correctly.	Able to get 1 item correctly.

4. Work out the sums below.

i) 2 + 3=

ii) 5 + 3=

iii) 7
+ 2
_____
_____

iv) 5
+ 2
_____
_____

Assessment Rubric

Above Expectation	**Meets Expectation**	**Approaches Expectation**	**Below Expectation**
4	**3**	**2**	**1**
Able to get the 4 items correctly.	Able to get 3 items correctly.	Able to get 2 items correctly.	Able to get 1 item correctly.

5. Work out the sums below.

i) 5 - 4= ii) 9 - 3= iii) 7 - 4 = _____ iv) 8 - 2 = _____

Assessment Rubric

Above Expectation	**Meets Expectation**	**Approaches Expectation**	**Below Expectation**
4	**3**	**2**	**1**
Able to get the 4 items correctly.	Able to get 3 items correctly.	Able to get 2 items correctly.	Able to get 1 item correctly.

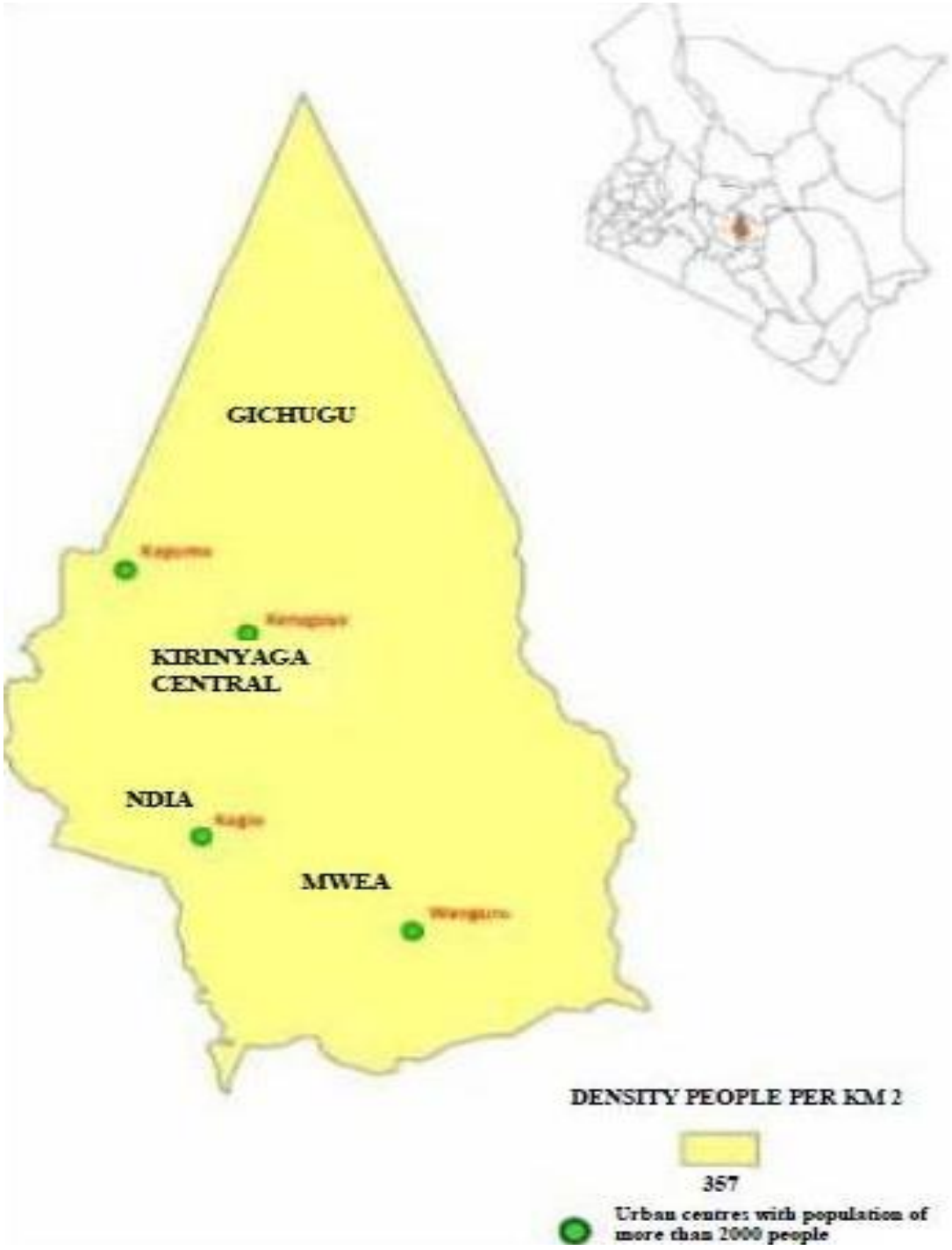
APPENDIX XVI

SAMPLE SIZE TABLE

Learners' pre-school	Boys' Percentage	Girls' Percentage	Total Percentage
Pre-School 1	2.0%	3.1%	5.2%
Pre-School 2	3.9%	3.3%	7.2%
Pre-School 3	2.2%	1.6%	3.8%
Pre-School 4	3.9%	2.7%	6.6%
Pre-School 5	2.7%	1.9%	4.5%
Pre-School 6	2.2%	1.9%	4.1%
Pre-School 7	3.4%	3.9%	7.4%
Pre-School 8	4.2%	5.0%	9.2%
Pre-School 9	1.6%	1.9%	3.4%
Pre-School 10	2.7%	3.3%	5.9%
Pre-School 11	2.3%	1.9%	4.2%
Pre-School 12	2.0%	1.6%	3.6%
Pre-School 13	2.0%	1.6%	3.6%
Pre-School 14	2.8%	1.6%	4.4%
Pre-School 15	2.2%	1.3%	3.4%
Pre-School 16	3.4%	3.0%	6.4%
Pre-School 17	0.8%	2.3%	3.1%
Pre-School 18	1.9%	2.5%	4.4%
Pre-School 19	2.0%	2.0%	4.1%
Pre-School 20	3.1%	2.3%	5.5%
Total	**51.5%**	**48.5%**	**100.0%**

APPENDIX XVII

MAP OF KIRINYAGA COUNTY



Source: IEBC (2012)