EFFECTIVENESS OF IN-SERVICE TRAINING OF TEACHERS ON COMPETENCY BASED FORMATIVE ASSESSMENT OF MATHEMATICAL ACTIVITIES IN PUBLIC PRE-PRIMARY SCHOOLS IN GEM SUB-COUNTY, KENYA

BY

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DECLARATION

Declaration by Candidate

This thesis is my original work and has never been submitted in any other university for an award of any degree, diploma or certificate.

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DEDICATION

To my beloved dad Francis Onyango who has always inspired and supported me to press on amidst challenges during my studies.

ABSTRACT

Competency Based Formative Assessment (CBFA) is a key component of the Competency Based Curriculum (CBC) education reform initiative in Kenya. Effective in-service training of teachers is crucial for the conduct of CBFA at pre-primary school. A lot of teacher retraining has been conducted since the inception of CBC. However, its scope and effectiveness has not been established. Only 42.79% of pre-primary teachers in Gem have been retrained on CBC, a percentage lower than other sub-counties in Siaya. After the in-service training, it was expected that the teachers conduct assessment for learning following the CBC rollout. Further, Mathematical Activities in Gem registered the lowest performance at a mean of 1.50 compared to other Sub-Counties in Siaya. This raises questions whether the teachers poses the requisite knowledge to conduct formative assessment, which aids learning and achievement. The purpose of the study was to assess effectiveness of in-service training of teachers on Competency Based Formative Assessment of Mathematical Activities in public Pre-primary schools in Gem. Objectives of the study were to establish effectiveness of in-service training of teachers on knowledge and skills to conduct CBFA of mathematical activities, establish effectiveness of in-service training of teachers on psychological factors to conduct CBFA of mathematical activities and to establish effectiveness of in-service training of teachers on social factors to conduct CBFA of mathematical activities. Conceptual framework was based on Schildkamp et al. (2020) model of three categories of the prerequisites for in-service training of teachers a requirement for CBFA of Mathematical Activities. The study employed descriptive survey research design using the mixed methods of data collection to gather both quantitative and qualitative data. The target population was 95 teachers (selected purposively from the schools), 95 headteachers and one Gem Sub-County ECD Coordinator (SCECDC). Saturated sampling was used to obtain a sample size of 85 pre-primary teachers. The sample of headteachers (10) was obtained by drawing 10% of their population. Simple random sampling was used to select headteachers while purposive sampling to obtain the one SCECDC and pre-schools. Data was obtained using questionnaire, classroom observation checklist and interview schedule. A pilot study was conducted on 10% (10) of pre-primary teachers not sampled for the final study. Reliability of teacher questionnaire was obtained through test-retest at an interval of two weeks using Pearson correlation coefficient ($r= 0.83$). Inter-rater reliability was used to determine reliability of the observation checklist on the teachers used for piloting. The reliability of interview schedule was determined by expert judgment of supervisors. Validity of the instruments was determined by expert judgment by supervisors. Quantitative data was analyzed using descriptive statistics involving frequency distribution tables, percentages and means while qualitative data was analyzed using thematic categories. The overall average mean was 2.84 implying teachers are ineffectively retrained to conduct CBFA. Findings indicate that teachers have limited knowledge on using ICT; they could not differentiate formative from summative evaluation; they have negative attitude towards formative assessment practice as well as not retrained on strategies of involving learners during formative assessment. The study findings delineate the significance attached to acquisition of prerequisites suggested by Schildkamp et al. (2020) for formative assessment. The findings imply that there is need for better structured INSET based on prior identification of teachers needs by relevant education stakeholders to undertake assessment. Further research on ICT integration in the implementation of CBC through assessment practice may need to be carried out.

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LIST OF ABREVIATIONS AND ACRONYMS

AfL	Assessment for Learning
CATs	Continuous Assessment Tests
CBA	Competency Based Assessment
CBC	Competency Based Curriculum
CBE	Competency Based Education
CBFA	Competency Based Formative Assessment
CECDC	County ECD Coordinator
CPD	Continuing Professional Development
ECDE	Early Childhood Development Education
FAS	Formative Assessment Strategies
ICT	Information Communication and Technology
KICD	Kenya Institute of Curriculum Development
KNEC	Kenya National Examinations Council
MOE	Ministry of Education
MUSERC	Maseno University Ethics Review Committee
NACOSTI	National Commission for Science, Technology and Innovation
SCECDC	Sub - County ECD Coordinator
TOCF	Technology Observation and Conversation Framework

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CHAPTER ONE
INTRODUCTION

1.1 Introduction

The study sought to assess the effectiveness of in-service training of teachers on Competency Based Formative Assessment (CBFA) of Mathematical Activities in public Pre-primary school in Gem Sub-County. The chapter gives an overview of the Competency Based Curriculum (CBC) and its focus on formative assessment, the perceptions of teacher effectiveness to conduct assessment in the Sub-County as well as discussion on the prerequisites relevant for carrying out CBFA. The discussion has been made in relation to Schildkamp et al. (2020) framework and the Kenya National Examinations Council – KNEC (2021) training manual expectation for Competency Based Assessment (CBA), Early Years Education.

1.2 Background of the study

Competency Based Education (CBE) is a system of instruction, assessment and feedback based on learners demonstrating what they have learned; knowledge, attitude, self-perceptions and skills as they progress with the education. The CBE system was first introduced in the United States in the 1960s (Ford, 2014).This resulted in formulation of policies facilitating curriculum reforms that led to the implementation of Competency Based Curriculum in order to impart technical competence abilities to enable graduates compete globally for opportunities. Since then, the curriculum has been implemented internationally, regionally and nationally in order to impart 21st century skills to the learners for example in Germany, 1980s; Steinhaeuser, Chenot, Roos, Ledig and Joos (2013), in Rwanda, 2015; Habiyaremye and Ndihokubwayo (2018), in Tanzania, 2005; Komba and Mwandaji (2015), and Kenya in 2019.

The transformation of basic education curriculum across the world from objective based to competency based and with inclusion of new concepts and assessment strategies, there has been need for investment in educators' awareness in order to promote appreciation of the new approach. To achieve this, attempt has been made by various education stakeholders to ensure teachers refresh and enhance their existing knowledge and skills through in-service training (Schneider & Johnson, 2018; Heritage &Wylie, 2019; Burgos & Godino, 2022). Additionally, effective in-service training of teachers has been reiterated by Ondimu (2018) as requisite before conducting formative assessment. However, to realize this, it is important that teachers' poses basic ideas and relevant information in understanding methods of assessment, assessment feedback and developing competency based assessment tools for example rubrics outlined in the training manual for Competency Based Assessment, Early Years Education (KNEC, 2021), the extract attached as Appendix IX. The manual provides for the need to build teacher capacity to undertake competency based formative assessment at school level. It is for this reason that KNEC has developed the training manual to build teachers and other education stakeholders' capacity aiming at providing quality assessment, however, the learning outcomes has not been fully realized due to poor performance.

The study adopted Schildkamp, Van der Kleij, Heitink, Kippers and Veldkamp (2020) model who carried out a comprehensive review of literature and identified three prerequisites relevant to teachers before carrying out formative assessment. Scholars including Tuttle (2013) have examined formative assessment models however, important aspect of KICD (2017)'s requirement of ICT integration during assessment for recording and reporting learners' achievement was not factored therefore, this model was considered. The framework addressed the pertinent issues including teacher knowledge on assessment tools, ICT integration and learner involvement during

the learning and assessment process KICD (2017) and KNEC (2021). The prerequisite include; a) Knowledge and skills (pedagogical content knowledge, feedback, goal setting and Information Communication Technology (ICT) skills); b) Psychological factors (attitude/belief, ownership, social pressure and perceived control); and finally c) Social factors (teacher collaboration and involving learners). According to KICD (2017), KNEC (2021) and Vingsle (2014), pedagogical content knowledge is necessary in giving learners prompt feedback for their achievements and better address areas of challenge. KNEC (2021) directs provision of feedback to inform learners, parents and relevant stakeholders such as Ministry of Education (MOE) on successes and challenges in assessing various learning areas. Goal setting should be measurable and within learners' retention ability to meet the KICD (2017) requirement and Dilova (2021) suggests that each teacher and learner should understand what their goal is. In order to record learners' achievements and increase their engagement using devices including computer, smart phone and Google, ICT skills will be required (KICD, 2017; Li, Yamaguchi & Takada, 2018; Van der Kleij & Adie, 2018).

As indicated by Schildkamp et al., psychological factors will show teachers relationship and view of formative assessment and comprise of attitude, ownership and social pressure and perceived control. Attitude will enhance acceptance of assessment process and can be attained through Continuous Professional Development-CPD (Widiastuti, Mukminatien, Prayogo & Irawati, 2020). Ownership will ensure teachers have autonomy of making assessment decisions on the other hand social pressure and perceived control will give teachers authority to make adjustments to instruction and curriculum through assessment feedback (Bhushan, 2018).

Social factors prerequisites involves collaboration between teachers and learner involvement. According to KICD (2017) and Loo (2022) collaboration between teacher is recommended

through teaming up to develop and execute assessment process. Finally, involving learners is vital for the analysis of test scores, making learners understand achievement of abilities and areas of inadequacies through assessment as learning. Proponents of formative assessment have carried out various studies to establish perceptions on teacher's effectiveness to conduct the formative assessment in respect to acquisition and practice of the assessment strategies.

In Malaysia, Thinwiangthong, Eddy and Inprasitha (2020) examined mathematics teachers' abilities in developing formative assessments through question quality and nature of questioning when teaching algebraic reasoning. The AssessToday rubric, the main instrument used to find out teachers 'ability indicated they made significant improvements in developing formative assessment after teaching. Similar results were replicated in a study done in Canada by Suurtamm, Koch and Arden (2010) where teachers teaching mathematics in grade 7-10 were found to be competent in developing various forms of assessment through questioning, observation and quizzes to improve student learning. In Kenya, according to KNEC (2021) on CBA for early years education, teachers are tasked to develop practical mathematical assessment activities with resources derived from immediate environment for learners to develop required skills through self-discovery. In contrast to the earlier researchers, teacher capability in developing practical mathematical activities assessment tasks has not been established hence this was uncovered from the respondents.

According to surveys by (Arrafii & Sumarni, 2018; Chemeli, Kisilu, Chumba & Karsten, 2019; Govender, 2019; Mahlambi, 2021), little literature has been gathered on teacher knowledge to conduct formative assessment at pre-primary school. This despite pre-primary stage being initial learning level and assessment is a practice supposed to be carried out across all levels of learning for transition of learners. In a study by Arrafii and Sumarni (2018) on teachers understanding of

formative assessment at secondary school level. The study focused on both public and private schools teaching in Central Lambok and examined factors related to teacher assessment in literacy level with findings indicating that teachers had inadequate knowledge of formative assessment as well as insufficient training, raising questions on the teacher competence to conduct assessment at the ECDE level. This study filled the gap by using mixed methods of research to obtain both quantitative and qualitative data from the teachers in order to determine their ability to undertake competency based formative assessment.

Integration of ICT during formative assessment has been discovered to yield a number of benefits to learners such as efficient, immediate and effective feedbacks (Kent, 2019). Research by (Elmahdi, Al-Hattami & Fawzi, 2018; Remmi & Hashim, 2021) sought to explore teachers' usage of ICT and perception of online formative assessment tools. The studies employed mixed methods design involving questionnaires and open-ended questions. Findings from the studies revealed most teachers agreed the use of online formative assessment tools to assess learners' performance made teaching easier even though challenges such as facilities and location of schools were noted. However, use of ICT is a practical activity and there was need for triangulation for observation of its use during assessment. A part from the use of questionnaire as the main data collection tool in the aforementioned studies, classroom observation was vital to report on practical use of ICT during mathematical activities lesson to determine if teachers have gaps.

To uncover psychological factor relevant for formative assessment, Yan and Cheng (2015) attributes teacher preparedness in assessment process vital for attitude practice among teachers while investigating on primary teachers' attitude towards formative assessment among 450 teachers in 10 primary schools. Similarly, Widiastuti et al. (2020) asserts that teachers with CPD have a stronger belief towards formative assessment. Teachers who are adequately equipped are

knowledgeable on assessment criteria hence more confident and better placed to teach and assess learners' as it positively affects their morale and attitude. To justify the assertions in the studies, teachers' opinion was sought in order to determine their attitude towards formative assessment after the in-service training.

Ontiveros (2017) utilized survey with teachers and data drawn from math test results on concepts such as operations algebraic thinking to find out learner involvement in utilization of formative assessment. Results indicated lack of student engagement through the process furthermore learners were not aware of their assessment results. However, Brookhart, Moss, and Long (2009) in their study reports positive learner involvement in formative assessment to improve performance and reiterated by Hill and Edwards (2019) who asserts learners valued and appreciated their involvement in formative assessment practice while acknowledging high engagement. In Kenyan context, learner engagement during formative assessment is a practice that is limited in classroom set up due to challenges including teacher competence, inadequate ICT devices and high learner enrolment (Asava, 2021). Despite this, teachers are expected to conduct assessment.

In Rwanda, CBC was implemented in the year 2015 (Habiyaremye & Ndihokubwayo, 2018) to impart critical thinking skills, research and innovation to the graduates. Additionally, other cross-cutting issues including genocide studies, sexuality, and environmental sustainability led to the implementation of the curriculum (REB, 2015). The curriculum has been appreciated by teachers in Rwanda since quality of learning has been improved with a shift from memorization of subject content matter to the practical aspects during learning. Nevertheless, Nsengimana (2020) remarks that lack of adequate teaching and learning resources has hampered the implementation process such as laboratories. This has forced teachers to teach and assess practical learning areas

theoretically. Lack of teacher involvement during the curriculum development has also been a challenge since their role has been left at implementation stage.

The 8.4.4 system of education in Kenya was implemented in the year 1985 as a result of the need for a system that would guarantee learners independence. This was to enhance their career prospects in both the formal and informal sectors, however, the curriculum has been criticized for being overly broad, theoretical, and exam-oriented with its primary focus on summative evaluation. Therefore, it failed to offer flexible education pathways for identifying and nurturing learners talents, abilities, and interests early enough to prepare them for the workforce (Ambaa, 2015 & Mwanzia, 2019). In an attempt to solve the challenges facing the 8.4.4 education system, the 2012 taskforce report on the realignment of the education sector to Kenya vision 2030 and the 2010 Kenyan Constitution recommended a Competency Based Curriculum and early talent identification and nurturing. This resulted to the development of Sessional Paper No. 2 of 2015 by the government (Republic of Kenya, 2012). These recommendations among others were made because the education system did not address the underlying issues such as grade wastage and unemployment among the graduates. This led to the implementation of CBC under the 2.6.6.3 system of education.

The Competency Based Curriculum was rolled out in Kenya in the year 2019 and its foundation is anchored in the first two early years of schooling (Pre-primary 1 and 2) which the study focused on before transition to primary school. The mode of assessment emphasis has been on CBFA and its aim at pre-primary school is to track each learner's progress, acquisition of learning ideas, talents and abilities using appropriate methods or tools. This involves the use of learner portfolios, rubrics, observations among others to ease transition to Grade one (KICD, 2017) and KNEC (2021). The paradigm shift in assessment from objective based to competency based has led to the

demand for in-service training of teachers by relevant education stakeholders to retrain them on the new assessment strategies. This is significant since according to Black and Wiliam (1998), the teacher is tasked to decides what to test about the learner, and select acceptable methods and procedures to elicit learner thought and provide considerable insight during assessment.

Prior to implementation of CBC in Kenya according to Odera, Odundo and Onyiengo (2020), formative assessment was attempted in the form of Continuous Assessment Tests (CATs), Random Assessment Tests (RATs) among others. However, this kind of assessment did not have the intended purpose of influencing the learning process and were not taken into consideration in final grading of learners. Consequently, it was the final exam (summative evaluation) that counted in determining student grading in pre-primary, primary and secondary school for transition to the next class. However, in order to refresh teachers knowledge of formative assessment, pre-primary teachers teaching in the Early Childhood Development Education (ECDE) schools in Siaya County were retrained on CBC between 2016 and 2018 as reported by County ECD Coordinator. The training was conducted by KICD and MOE in collaboration with the County government of Siaya through TAYARI program approach.

According to data as per year 2022 from County ECD Office, Gem recorded the second highest number of pre-primary teachers at 222 after Alego Usonga with 254. Other sub-counties; Ugunja 175, Ugenya 151, Rarieda 206, and Bondo 198. Similarly, a report by County ECD Coordinator (CECDC) indicates that only 42.79% of pre-primary teachers were trained in Gem, a percentage lower than other sub-counties despite expectation by KICD that all teachers are retooled to enable collaboration during teaching and assessment. Table 1.1 indicate the status of in-service training of teachers in Siaya County.

Table 1.1 Status of in-service training of teachers on CBC in Siaya as per the year 2022

No.	Sub-County	Number of Teachers	Number of In-service trained teachers	Percentage trained
1	Gem	222	95	42.79%
2	Ugunja	175	98	56%
3	Ugenya	151	104	68.87%
4	Rarieda	206	117	56.79
5	Alego-Usonga	254	136	53.54%
6	Bondo	198	112	56.56%
	TOTAL	**1,206**	**662**	

Source: Siaya County Early Child Development Education Office (ECDE) 2022 data.

Data from Table 1.1 above indicate deficiency in the percentage of retrained teachers in Gem at 42.79% compared to other Sub-Counties. Teachers who have undergone in-service training are expected to be conversant with the prerequisites and poses numeracy skills to undertake CBFA.

A survey was conducted to find out learners' performance in the five learning areas among the public pre-primary school teachers in the six Sub-Counties in Siaya. According to the teachers' data collected by the researcher on learners performance in the various learning areas, mathematical activities was performed very poorly in Gem compared to other Sub-Counties. The ranking was done on a scale of 1-5. Table 1.2 below show teachers' data on learners' performance in the learning areas taught and assessed at pre-primary schools in the County.

Table 1.2: Pre-primary Learners' performance in the learning areas in Siaya County

No.	**Learning Area**	**Sub-Counties**					
		Gem	Rarieda	Alego-Usonga	Ugenya	Ugunja	Bondo
1.	Mathematical Activities	1.50	3.10	2.76	2.70	2.95	3.46
2.	Language Activities	4.25	3.64	4.39	4.60	4.18	3.88
3.	Environmental Activities	4.50	3.09	3.60	4.40	3.78	3.76
4.	Psychomotor and Creative Activities	3.25	4.01	4.39	3.59	4.51	4.29
5.	Religious Activities	3.50	3.77	3.61	4.10	3.91	3.65

Source: Teachers in Pre-primary schools in Siaya County as per October, 2022

KEY: 1- Very poorly performed, 2-Poorly performed, 3- Averagely performed, 4-Well performed and 5- Very well performed

According to Gem sub-county pre-primary teachers, mathematical activities performed very poorly since learners experienced challenges in physically arriving at mathematical solutions. At

pre-primary school, learners majorly use hands on manipulation and accuracy is necessitated in problem solving compared to other learning areas. Therefore, Mathematical activities was chosen for research. The learning area at pre-primary curricula comprises of basic mathematical concepts through manipulation of concrete objects and enables learners engage in basic analysis of problems and development of appropriate solutions in everyday life. Therefore, teachers should poses numeracy skills to effectively carry out assessment of the learning area.

1.3 Statement of the problem

To demonstrate expertise in CBFA, teachers should have a thorough understanding of learner's abilities, interests as well as goal of assessment practice. The role of formative assessment in facilitating learning has been established in the literature. The Kenya National Examinations Council has incorporated Competency Based Assessment as key element in the new curriculum at both levels of pre-primary school to enable teachers identify attainment of competencies by the learner for transition to Grade one. Gem Sub-County ECD Coordinator reported that teachers teaching in the pre-primary schools were taken through in-service training on CBC under TAYARI program approach between 2016 and 2018. As a result, they are expected to conduct assessment of the learning areas at pre-primary level. Even though focus has been on in-service training, survey has indicated lowest performance in Mathematical Activities in Gem compared to other sub-counties. This raises questions on the scope and effectiveness of the in-service training in respect to providing teachers with the knowledge and skills outlined in Schildkamp et al. framework as well as expectation by KNEC assessment framework to carry out CBFA practices in the classroom.

1.4 Purpose of the study

The purpose of this study was to assess effectiveness of in-service training of teachers on Competency Based Formative Assessment of Mathematical Activities in public pre-primary schools in Gem Sub-County, Kenya.

1.5 Objectives of the study

The study was guided by the following objectives:

1. To establish effectiveness of in-service training of teachers on knowledge and skills to conduct competency based formative assessment of mathematical activities in public pre-primary schools in Gem Sub- County.
2. To establish effectiveness of in-service training of teachers on psychological factors to conduct competency based formative assessment of mathematical activities in public pre-primary schools in Gem Sub- County.
3. To establish effectiveness of in-service training of teachers on social factors to conduct competency based formative assessment of mathematical activities in public pre-primary schools in Gem Sub- County.

1.6 Research questions

The study was guided by the following research questions

1. To what extent does in-service training of teachers on knowledge and skills affect competency based formative assessment of mathematical activities in public pre-primary schools in Gem Sub-County?
2. To what extent does in-service training of teachers on psychological factors affect competency based formative assessment of mathematical activities in public pre- primary schools in Gem Sub-county?

3. To what extent does in-service training of teachers on social factors affect competency based formative assessment of mathematical activities in public pre-primary schools in Gem Sub- County?

1.7 Scope of the study

The study assessed on effectiveness of in-service training of teachers on CBFA of mathematical activities in public Pre-primary schools in Gem. Respondents included pre-primary 1 and 2 teachers, headteachers and Sub-county ECD Coordinator. Learning area covered was Mathematical Activities.

1.8 Limitations of the study

1. The Likert scale questionnaire has a limitation on finite number of responses that respondents are limited to. In this study it posed a limitation since it may not have fully captured the complexity of the pre-primary teacher's attitudes and opinions towards formative assessment practice.
2. The results relates to in-service training conducted in Gem and therefore the findings may not apply to other training elsewhere.

1.9 Assumptions of the study

The following assumptions were made for the study:-

That the teachers teaching in public Pre-primary schools in the Sub-county had adopted the new strategies of assessment outlined in the Competency Based Assessment Framework (CBAF) and that that all public Pre-primary schools chosen for study had similar infrastructural resources and materials that supports CBFA.

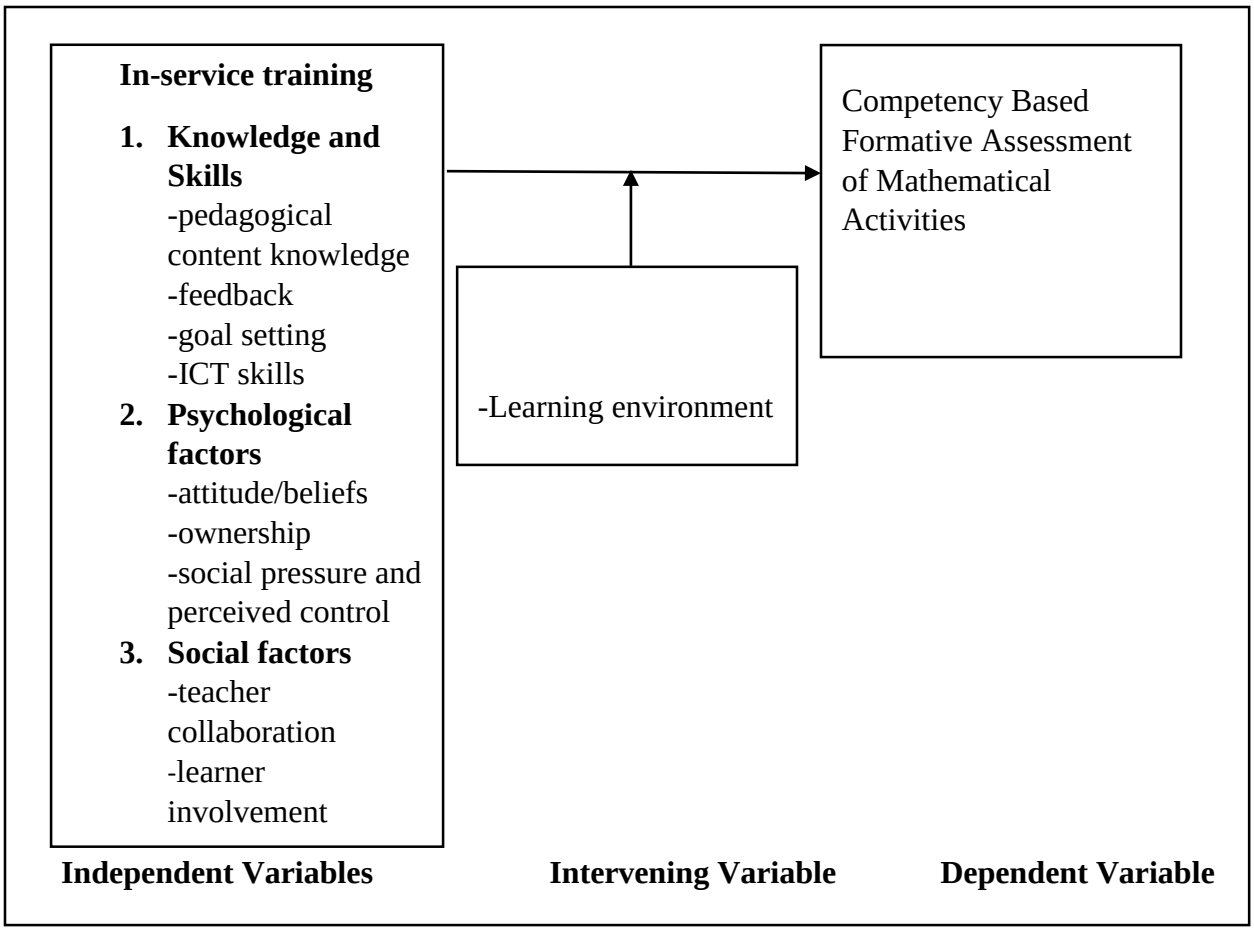
1.10 Significance of the study

1. The study may enlighten pre-primary teachers on relevant prerequisites for CBFA and identify the gaps in the prerequisites for formative assessment based on Schidkamp et al framework.
2. The identified gaps may inform contents of in-service training of teachers. In-service training organizers including Sub- County ECD Coordinator (SCECDC) and County ECD Coordinator (CECDC), may use the findings to organize relevant inset programs.
3. Results may inform the Ministry of Education on the status of teacher acquisition of relevant prerequisites and any shortcomings teachers face for policy decision and implementation.

1.11 Conceptual framework

Formative assessment is essential in recognizing learner's strengths and weaknesses as well as giving teachers feedback they may use to improve their instruction. In order to conceptualize this study, the framework was hinged on Schildkamp et al. (2020) model of formative assessment. The model identified three categories of prerequisites for formative assessment. These are basic ideas and information required by teachers before carrying out assessment. In-service training of teachers forming independent variable involves possession of prerequisites including; 1) Knowledge and skills, involving; a) pedagogical content knowledge- significant for teachers to present practical mathematical activities to learners by employing hands on manipulation tasks that capture their attention since at this age learners easily get distracted. b) feedback- entails informing learners about their accomplishments and strategies for improvement, c) goal setting - which should be explicit, measurable and within learners' retention ability to meet the KICD (2017) and KNEC (2021) requirement, and d) skills in ICT for recording and reporting learner's

achievement by utilizing digital assessment materials such as computers. 2) Psychological factors including a) attitude which refers to feeling toward assessment process, b) ownership-enabling teachers have freedom of making assessment decisions and c) social pressure and perceived control that will give teachers autonomy over making changes to instruction and curriculum based on assessment feedback and finally 3) Social factors involving a) teacher collaboration important in ensuring they plan and implement assessment jointly, and b) Involving learners who will observe and imitate process leading to assessment and later take part. The teacher's ability to carry out CBFA of mathematical activities which is dependent on in-service training, was the dependent variable and was determined by teacher's possession of numeracy skills. The learning environment may affect the assessment process in respect to availability of resources and materials for the process and this was controlled by selecting public Pre-primary schools assumed by the researcher to have similar infrastructural resources and materials that support assessment process. This factor informed intervening variable and impacted dependent variable for effectiveness of CBFA of mathematical activities either positively or negatively.



Source: Researcher, 2022

Figure 1:1 Conceptual Framework on the effectiveness of in-service training of teachers on CBFA of Mathematical activities

1.12 Operational definition of terms

Competency Based Formative Assessment - refers to giving learner an opportunity to put into practice knowledge, skills and abilities acquired in mathematical activities to determine achievement according to specific strand during teaching.

Competency Based Curriculum – refers to an educational program that requires learners demonstrate capacity to apply the knowledge, skills, attitude and values in mathematical activities acquired during their education.

Effectiveness – refers to perceptions of teachers, headteachers and SCECDC on extent to which in-service training of teachers provided knowledge and skills as outlined in Schildkamp et al. framework for the purpose of conducting CBFA. Their perceptions have been measured on a Likert scale.

Formative assessment - a type of assessment where teachers gather information in mathematical activities during teaching process with a view to providing feedback to the teacher and learner using exploratory tools to monitor individual learner progress.

Knowledge and skills – refer to teacher's pedagogical content knowledge, assessment feedback, goal setting and ability to use ICT before conducting assessment.

In-service teacher training – refers to training given to pre-primary teachers after they have entered into teaching aimed at equipping them with the three prerequisites namely knowledge and skills, psychological and social factors.

Learning area – refers to mathematical activities curriculum containing knowledge, skills and attitude that leaners are supposed to acquire.

Mathematical activities – refers to learning area at pre-primary meant to equip learners with competencies in classification, number and skills in measurement.

Psychological factors – refers to teacher attitude/beliefs, ownership and social pressure as well as perceived control relevant for this study before conducting formative assessment.

Public pre-primary schools- refer to government owned and funded initial learning centers learners attend before proceeding to primary school.

Retooling – refers to process meant to increase professional knowledge and skills for teachers in understanding strategies of formative assessment in order to improve classroom outcomes.

Social factors – refers to teacher collaboration and involving learner's requisite for conducting formative assessment in this study.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter discusses various literature concerning Mathematical activities, a learning area in Competency Based Curriculum at Pre-primary school and the focus on CBFA practice. The teachers' perceptions and abilities to undertake assessment of mathematical activities has been discussed in line with possession and practice of the prerequisites outlined in the Schildkamp et al. (2020) framework as well as Basic Education Curriculum Framework (KICD, 2017) and Competency Based Assessment training manual (KNEC, 2021), an extract attached as Appendix IX. The study has further outlined the existing gaps and ways of addressing them to ensure effective implementation of the curriculum through formative assessment. This chapter is organized based on themes related to objectives of study.

2.2 Mathematical Activities

Mathematical activities at both levels of Early Years Education aims at developing knowledge, skills and attitudes in numeracy at the learners' level. It employs hands on manipulation approach and enables learners develop the required skills and competencies in classification, number and skills in measurement through self-discovery by relating the learning points to real life situations (KICD, 2017). According to Margaret and Rao (2005), mathematics teachers at ECDE should be aware of the manipulation of teaching and learning materials as well as being positive towards teaching and assessing mathematical concepts. This is practical through collaborative approach between the teachers and learners in exploring mathematical problems and strategies to solve them in day to day life (Hausfather, 1996; KNEC, 2021). To ensure teachers monitor learners attainment of mathematical activities abilities and competencies for transition to the next grade, KICD (2017)

recommends use of appropriate formative assessment tools including use of checklist, observation schedule, rubrics among others to enable identify their strengths and weaknesses.

2.3 Effectiveness of in-service training of teachers on knowledge and skills to conduct Competency Based Formative Assessment

The inclusion of new concepts and assessment strategies in CBC requires teachers to be knowledgeable on the new strategies of conducting assessment. This involves use of various formative assessment tools such as checklist, rubrics as well as reporting assessment outcomes outlined in the curriculum framework for in-service teacher training. When properly administered, CBFA can give teachers and students information they need to advance to the next level (Heritage, 2007; Yan, Panadero, Yang, Yang & Lao, 2021). Schildkamp et al. (2020) specifies pedagogical content knowledge, feedback, goal setting and ICT skills as key indicators in teacher knowledge and skills prerequisites for formative assessment.

2.3.1 Pedagogical content knowledge

Pedagogical content knowledge refers to teachers' knowledge about broad principles and strategies of understanding how students learn, methods of teaching and assessment in line with educational objectives.

Govender (2019) researched on formative assessment as formative pedagogy in Grade 3 Mathematics. Using purposive sampling and data obtained through interviews and observations of at least three classroom sessions for each teacher of mathematics selected in districts found in Gauteng province. Findings showed teachers carry out formative assessments when they have thorough understanding of their mathematical cognition and conceptual development. Izci (2016) holds similar view. Competency based curriculum is a new phenomenon in Kenyan education system that extensive literature needs to be established on teachers' pedagogic content knowledge

in assessment especially in formulation of assessment task, preparation and use of assessment tools. Whereas in 8.4.4 education system, the curriculum provided for administration of formative assessment in form of CATs and RATs, teachers' knowledge in assessment was established through comparison of learners' test scores (Odera et al., 2020). KICD (2017) does not recommend grading of learners at pre-primary for analysis of test scores to determine teacher knowledge in formulating, administering and reporting assessment tasks, instead directs use of formative assessment for monitoring learner's progress in acquisition of skills and knowledge. However, relevant information on this subject matter was obtained through questionnaire and observation of teacher assessment activities during mathematical lesson and reported on the findings.

Mahlambi (2021) sought to find out on Assessment for Learning (AfL) which is important for active learning mathematics participation in primary schools in Alexandra Township. Semi-structured questionnaires, interviews and non-participant observation were used to collect data from nine purposefully sampled mathematics teachers. Findings showed teachers had inadequate pedagogic knowledge in using assessment for learning to promote active learning. Recommendations were made on planning AfL. The current study finds a methodological gap from the aforementioned research based on the smaller sample size as varied responses may not have been attained to represent the whole population of teachers' on knowledge of assessment. According to Creswell and Creswell (2018) sample size between 10 -50 is ideal for quantitative research. To fill the gap, this study employed a larger sample size of 85 teachers' to obtain data.

In Kenya, Isaboke, Mweru and Wambiri (2021) used interview schedules, observation schedules and document analysis, to investigate teacher preparedness in implementation of CBC in Nairobi city and sampled 90 pre-primary school teachers. During the training, both trained and untrained

teachers experienced challenges in formative assessment due to inadequate knowledge. Out of the teachers, 46.6% untrained had difficulties even with support in formative assessment while 16.7% trained had difficulties. Teacher possession of numeracy skills in carrying out assessment tasks greatly depend on efficiency of in-service training. Based on this, there was need to gather information involving duration and frequency of in-service training which are integral for teacher effectiveness to conduct formative assessment from the respondents.

In another study in Kenya, Chemeli et al. (2019) investigated five key formative assessment strategies (FAS) in Nandi County. The strategies involve clarifying learning intentions, classroom discussion, feedback, peer and self-assessment in mathematics instruction. Results however indicated low utilization of FAS due to lack of awareness of evaluation strategies. The lack of awareness could probably manifest due to inadequate knowledge on forms of assessment and use of appropriate tools during application of FAS a matter that required research from Gem ECDE teachers. However, Kogo (2019) remarks that teachers employed in Nandi County had current pedagogic skills attained during in-service training. Based on the two studies and with the inconsistency in findings, the current study was significant to report on the Gem ECDE teachers' perception on their pedagogic knowledge to carry out assessment.

2.3.2 Assessment feedback.

According to KNEC (2021), Competency Based Assessment Framework (CBAF) for Early Years Education, teachers are to use exploratory tools to monitor learner progress in acquisition of competencies. This will involve the use of formative assessment tools including checklist, observation schedule, rubrics among others to track learner's progress in acquisition of knowledge, skills and attitudes. The feedback gathered will be used to establish if learning took place and any

challenge experienced by learner in understanding a concept. It should be constructive, meaningful, timely and sufficiently detailed (KNEC,2021 & Schildkamp et al., 2020).

Beesley, Clark, Dempsey and Tweed (2018) published a paper on enhancing formative assessment practice and encouraging middle school mathematics engagement and practice using Assessment Work Sample Method (AWSM). This was to enable middle school teachers understand characteristic of high-quality formative process for easy use in their classroom. Regardless of their educational content at entry, AWSM increased teacher's use of formative assessment particularly feedback practice. To support Beesley et al. (2018) assertion, the questionnaire used gathered information on teachers' educational background and ascertained whether preparation and use of formative assessment materials for reporting learners achievement in Mathematical activities is a contingent on pre-service academic qualifications.

Another case study from Hong Kong by Lei and Xie (2019) through interviews and lesson observations to evaluate instructor formative evaluation, feedback practices and challenges. Teachers focused on what student did and could achieve in future assignments but experienced difficulties in giving learners feedback for lifelong learning. This is in agreement with Heritage and Wylie (2018) who believe assessment is meant to propel learning forward. KICD (2017) necessitate assessment for learning be continuous to ensure learners are able to exhibit abilities and talents which is a lifelong process. Mathematical activities is supposed to equip ECDE learners with skills to enable them solve everyday problems such as involving numbers, a lifelong process. However, this can only be achieved if teachers are knowledgeable.

Hasim, Di, and Barnard (2018) interviewed 10 Malaysian primary school teachers of English on their understanding of formative assessment and feedback practice in School Based Assessment (SBA) environment. They reported implementing various forms of feedback some of which might

be regarded as formative since initially they could not differentiate between summative and formative evaluation. Findings of the study aligns to that of Figa, Kebede and Tarekegne (2020) who concluded that teachers at times provided formative assessment feedback for lacking necessary prerequisites. Teachers should be knowledgeable on assessment areas, methods, learning gap and nature of assessment when providing feedback (KICD, 2017). However, limitations may arise from using only interviews as indicated in the study by Hasim et al. (2018) to obtain self-reported data from teachers. Therefore, the need to use multiple data collection tools may provide comprehensive findings which in this research both qualitative and quantitative data were obtained from the respondents. This was necessary to provide justification if Gem ECDE teachers are able to differentiate between formative and summative evaluation.

In Kenya, case study by Musyimi (2020) shows that feedback should motivate learners to work towards their goals therefore, assignments and CATs should provide learners with an environment to practice learnt concepts through feedbacks. The goal of assessment feedback according to KICD (2017) is to increase learners' competence and confidence in their subject matter. Considering KNEC (2021) recommends verbal or written feedback during teaching, the researcher established from the teachers on the type of feedback provided to help improve on the performance of mathematical activities.

2.3.3 Goal setting

Formative assessment technique relies on formulation of assessment goals and targets to allow teachers and learners receive feedback on their progress toward established objectives. According to Brookhart, Long and Moss (2008) and Brookhart and Moss (2019) students are capable of creating their own goals and producing evidence of their progress toward their academic goals hence teachers should support them. Nordengren (2019) investigated how teachers should set goals

in a learning set up or classroom and suggested timely setting, student centered and short term for effective process (KICD, 2017). However, apart from setting short term lesson goal, teachers should also ensure lifelong goals that will enable nurturing of learners talents and abilities such as use of mathematical skills to solve everyday problems.

To determine the basis for success in CBC, Chepsiror (2020) carried out a study in Bureti sub-county and collected data from 95 Pre-primary 1 teachers randomly selected from public and private schools and data obtained through questionnaire and observation checklist. Among the factors found to hamper reading strategies leading to assessment included unclear goals. The findings of Dotson (2016) involving 328 students which 69% advanced in performance after goal setting compared to 60% before setting goals to be attained concurs with the aforementioned study. Nevertheless, little is known on teachers perceptions on ability to structure lesson goal that meet learner needs and characteristics considering the low performance in mathematical activities.

2.3.4 Information communication and technology (ICT) skills

Competence Based Assessment (CBA) provides for integration of ICT at all levels of learning in Kenya Early Years of Assessment (KEYA). KICD (2019) and KNEC (2021) recommends ICT integration during assessment for recording, scoring and reporting evidence of learners' achievements. This calls for teacher competence in using the ICT gadgets including laptops, desktops, and smart phones among others.

Elmahdi et al. (2018) researched on the use of technology for formative assessment to improve student learning employing 'Plickers' a technology based formative assessment tool. The usage of 'Plickers' for formative assessment aids in learning process and saves time, according to data obtained from 166 students in Bahrain teachers college using questionnaires. The findings of Elmahdi et al. (2018) agree with (Cosi et al., 2020; Ogange, Agak, Okelo & Kiprotich, 2022; Webb

et al., 2018) who remarks combining formative assessment feedback with the use of technology improves learning outcomes and assessment flexibility. It should be noted that learners' achievements are supposed to be maintained and reported qualitatively through integration of ICT. Nevertheless, this cannot be achieved without teachers attaining requisite skills on ICT use. Neumann, Anthony, Erazo and Neumann (2019) on assessment and technology; mapping future directions in early childhood classrooms remarks that technology give an avenue for test construction, administration, scoring and interpretation. This links curriculum to individualized learning however, challenges such as teacher implementation and developmental appropriateness are issues of concern and its success depends on collaborative efforts among educators, students and policy makers.

In another study by Rr, Fox-Turnbull, Earl-Rinehart and Calder (2020) where Technology Observation and Conversation Framework (TOCF) identified as a framework of higher order questions designed for technology classroom. The findings from teachers interviewed showed they majorly found TOCF necessary when using it. It helped teachers expand their understanding over use of technology and deepening learners understanding of technology, constrains were also experienced and recommended slow introduction of any resource in the classroom. Low technology utilization is a challenge experienced in most pre-primary schools in rural areas in Kenya due to inadequate internet, electricity and exposure, (Ngugu, Ogembo & Pelowski,2012).

In Kenya, the county government through Ministry of Education is tasked to ensure public pre-primary schools are equipped with necessary ICT infrastructure even though, study by Murithi and Yoo (2021) in which 351 teachers filled online questionnaires indicated inadequate ICT facilities in schools and ill equipped with basic ICT skills hence implications for this research. Capacity building for teachers on this matter has also been stressed (Abdullahi, 2019; Musungu, Ogula &

Munyua, 2021). In addition to regular training, the study uncovered if capacity building programs have been undertaken to reskill teachers by identifying areas of inadequacies in order to put necessary measures to improve performance in mathematical activities.

A number of scholars are of the same school of thought that effective knowledge and current pedagogical skills on formative assessment can only be realized when educators have relevant prerequisites (Govender, 2019; Izci, 2016 & Mahlambi, 2021). Subsequently, low utilization of assessment strategies has been noted by Chemeli et al. (2019) and Isaboke et al. (2020) an issue that raises concern over Gem ECDE teachers' competence. However, Kogo (2019) remarks that teachers in Nandi have current pedagogical knowledge from the in-service training attended. Notably, emphasis has been put on integration of ICT during assessment even though educators and various education stakeholders still suffers major setbacks coupled with challenges emanating from poor infrastructure, internet connectivity and attitude towards its use (Ngugu, Ogembo & Pelowski, 2012; Rr, Fox-Turnbull, Earl-Rinehart & Calder, 2020). Nonetheless a number of issues still remains underexplored concerning availability of the ICT gadgets in Gem pre- schools and whether the executors (teachers) have the relevant technical skills for their use.

2.4 Effectiveness of in-service training of teachers on psychological factors to conduct Competency Based Formative Assessment

According to Schildkamp et al. (2020),psychological aspects including attitude/beliefs, ownership, social pressure and perceived control are necessary for teachers to carry out CBFA. Understanding the learners' background will help teachers overcome challenges if any during teaching that would affect assessment practice.

2.4.1 Attitude/Beliefs.

To find out teachers beliefs and practices in formative assessment in teaching and writing, Boersma and Guadu (2018) utilized mixed method of research using questionnaires, semi-structured interviews and student assessment papers. The findings' revealed teachers have a positive belief toward formative assessment. This concurs with Van der Kleij (2019) and Vanhoof, Van Petegem and De Maeyer (2009) who posits feedback perceived positive by teachers than students. Teachers beliefs about enquiry are consistent with how they teach and assess learners (Correia & Harrison, 2020). Additionally, learning environment plays a role in attitude development for assessment as established in this study. Saneewong (2020) remarks school environment should be conducive to support assessment for learning and as also noted by KICD (2017) that learning environment should be structured according to education trends, learner needs and characteristics.

Widiastuti et al. (2020) sought to find out dissonances between teachers' beliefs and practices of formative assessment in EFL classes in different Continuing Professional Development (CPD). Results showed teachers with high CPD has stronger belief in formative assessment than those with lower involvement despite no impact towards success of formative assessment among teachers who took part in CPD. Ahmedi (2019) reports significant correlation between teacher's attitude and practices towards formative assessment. Using interviews to collect qualitative data, this study may contribute to the body of knowledge by informing on how continuous in-service training has impacted on teachers' attitude towards formative assessment.

In Rwanda however, Kizito,Telesphore and Rukundo (2019) investigated challenges of implementing CBC. A total of 731 respondents were surveyed involving 256 primary and 453 secondary teachers during their training and of averagely 10 years teaching experience. It was discovered 82 percent of the respondents appreciated the new curriculum however found it difficult

to complete training due to its loaded content. Opara Ijeoma (2018) remarks that teaching experience also determines attitude towards assessment. Teachers with more experience are perceived to have positive attitude as they are conversant with learning and assessment areas.

Waigera, Mweru and Ngige (2020) discovered teachers with positive attitude attained higher levels of using instructional resources in their classroom. This significant as teachers will appreciate scoring learners' achievement and feedback compared to those with negative attitude.

A study done in Kenya by Wambua (2019) while utilizing descriptive survey approach involving 83 headteachers, 367 grade one to three teachers and 3 SCECDC to find out constrains in implementation of CBC in Machakos County. The study concluded positive attitude towards assessment in CBC requires training and participation in the curriculum change process. School environment may contribute to teachers attitude and beliefs and impact on assessment as posited by Saneewong (2020) and Wambua (2022). It is a policy in Kenya that all public pre-primary schools are managed and supported by county government. Therefore, it was assumed by the researcher that assessment support materials and infrastructure had been availed to provide an environment that promotes teachers attitude towards assessment practice.

2.4.2 Ownership

The extent teachers can make decisions relates to ownership over assessment results as low efficacy and lack of ownership greatly affect assessment practice (Schildkamp et al., 2020). To research on teachers self-efficacy and formative assessment of students, Xiang,Yum and Lian (2020) found out the relationship between teachers self-efficacy and their use of formative assessment practice. The study involved 507 Chinese primary schools and findings indicated teacher's self-efficacy involving formative assessment and perception of school mastery goal structure positively influenced the use of formative assessment. Similarly, Ng (2020) notes that

the strength of teachers conviction in one's ability affect the desired outcome of formative assessment. However, Gotch, Poppen, Razo and Modderman (2021) holds a different view that high levels of self-efficacy does not necessarily depict successful implementation of formative assessment. In order to encourage ownership in assessment practice which existing researches fails to bring out, the curriculum in-service trainers need to adopt measures that will make teachers autonomous when carrying out the practice. There was need to interview SCECDC who is instrumental during the retraining of teachers to find out measures put in place to encourage teacher's ownership of assessment.

Ahmad and Akbar (2020) and KNEC (2021) recommend additional practical work in the program to improve teacher's competence in the implementation of curriculum and assessment for ownership. This after finding out that teachers were moderately confident in their abilities considering assessment practice. This is significant in making them responsible for learning and progress than concentrating on curriculum according to Schildkamp et al. (2020).

In order to realize improved performance in mathematical activities in Gem, ownership of the new mode of assessment is crucial and this calls for the curriculum trainers to put the necessary measures in place such as availing ICT assessment gadgets for teachers to own the paradigm shift in the new assessment strategies.

2.4.3 Social pressure and perceived control

Social pressure and perceived control refers to the autonomy of teachers over assessment practice (Schildkamp et al., 2020). The freedom to make decisions during formative assessment results in teacher motivation, an important aspect of psychological factor, unlike when there is too much social pressure from the school administration or curriculum constraints. It enables one work independently while performing actions for developing learning experiences (Bhushan, 2018).

Ho (2010) researched on teacher participation in curriculum and pedagogical decisions in Hong Kong. This was to unravel issues of teacher participation in curriculum and pedagogical decision making at pre-primary schools. Findings showed pre-school leadership plays a role in promoting school culture for development of teacher participation in curriculum and pedagogical decision making. Similarly, Salokangas, Wermke and Harvey (2020) alludes that teachers in Irish and Finish consider themselves as autonomous in making educational decisions and classroom practices during teaching and assessment. However, Finish teachers have a lot of freedom in making decisions on educational matters as supported by Pollari, Salo and Koski (2018), compared to Irish where the principal and senior management is actively involved in controlling how teachers work putting much pressure on them. Similarly, since the CBC had been implemented at ECD levels, an assumption was made during this study that Gem ECD school teachers were effectively retrained, confident and had control over teaching and assessment of mathematical activities.

Schildkamp et al. model attributes importance attached to psychological aspects prerequisite for formative assessment practice. It should be noted that teacher attitude, social pressure and perceived control as well as ownership of the process requires an assessment environment where teachers are given opportunity to independently make decisions (Bhushan, 2018). Whether the in-service training was conducted as well as curriculum's content disseminated in a manner that makes Gem ECDE teachers have freedom and control over assessment is a matter that necessitated this study as it can impact learners' performance in mathematical activities.

2.5 Effectiveness of in-service training of teachers on social factors to conduct Competency Based Formative Assessment

Social factors entails activities taking place within the learning environment that significantly affect assessment. Schildkamp et al. framework identifies collaboration between teachers and

involving learners' pertinent social factor prerequisite that teachers should be conversant with. Performance in mathematical activities requires engaging learners in assessment by analyzing social problems and developing solutions in everyday life together (KICD, 2017).

2.5.1 Collaboration between teachers

Working together among teachers in understanding and using learners test scores will improve instruction outcomes (Rinehart, Schleifer & Yanisch, 2017). When evaluating learners from diverse cultural backgrounds, Loo (2022) recommends teachers collaborate with their colleagues especially when developing assessment tasks. Similarly, KICD (2017) mandates teachers to collaborate especially those who have undergone training to enlighten their colleagues.

Nelson (2019) investigated impact of collaborative formative evaluation on academic achievement of middle school students in New York. Using mixed method to gather qualitative and quantitative data, the researcher used observations, interviews and standard assessment tools. The observation took place in two different 6^{th} grade English language Art classrooms. The findings did not support that teacher collaboration result to positive learner academic achievement. However, an examination of German 2012 PISA by Gebhardt, Heine and Mora-Ruano (2019) to determine if teacher collaboration improves student accomplishment. The findings revealed it has a positive influence on student achievement through assessment practice. In a regular ECD classroom during teaching and learning, teachers are supposed to work as a team during assessment to adequately guide learners on attainment of competencies and developmental milestones. Nevertheless, it is unclear if the staffing position in pre-primary schools in the Sub-County support collaborative approach and if the teachers are aware on specific areas of collaboration during CBFA.

2.5.2 Involving learners

Involvement of learners during Assessment for Learning (AfL) has been touted as vital in peer and self-assessment while communicating the rationale and teaching students how to provide feedback (Duncan & Noonan, 2019; Parkison, 2014; Schildkamp et al., 2020). This takes place through peer assessment which Topping (2017) refers to allowing learners discuss among themselves their judgments of elaborated feedback to achieve agreed outcomes.

According to Falchikov (2004) and Fluckiger, Vigil, Pasco and Danielson (2010) positive results has been realized through learner involvement in assessment process such as improved instruction and going beyond ability to produce marks resembling those awarded by teachers.

Buyukkarci and Sahinkarakas (2021) researched on the impact of formative assessment on student's assessment preferences while using learners in control and experimental group. The study echoed that formative assessment leads to active involvement of learners in assessment practice. Despite the two groups still holding importance of traditional assessment, learners in experimental group preferred taking active role in own assessment process while appreciating need for peer and self-assessment. Fluckiger et al. (2010) outlines strategies of involving learners when providing feedback; a) group quiz with feedback on product, process and progress b) shared revision of student generated statements c) midterm learner conferencing and d) timely feedback using collaborative assignment. The CBC expects learner involvement through authentic assessment where teachers uses real life task to determine learners level of acquisition of knowledge, skills and attitudes to enable learners reflect on real life experiences (KNEC, 2021). However, there is need to liberate on practical areas of involvement at ECDE schools that motivates and attracts learners to be partners in assessment to enable them appreciate their developmental milestones through attainment of abilities in mathematical activities.

Jeanne and Mukamazimpaka (2020) has reiterated need for learner participation in CBC implementation. While employing descriptive research design, 112 respondents were sampled and data obtained through interview guide and questionnaires. Finding showed 67.88% agreed it is significant for curriculum implementation.

Learner involvement in assessment also requires that classroom environment is safe, healthy and supportive for good rapport between teacher and learner, (Prashanti & Ramnarayan, 2019; Amalu & Sunday,2020). The study by Chesire (2020) on effect of classroom environment on ECDE learners achievement in Keiyo North sub-county also support that classroom environment has an impact on learners' achievement for teacher learner activities.

In Kenya, Asava (2021) while investigating on impact of teachers teaching on application of skill based curriculum involving 26 public elementary schools in Westlands, Nairobi recommended involvement of learners'. This is also an expectation by KICD (2017) and KNEC (2021) to enable individualized learner attention and attainment of skills and abilities in mathematical abilities through self-discovery.

The shift to a learner centered curriculum that advocates for early talent, skills and abilities discovery by the learners has put a lot of emphasis on learner involvement. This is not only during teaching but also assessment practice to enable them recognize their strengths and abilities for progression and can be realized through teachers collaborative efforts Loo (2022). Researchers including (Falchikov, 2004; Fluckiger et al., 2010; Jeanne & Mukamazimpaka, 2020; Buyukkarci & Sahinkarakas, 2021) have alluded benefits attributed to learner involvement such as active participation in the lesson for positive results, it is therefore necessary that curriculum experts educate teachers on various areas and stages of learner involvement during assessment if the CBC objectives are to be met at pre-primary level.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter includes research design, area of study, target population, sampling technique, data collection instruments and techniques and finally how the data was analyzed as per the three objectives; effectiveness of in-service training of teachers on knowledge and skills to conduct CBFA; effectiveness of in-service training of teachers on psychological factors to conduct CBFA and effectiveness of in-service training of teachers on social factors to conduct CBFA in pre-primary school.

3.2 Research design

Research design is a blue print or plan how the researcher intends to conduct the study. This research employed descriptive survey design. The design was appropriate for survey of views and opinions from respondents on their perceptions of pre-primary teachers effectiveness to undertake formative assessment practice after the in-service training (Castro, Kellison, Boyd & Kopak, 2010) and provided a wide range of information pertinent to the study objectives.

3.3 Area of the study

The study was carried out in Gem. It is one of the six sub-counties in Siaya with 118 public pre-primary schools and a total of 222 ECDE teachers from which 95 (42.79%) have received in-service training on CBC, 95 headteachers of the ECDE schools and 1 SCECDC. The study location was chosen because of its lowest performance in Mathematical Activities compared to other Sub-Counties in Siaya. It has a geographical area of 403.1 km^2 with a total population of 138,261 people. Its population density is 343 persons per km^2 and lies between latitude 0^o 3’45.4644’’ N and Longitude 34^o 17’16.1052’’ E (Appendix X). The main economic activities carried out in the area includes subsistence farming and mining of construction materials like stones. Its poverty

index is 27.3% against the national figure of 47.9%, predominantly rural with majority of inhabitants being Luos hence admits most of the learners from the local community.

3.4 Population of the study

Target population refers to the full group of individuals that a researcher is interested in and that share observable features in order to generalize the results (Mugenda & Mugenda, 2003). This study focused on 95 teachers who were selected purposively from the schools which had teachers retrained on CBC, 95 headteachers of the schools and one Sub-County ECD Coordinator.

3.5 Sampling technique and sample size

Saturated sampling technique was used to obtain a sample size of 85 teachers after 10% of the population (95) was used for piloting. The sample of headteachers was obtained after drawing 10% of their population for interview. This was based on Mugenda and Mugenda (2003) who recommends manageable size for interview. The sample sizes were arrived at after considering Chander (2017) conclusions that a researcher should adopt a scientific technique that takes into account time constraints, financial availability as well as the research design. The SCECDC and pre-primary schools were identified using purposive sampling (Palinkas et al., 2015). The Table 3.1 below show the sampling methods and sample sizes.

Table 3.1 Sample size

Respondent	Target population	Sample size	Percentage	Sampling method
Pre-primary teachers	95	85	89.47	Saturated sampling
Headteachers	95	10	10.53	Simple random sampling
SCECDC	1	1	100	Purposive sampling

3.6 Data collection Instruments

This study employed use of questionnaire for teachers, interview schedule for headteachers and SCECDC and classroom observation checklist all formulated by the researcher based on the study objectives and gaps from the literature. Observation checklist was used to triangulate findings obtained using teacher questionnaire.

3.6.1 Questionnaire for the pre-primary teachers

The questionnaire was used to gather quantitative data using items on a 5-Likert Scale to obtain information on among aspects including teachers' ability to use assessment tools for example (checklist and rubrics) , attitude, extent of learner involvement in assessment process and their overall opinion on ability to conduct CBFA. The questionnaire was divided into two sections 'I' containing respondents' general information and 'II' addressing teacher knowledge and skills, psychological factor and social factor objectives. Teacher questionnaire attached as (Appendix I) was deemed appropriate due to its ability to collect primary data, opinions and attitudes from large number of respondents (Cohen,Manion & Morrison, 2013; Roopa & Rani, 2012).

3.6.2 Interview schedule for the headteachers

To find out headteachers opinions and perception on teachers' possession of knowledge and skills, psychological and social factors prerequisite, a one-on-one interview was held with them in their respective offices (Appendix II) to collect qualitative data to address issues on frequency of CBC training, provision of feedback by the teacher, availability of ICT gadgets, involving learners as well as their general opinion on CBC in-service training.

3.6.3 Observation checklist

Ten percent of the teachers sampled for the study, which involved nine randomly selected teachers who received CBC in-service training, was intended for observation by the researcher in the

classroom while teaching Mathematical Activities. The classroom observation checklist (Appendix III) contained sixteen items. According to Mugenda and Mugenda (2003), 10% of sample size is adequate and manageable for observation purposes. It gathered evidence on the three objectives that is knowledge and skills (on preparation and use of assessment tools such as rubrics, use of ICT gadgets), psychological factor (social pressure and perceived control; ownership) and social factor objectives (teacher collaboration and learner involvement) during assessment practice for validation of responses obtained from the teacher questionnaire. The use of observation checklist has been used and found appropriate (Isaboke et al., 2021; Mahlambi, 2021) and suggested by Yan and Pastore (2022) for triangulation purposes.

3.6.4 Interview schedule for Sub-County ECD Coordinator

The SCECDC play a critical role in teacher supervision to ensure curriculum implementation through quality teaching and assessment at the pre-primary level. Therefore detailed information on their opinions was obtained through telephone recorded interview schedule (Appendix IV) containing 10 items to find out on issues including the frequency of CBC training, teacher competence and attitude, learner involvement and challenges experienced by teachers during assessment. Gill, Stewart, Treasure and Chadwick (2008) and DeCarlo (2018) remarks that the use of interview is necessary in allowing the interviewer collect detailed information and elaboration on important issues but was not thought as pertinent by the researcher.

3.7 Validity

Validity is the extent to which scores from a measure represent the variable they are intended to (Chiang, Jhangiani & Price, 2015; Roberts, Priest & Traynor, 2006). In this study, content and face validity was ensured by submitting instruments of data collection for review by expert judgment by supervisors in the school of education to ensure they measured stated objectives of

the study. The views suggested by the experts including need to realign the items to the topic of study and use of simple language when writing the items were instrumental in revising the instruments.

3.8 Reliability

Reliability is the degree to which research produces consistent outcomes under varied conditions (Priest, Roberts & Traynor, 2006; Chiang, Jhangiani, & Price, 2015). To determine reliability coefficient of the teacher questionnaire instrument, a pilot study was conducted through test-retest in a span of two weeks on 10% of the targeted teachers which included 10 teachers randomly selected from the ECDE schools and who did not take part in the final study. After the instrument was administered, the responses were scored then calculated using Pearson's correlation coefficient to check the reliability of the questionnaire. The computed reliability of .83 was obtained by applying the formula shown below.

$$r = \frac{\mathrm{n}(\sum xy) - (\sum x)(\sum y)}{\sqrt{\{n\sum x^2 - (\sum x)^2\}\{n\sum y^2 - (\sum y)^2\}}}$$

Where;

n – refers to the number of respondents

x – refers to the scores of the test

y – refers to the scores of the retest

According to Mugenda and Mugenda (2003), coefficient of 0.7 is usually accepted and indicates a higher reliability while 0.8 and above indicate good reliability. Therefore, in this study the instrument used met the threshold by obtaining a reliability coefficient of above 0.8.

The classroom observation checklist reliability was determined by inter-rater reliability. This involved conducting a pilot observation on 10% of targeted teachers who did not take part in the final study. The responses were recorded and rated in order to check the consistency (Cole, 2023).

Given that the interview schedule required engagement with the respondents, its reliability was determined through expert review by supervisors (Bogdan & Biklen, 2007).

3.9 Data collection procedure

Upon approval of the study by the Maseno University Ethics Review Committee (MUSERC) attached as (Appendix VII) and obtaining research permit from the National Commission for Science, Technology and Innovation (NACOSTI) attached as (Appendix VIII), data was collected by the researcher in person. The researcher proceeded to pre-primary schools which had teachers who were trained on CBC and sought permission to carry out research from the schools administration. The respondents were informed about the research, how their anonymity will be guaranteed, measures taken to ensure confidentiality of responses as well as their voluntary participation. After which the sampled teachers and headteachers were asked to consent by signing consent forms before taking part in the study.

The questionnaires were administered to sampled teachers between 24th and 26th October, 2023 in their respective schools and collected between 28th and 31st October, 2023 personally by the researcher. Non-participant classroom observation was undertaken on 27th October 2023 by the researcher using an observation checklist where 10% that is nine randomly sampled teachers for study were observed when teaching mathematical activities. The non-participant lesson observation involved researcher sitting at the back of the class during the lesson and observing teacher activities without actively participating. This followed ticking appropriately against each item contained in the checklist and writing comments where necessary to find out on among other aspects; use of ICT gadgets, assessment tools used, involving learners and teacher collaboration. Interview sessions with the SCECDC and headteachers was the last stage of data collection. Following a busy schedule of the SCECDC, telephone recorded interview was conducted on 1st

November, 2023. A face-to-face interview with ten headteachers of different schools sampled was conducted on 9th, 10th and 11th January 2024 in their respective primary schools.

3.10 Data analysis procedure

Quantitative data was analyzed using descriptive statistics involving frequencies, percentages and mean scores with the help of Statistical Package for Social Sciences (SPSS) version 16. Presentation of data was done in the form of frequency tables and bar graph. To analyze qualitative data from the telephone recording interview with the SCECDC, the researcher transcribed all questions through repeated listening to the audio for familiarity with the data to ensure accuracy of the interviewee's opinions, views and responses after which together with the one-on-one interview with headteachers, findings were coded, synthesized and patterns drawn according to specific themes. The themes included; frequency of CBC in-service training and use of formative assessment tools, ability to independently provide assessment feedback, availability and use of ICT (knowledge and skills objective); teacher attitude towards assessment, ownership of assessment practice and teacher autonomy in making assessment decisions (psychological factor objective) and finally, teacher collaboration and learner involvement as well as areas of involvement (social factor objective) and the results written (Bogdan & Biklen, 2007). The variables of the Likert scale were measured on a scale of 1-5 for each item with 1 indicating low score while 5 a high score. Therefore, Strongly Disagree scored 1, Disagree -2, Somewhat Agree-3, Agree-4 and Strongly Agree- 5. Interpretation of means was based on Imsa-ard et al., (2021) scale of 1.00-1.80 as Strongly Disagree, 1.81-2.60 as Disagree, 2.61- 3.40 as Neutral, 3.41-4.20 as Agree, 4.21-5.00 as Strongly Agree. Based on the mean interpretation, effectiveness of in-service teacher training to enable teachers conduct formative assessment of mathematical activities was indicated if the aspects investigated under each prerequisite overall mean fell between 3.41 and

5.00 while infectiveness 1:00 and 3.40. A summary of the teacher mean scores on the three prerequisites forming the study objectives was calculated to establish effectiveness of teachers' to conduct CBFA of mathematical activities.

3.11 Ethical considerations

These are set of guidelines that were used to guide the study design and implementation principles. The following ethical considerations guided the study as posited by (Akaranga & Makau, 2016; Fleming & Zegwaard, 2018). The respondents' informed consent was obtained to ensure their participation was voluntary by signing the consent form attached as (Appendix VI) for pre-primary teachers and (Appendix VII) for headteachers. After which the researcher explained to them the intention of the study and the benefits that will accrue to it. During the study all the respondents' confidentiality and anonymity was achieved by ensuring instruments used for data collection did not contain any biographical identifier beyond what is needed for the study, this was achieved by giving instructions to the respondents before giving their responses. Additionally, their privacy was ensured by making sure no rights and freedoms are violated such as infringing on personal life. Finally, all confidential publications and information provided by respondents were protected and solely used for the research purpose.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

The chapter presents findings of research on effectiveness of in-service training of teachers on CBFA of mathematical activities in pre-primary schools in Gem. It has been organized based on themes addressing the three objectives under study including effectiveness of in-service training of teachers on knowledge and skills, psychological and social factors necessary to conduct CBFA practice. The demographic data includes respondents' response rate, gender, academic background, and their response on formative assessment topics covered during the in-service training. Data analysis, and presentation is based on the study's objectives.

4.1.1 Demographic data

In order to understand the characteristics of the respondents who took part in the study, the researcher found out their response rate, gender, academic background, and their response on formative assessment topics covered during in-service training.

4.1.1.0 Response rate

The researcher determined the instruments return rate as indicated in Table 4.1 below.

Table 4.1 Response rate

Respondent	Sample	Return rate	Percentage (%) Return
Pre-primary teachers	85	72	84.71
Headteachers	10	10	100
SCECDC	1	1	100

Table 4.1 shows that out of the 85 pre-primary teachers who were sampled for the study, 72 completed and returned the questionnaire, representing 84.71% return rate. All the 10 headteachers and one SCECDC sampled were interviewed, representing 100% return rate. Classroom

observations were done in eight out of the nine sampled schools, representing 88.87% response rate. Thirteen teachers however failed to fill the questionnaires in time due to their busy schedule as they were conducting learner assessment and preparing to close school for holiday, a similar case in the school where classroom observation did not take place. Despite this, all the respondents' instruments had a return rate of above 70%, which is considered excellent by Mugenda and Mugenda (2003). As a result, the study's data were deemed sufficient to produce accurate and representative results.

4.1.1.1 Gender distribution of the respondents

The researcher sought to find out the gender distribution of the respondents including pre-primary teachers, headteachers and SCECDC. The existence of both genders handling learners at ECDE level is important for the social and emotional development of the child which affects learners' performance either positively or negatively. The Table 4.2 below shows the distribution.

Table 4.2 Respondent Gender distribution

Respondents	**Teachers**		**Headteachers**		**SCECDC**	
Gender	f	%	**f**	**%**	**f**	**%**
Male	3	4.2	7	70	1	100
Female	69	95.8	3	30	0	
TOTAL	**72**	**100**	**10**	**100**	**1**	**100**

Key: f- frequency, % - percentage

Table 4.2 shows that from the 72 Pre-primary teachers who responded, 69 are females representing 95.8% while males are 3 (4.2%). This also agrees with the findings of Abdullahi (2019) who researched on School based factors in implementation of Competency Based Curriculum in Garissa Sub-County, Kenya that majority (74%) of teachers in pre-school are females. The gender disparity of ECDE teachers show that societies does not easily attribute to men the nurturing

qualities and abilities at this level of learning. According to Ingolfur (2003), feminism and struggle for gender equality is scaring men from taking teaching courses at pre-primary level. Similarly, Kivuva (1996) remarks that the society views it as an odd job for men to look after children since apart from instilling knowledge, the caregivers are tasked with their character development and basic life skills. In Kenya, Koech (2004) indicates that in respect to Kenyan culture and belief, the responsibility of raising children both in the home and in collective approach is a preserve for women. This explains why most pre-primary school teachers in Gem are females and however, may pose a challenge especially when the children needs a fatherly figure for emotional and social support in school and subsequently may affect their performance. Based on the findings, a higher percentage (70%) of headteachers are males compared to females who are only 30%. The headteachers are very instrumental in the management and smooth running of activities at ECDE level as they are the immediate supervisors of the teachers (Abdullahi, 2019).

4.1.1.2 Pre-Primary Teachers' Academic Qualifications

Teacher academic qualification is key prerequisite in learner assessment at pre-primary school. Research by Kamwitha, Khatete, Riechi and Muasya (2022) indicate that teacher professional qualification at ECDE is necessary for learners academic growth and transition to primary school. Therefore, the teachers were requested to give information on their highest level of academic qualification as shown in Figure 4.0 below.

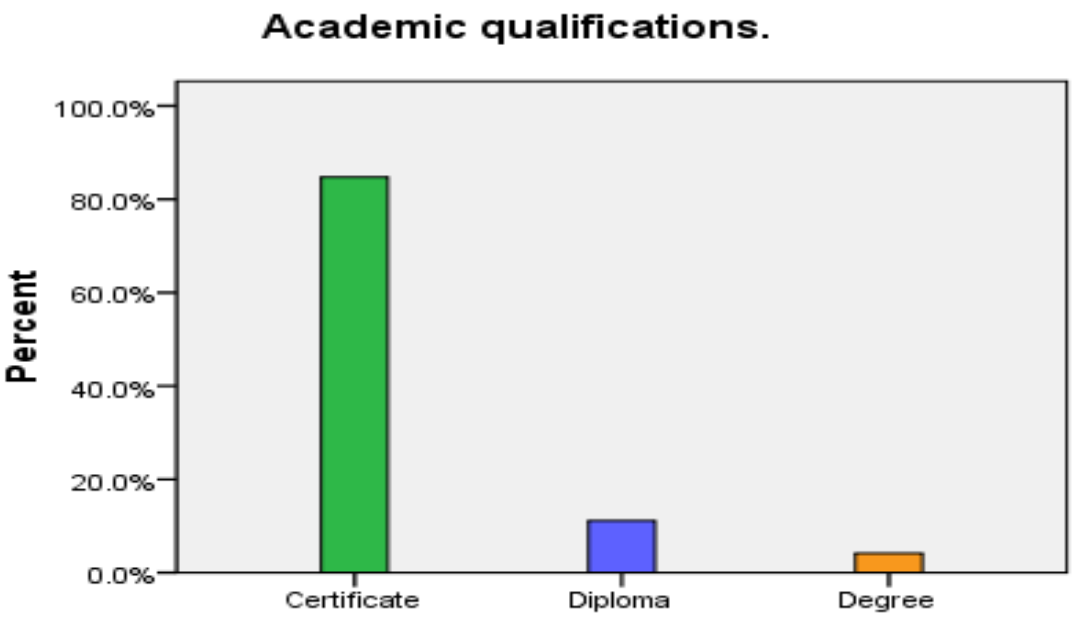


Figure 4.0 Pre-primary teachers' academic qualifications

The Figure 4.0 above indicates that all the teachers who took part in research met minimum academic qualification to carry out formative assessment at pre-primary school. As shown, 84.7% of the teachers had the minimum qualification (certificate), 11.1% attained diploma while 4.2% were degree holders.

4.1.1.3 Formative assessment topics covered during in-service training of teachers

The topics under study were investigated from the teachers whether they were covered during training and the responses were as shown in the frequency Table 4.3 below:-

Table 4.3 Teacher responses on Formative Assessment topics covered during in-service training

Formative Assessment topic	Yes f (%)	No f (%)
1.Pedagogical Content Knowledge	42 (58.3%)	30 (41.7%)
2.Feedback	72 (100%)	- -
3.Goal setting	32 (44.4%)	40 (55.6%)
4.Information Communication Technology (ICT)	17 (23.6%)	55 (76.4%)
5.Attitude	16 (22.2%)	56 (77.8%)
6.Ownership	26 (36.1%)	46 (63.9%)
7.Social pressure and perceived control	10 (13.9%)	62 (86.1%)
8.Collaboration between teachers'	56 (77.8%)	16(22.2%)
9.Learner Involvement	60 (83.3%)	12 (16.7%)

According to Table 4.3 more than half of the teachers 42(58.3%) indicated they were retrained on pedagogical content knowledge topic which is key in enabling teachers identify assessment areas, interpret and use outcome to modify instruction (Vingsle, 2014) however, 41.7% of the teachers reported they were not retrained on it. All the teachers (72) indicated they were retrained on feedback topic. On goal setting, 44.4% of the teachers indicated they were retrained even though more than fifty percent (55.6%) responded they were not. ICT topic which is integral in recording and reporting assessment outcome according to KICD (2017), only 23.6% of the teachers reported they were retooled using it while 76.4% responded they were not. When responding to whether they were retrained on Attitude topic, 22.2% of teachers indicated they were retooled while most (77.8%) reported they were not. On ownership topic, 6.1% of the teachers indicated they were retrained while 63.9% responded they were not. 62(86.1%) reported they were not retrained on social pressure and perceived control topic while 10(13.9%) teachers indicated they were retrained. When responding on teacher collaboration topic, 77.8% indicated they were retooled and only

22.2% responded they were not retrained. Lastly, on learner involvement, 83.3% of the teachers indicated they were retrained while only 16.7% reported the topic was not covered.

4.2 Effectiveness of in-service training of teachers on knowledge and skills to conduct Competency Based Formative Assessment

The first objective was to establish effectiveness of in-service training of teachers on knowledge and skills to conduct CBFA of mathematical activities. In response, teacher questionnaire; classroom observation checklist; headteacher and SCECDC interview was used to collect data. The classroom observation checklist was used to triangulate the findings obtained in the teacher questionnaire in order to establish perceptions of teachers' effectiveness to carry out CBFA after the in-service training with respect to possession and practice of the assessment activities. The findings were reported in frequency distribution tables showing means and percentages covering the four prerequisites on teacher knowledge and skills including pedagogical content knowledge, feedback, goal setting and use of ICT identified by Schildkamp et al. (2020) pertinent and which teachers should be aware of before conducting formative assessment.

4.2.1 Pedagogical content knowledge

The key items included teachers' ability to formulate practical assessment activities, time of assessment and competence in using formative assessment tools including Checklist, Rubrics and Observation schedule. The survey questionnaire result is presented in Table 4.4 below

Table 4.4 Teacher responses on Pedagogical content knowledge in the survey Questionnaire.

No	Statement	Strongly Agree f (%)	Agree f (%)	Somewhat Agree f (%)	Disagree f (%)	Strongly Disagree f (%)	Mean $\bar{x}$
1.	Teacher presents mathematical activities assessment in practical activities.	- -	4(5.6%)	25(34.7%)	42(58.3%)	1(1.4%)	2.44
2.	Teacher assess learners during mathematical lesson.	1(1.4%)	7(9.7%)	28(38.9%)	32(44.4%)	4(5.6%)	2.57
3.	Teacher assess learners after mathematical lesson.	14(19.4%)	28(38.9%)	30(41.7%)	-	-	3.78
4.	Teacher use Checklist for assessment.	-	6(8.3%)	21(29.2%)	45(62.5%)	-	2.46
5.	Teacher use Rubrics for assessing mathematical activities.	10(13.9%)	42(58.3%)	19(26.4%)	1(1.4%)	-	3.85
6.	Teacher use Observation schedule for assessment.	-	5 (6.9%)	20(27.8%)	44(61.1%)	3(4.2%)	2.38
	Mean						**2.91**

KEY: 5- Strongly Agree 4-Agree 3- Somewhat Agree 2- Disagree 1- Strongly disagree

The mean for teachers' Pedagogical content knowledge was 2.91 and on a 5-point Likert scale, the average ratings fell within the range of "somewhat agree" (3) and "disagree" (2). This demonstrates that the teachers are not well quipped on their Pedagogical knowledge since they are not confident on whether the in-service training has properly refreshed their knowledge to conduct assessment through for example using assessment tools. Based on the study's statistical mean interpretation, some areas of concern such as reskilling teachers on the use of checklist and observation schedule should be considered to improve on their knowledge for better performance in Mathematical

activities. In order to substantiate the questionnaire results, the researcher carried out classroom observation in eight schools' while teachers were teaching mathematical activities. The findings are shown in Table 4.5 below:-

Table 4.5 Classroom Observation Checklist on teacher's Pedagogical content knowledge.

No.	Statement	Yes (f)	No (f)
1.	Teacher presents mathematical assessment in practical activities	3	5
2.	Teacher assesses learners during mathematical activities lesson	4	4
3.	Teacher uses Checklist for assessment of mathematical activities	- -	8
4.	Teacher uses Rubrics for assessment of mathematical activities	3	5
5.	Teacher uses observation schedule for assessment practice	2	6

During lesson observation, the researcher determined whether teachers were practicing the various pedagogical knowledge characteristics listed in statements 1 through 5 when carrying out formative assessment. The research found that only 3 of the teachers attempted to provide practical assessment activities during the lesson though rarely. Notably, half (4) assessed learners during the lesson whereas the other half did not, those who did the assessment majorly conducted it verbally. All of the eight teachers observed did not use checklists while only three of them utilized rubrics. The researcher went further and interviewed the SCECDC and headteachers. The findings are presented based on the following theme.

i) Frequency of CBC in-service training and use of formative assessment tools

The SCECDC who was also a facilitator during the in-service training and oversees curriculum implementation at ECDE upon being interviewed reported that in addition to the assessment tools (Checklist, Observation schedule, and Rubrics) listed, teachers were also retooled on creating learner portfolios for assessment. However, he bemoaned the fact that teachers hardly ever used the tools while assessing learners. The SCECDC reported that;

"*the in-service training were conducted more than thrice from 2018 and a part from the assessment tools listed, the teachers were also retooled on preparing learner portfolios and we insisted that they carry out lesson observation, however the teachers rarely use them*".

The headteachers are the immediate supervisors of the ECDE teachers hence the researcher needed to learn more about the duration of in-service training and extent of teachers' competence in using formative assessment tools. In the interview, nine out of the ten headteachers noted that despite the regular training conducted, teachers rarely prepared assessment tools for conducting the practice and remarked need for more teacher sensitization on their preparation and use. Their sampled responses are indicated below;

One headteacher said;

"one of my ECDE teachers attended the CBC retooling exercise during the year 2018 April and August holidays however, she hardly use the formative assessment tools when teaching.''

Another one responded;

"when it comes to using formative assessment tools, I can confidently confirm that none of my teachers are doing so especially during the lesson…"

The findings above illustrates that the use of assessment tools among teachers in the sub-county remains an issue of concern that needs to be addressed since it is requisite for formative assessment. The teachers indicated they are well trained and positive towards the use of rubrics during assessment from their mean score of 3.85 even though the classroom observation findings showed that most teachers (5) did not use it. Subsequently, during the interview most eight out of

nine headteachers and the SCECDC reiterated that the retraining did not adequately prepare the teachers on the formulation and use of the tools. The disparity in teacher responses on the use of rubrics could be as a result of a few of them familiarity with the assessment tools as witnessed in the classroom observation. Whereas Govender (2019) emphasizes on the need for educators to have a thorough knowledge of mathematical cognition and conceptual development before carrying out formative assessment, however, this is not the case with respect to the study findings despite the retraining exercise. This concurs with Isaboke et al. (2021) findings that despite the training undertaken, 16.7% of teachers still had difficulties in conducting assessment. Similar to this, Chemeli et al. (2019) supports that teachers are not aware enough to use formative assessment strategies, which results in low usage. The research's findings, however, differ from those of Kogo (2019), who remarks that ECDE teachers in Nandi County already had current pedagogical skills acquired through training. Schildkamp et al. (2020) model attaches relevance of pedagogical knowledge for informing learners on their achievement as well as attainment of the lesson goal. The study results gives a justification perhaps for the low performance in mathematical activities in Gem and provide valuable insights on the need for intervention measures especially on reskilling the teachers on practical aspects of assessment such as preparation and use of tools including checklist and observation schedule to address the subject matter.

4.2.2 Feedback

The researcher sought to find out teacher capability to provide assessment feedback and made inquiries on the items including provision of written and verbal feedback, giving feedback during and after teaching and ability to differentiate formative from summative assessment. The results are shown in Table 4.6.

Table 4.6 Teacher responses on Feedback in the survey Questionnaire

No	Statement	Strongly Agree f (%)	Agree f (%)	Somewhat Agree f (%)	Disagree f (%)	Strongly Disagree f (%)	Mean $\bar{x}$
1.	Teacher provides written feedback to inform learners on attainment of mathematical abilities	3(4.2%)	32(44.4%)	20(27.8%)	13(18.1%)	4(5.6%)	3.24
2.	Teacher gives verbal feedback to inform learners on their abilities.	48(66.7%)	17(23.6%)	5(6.9%)	2(2.8%)	-	4.54
3.	Teacher provides assessment feedback during teaching.	1(1.4%)	6(8.3%)	24(33.3%)	30(41.7%)	11(15.3%)	2.39
4.	Teacher gives assessment feedback after teaching.	43(59.7%)	26(36.1%)	2(2.8%)	1(1.4%)	-	4.54
5.	Teacher able to differentiate formative and summative evaluation	-	2(2.8%)	24(33.3%)	35(48.6%)	11(15.3%)	2.23
	Mean						**3.39**

KEY: 5- Strongly Agree 4-Agree 3- Somewhat Agree 2- Disagree 1- Strongly disagree

Results in Table 4.6 show that teachers are knowledgeable in providing feedback when carrying out formative assessment practice from their mean of 3.39. The teachers however still expressed dissatisfaction on a number of aspects such as ability to differentiate formative from summative evaluation and provision of feedback during the lesson. This needed justification from classroom observation. Table 4.7 below show findings on teacher ability to provide written and verbal feedback during the lesson.

Table 4.7 Classroom Observation Checklist on Feedback provision.

Statement	Yes (f)	No (f)
1. Teacher provide written feedback during the lesson	1	7
2. Teacher provide verbal feedback during the lesson	6	2

It was noted during classroom observation that only one teacher provided written feedback with seven giving verbal feedback hence the findings not depicting the significance of written feedback such as for reference purposes (KICD, 2017 & Schildkamp et al., 2020). This conclusion however could not be made without getting views from the SCECDC and headteachers. An interview with the SCECDC to learn more about teachers' ability to independently provide feedback by formulating assessment tasks, the findings were presented in the following theme.

i) Ability to independently provide assessment feedback

The SCECDC responded that during the in-service training, the teachers were retrained to provide feedback through formulation of assessment tasks and applying appropriate tools. However, remarked that some headteachers were supplying teachers with commercial assessment materials to use some of which had content outside the recommended design. The SCECDC noted;

"*the teachers were retrained to independently provide feedback however, during supervision I noted that some headteachers had outsourced commercial assessment materials for pre-primary one and two, some of which had irrelevant content … this could be a reason for poor performance in mathematical activities''* he continued.

The headteachers on the other hand when asked to comment on whether their teachers preferred assessing learners during the lesson or after lesson to confirm independence in the process. Conclusively, 70% of the interviewed stated that teachers were still negative on assessing learners' during the lesson as they perceived it was time consuming. In a statement made by a headteacher;

"our teachers regularly conduct assessment after completing a sub-strand, some does after the lesson while in most cases they give tasks to learners as home assignments"

Another headteacher commented;

"I interact with the pre-primary teachers in my school and they tell me conducting assessment after the lesson makes them cover a lot of work within the lesson..."

The survey questionnaire results indicated teacher satisfaction with the in-service training to enable them deliver assessment feedback. However, from the lesson observation and interviews it emerged that teachers still needed to address their weaknesses especially on distinguishing between formative and summative evaluation as witnessed also in the questionnaire findings. This is to effectively provide written feedback when teaching and an expectation by Schildkamp model to help close the gap between where the learners are and where they need to be when making references to individual learners' achievement in various learning activities. The teachers' and SCECDC findings support the conclusions made by Hasim, Di, and Barnard (2018) and Figa, Kebede and Tarekegne (2020) that teachers lacked the training required to differentiate between formative and summative evaluations.

4.2.3 Goal setting

The researcher investigated on capability of teachers to set formative assessment goals for mathematical activities. Thy addressed the issue on ability to set short-term goals that meet learner needs and take into account their individual differences. Table 4.8 displays the results

Table 4.8 Teacher responses on Goal setting in the survey Questionnaire.

No	Statement	Strongly Agree f (%)	Agree f (%)	Somewhat Agree f (%)	Disagree f (%)	Strongly Disagree f (%)	Mean $\bar{x}$
1.	Teacher set short term mathematical activities learning goals that meet learner need	-	4(5.6%)	31(43.1%)	29(40.3%	8(11.1%)	2.43
2.	Teacher formulate mathematical activity's goal that caters for individual differences	-	2(2.8%)	20(27.8%)	40(55.6%	10(13.9%	2.19
	Mean						**2.31**

Key: 5 - Strongly Agree 4-Agree 3- Somewhat Agree 2- Disagree 1- Strongly disagree

The teachers' overall mean was 2.31, showing low level of readiness to develop formative assessment goals during teaching in spite recommendations from KICD (2017), Nordengren (2019), Schildkamp et al. (2020) and KNEC (2021) on timely, student centered, short term assessment goals that meet learner need and that are both measurable for teachers and learners. The findings were backed up with classroom observation in eight schools during assessment in mathematical activities lesson. It was noted that more than half (5) outlined assessment goal before the lesson and in contrary with teachers view in the questionnaire survey mean. The dissonance could mean that Gem ECDE teachers are setting and informing learners on the lesson goal unknowingly but again poking holes on whether the retooling adequately enlightened them on how lesson goals are formulated and if they were taken through practical examples.

4.2.4 Information communication technology skills

A number of aspects were investigated to determine the use Information Communication Technology (ICT). These included if teachers are retrained to use ICT for recording assessment

outcome during and after the lesson as well as in reporting assessment outcome through capacity building programs. The findings are shown in Table 4.9 below.

Table 4.9 Teacher responses on Information Communication Technology (ICT) use in the survey Questionnaire

No	Statement	Strongly Agree f (%)	Agree f (%)	Somewhat Agree f (%)	Disagree f (%)	Strongly Disagree f (%)	Mean $\bar{x}$
1.	Teacher use ICT to record assessment outcome during the lesson	-	3(4.2%)	8(11.1%)	43(59.7%)	18(25.0%)	1.94
2.	Teacher use ICT to record assessment outcome after the lesson	-	-	10(13.9%	43(59.7%)	19(26.4%)	1.88
3.	Teacher report learner outcome using ICT through capacity building programs.	-	-	17(23.6%)	45(62.5%)	10(13.9 %)	2.09
	Mean						**1.97**

KEY: 5- Strongly Agree 4-Agree 3- Somewhat Agree 2- Disagree 1- Strongly disagree

The teachers are dissatisfied with the retraining in respect to equipping them with the necessary skill to use ICT for formative assessment as indicated in their mean of 1.97 in Table 4.9 above. The use of ICT is a practical activity hence the researcher could not rely solely on the questionnaire survey responses, in addition, classroom observation conducted to find out extent pre-primary teachers were utilizing ICT when teaching mathematical activities. Table 4.10 show the results:-

Table 4.10 Classroom Observation Checklist on ICT use during formative assessment

No	Statement	Yes (f)	No (f)
1.	Teacher uses ICT to record mathematical activities assessment learner outcome during the lesson	- -	8
2.	Teacher uses ICT to record mathematical activities assessment learner outcome after the lesson	- -	8

During the lesson observation in the 8 schools, all the teachers neither used ICT to record mathematical activities assessment during the lesson nor after. At the time of observation only 2 schools had ICT gadgets however they were used to show learners various numeric in different colors when teaching them on the strand 'numbers' and not for assessment practice.

To gather more insight, an interview with the SCECDC and headteachers was conducted to find out on teachers' ability to use ICT during assessment and response made as per the theme below;

i) Availability and use of ICT during assessment

The SCECDC reported that very few teachers were using ICT majorly during digital literacy lessons to occasionally show learners pictures related to the lesson content and not for formative assessment. He reported;

"I have very few teachers who have knowledge on using ICT, though they usually use it for ICT literacy lessons and I can report that pre-primary school teachers in Gem were not retooled on using technology for assessment''

The headteachers were further interviewed to find out on the available ICT gadgets in their schools used for assessment. The headteachers revealed that they lacked ICT gadgets as well as infrastructure to support its use in their various ECDE section notwithstanding expectation of the CBC that ICT should be integrated in all lessons. One headteacher categorically stated;

"since the roll out of the CBC we have not received any ICT gadget for use in pre-primary school, however we hope that the government through the Ministry of education will look into it…"

Another responded;

"talking about availability of ICT gadgets in our ECDE is like a nightmare since even if they were available, our classes do not have electricity to support their use…"

A third one added that;

"during headteachers' meetings we have always been promised that relevant education stakeholders will ensure ICT gadgets are supplied in our ECDE schools to enable ICT integration during lessons, however, this is yet to be implemented…"

The teacher responses, classroom observations as well as the interviews are in agreement that availability and use of ICT gadgets among ECDE schools in the Sub-County is still a cause for worry. Even though observation results show that two schools had ICT gadgets, they were however not used for assessment, a clear indication that teachers lack requisite skills. The findings are supported by Rr et al. (2020) and Murithi and Yoo (2021) who discovered a number of constraints in the use of technology in schools such as inadequate ICT facilities. Most ECDE schools in the Sub-County are located in rural areas with majority having no access to electricity. This poses challenges to the implementation of the CBC despite a requirement by KICD and suggestion by Schildkamp et al. on ICT integration. Based on this, a number of gaps manifest on the availability of ICT gadgets and infrastructure that support CBFA which ought to have been filled after the piloting and before the actual roll out. Additionally, from SCECDC comment, little has been done to equip the teachers with the requisite ICT skills during the retooling exercise.

4.3 Effectiveness of in-service training of teachers on psychological factors to conduct Competency Based Formative Assessment

The second objective was to establish effectiveness of in-service training of teachers on psychological factors to conduct CBFA of mathematical activities. The data collection tools used were questionnaire; observation checklist and finally interview for both headteachers and Sub-County ECD Coordinator. The classroom observation checklist was instrumental in justification of the results obtained in the teacher questionnaire survey and was used in class during mathematical activities lesson to find out formative assessment activities by the teacher. The questionnaire survey and classroom observation findings were reported in frequency distribution

tables showing means and percentages while interview findings were reported thematically. The instruments covered the three prerequisites on teacher psychological factors including Attitude/Beliefs, Ownership and Social pressure and perceived control identified by Schildkamp et al. framework.

4.3.1 Attitude/beliefs

Findings on teachers' attitude/belief in using assessment tools, perception towards assessment and their take on if school environment affects attitude towards assessment. Table 4.11 indicate results

Table 4.11 Teacher responses on Attitude/Beliefs towards assessment in the survey Questionnaire

No	Statement	Strongly Agree f (%)	Agree f (%)	Somewhat Agree f (%)	Disagree f (%)	Strongly Disagree f (%)	Mean $\bar{x}$
1.	Teacher has a positive attitude towards using tools.	-	7(9.7%)	46(63.9%)	18(25.0%)	1(1.4%)	2.82
2.	Teacher like assessing learners when teaching	2(2.8%)	16(22.2%)	45(62.5%)	9(12.5%)	-	3.15
3.	Teacher positive towards formative assessment practice.	4(5.6%)	17(23.6%)	34(47.2%)	17(23.6%)	-	3.11
4.	Teacher believe school environment possibly affect attitude towards formative assessment.	7(9.7%)	20(27.8%)	32(44.4%)	13(18.1%)	-	3.29
	Mean						**3.09**

Key: 5- Strongly Agree 4-Agree 3- Somewhat Agree 2- Disagree 1- Strongly disagree

Results in Table 4.11 above indicate that the in-service training to some extent prepared the teachers to be positive towards formative assessment practice as shown in their overall mean of 3.09. This is because most teachers who took part in the study had teaching experience of 3 years and above hence possibly conversant with learning and assessment areas, a confirmation of results

in the study by Opara Ijeoma (2018). To obtain more insight on teachers' attitude and beliefs towards the process, an interview with the SCECDC and headteachers was carried out to get their opinion and findings presented based on the theme;

i) Teacher attitude towards assessment

The Sub-County ECD Coordinator stated that Gem ECDE teachers had a negative attitude towards assessment during the lesson perceiving it as too challenging especially when using assessment tools. Similarly, nine out of the ten headteachers interviewed consented that ECDE teachers in their various schools preferred summative assessment to formative and mostly conduct assessment after the lesson. In one of the schools a headteacher stated;

"my teachers in most cases write for the learners take away home assignments in their exercise books after the lesson especially in mathematical activities and checks the following day before another lesson, which tells you they don't like conducting assessment during the lesson."

Another headteacher commented;

"*pre-primary teachers' in our school conduct formative assessment during the lesson though rarely….*she continued *…you know they were used to teaching and carrying out assessment later when filling assessment books."*

The interview findings were in agreement with classroom observation showing only three teachers preferred to assess learners during the lesson even though, according to Schildkamp et al. (2020), this affects the purpose of formative assessment as the quality of classroom lesson delivery is not achieved. From the interview findings with the headteachers suggests the possible reason for poor performance in Mathematical activities since despite the practical nature of the learning area, the teachers does not give immediate feedback to the learners to help them develop mathematical abilities. When learners are given tasks to perform at home, the teacher does not get clear picture of the learner ability since some of them the tasks are done by their parents/guardians at home.

The findings from the survey questionnaire are in agreement with those of Ahmedi (2019) and Widiastuti et al. (2020) who alluded that teachers with CPD have a stronger belief hence a positive correlation between teachers' attitude and practice of formative assessment. This could be as a result of regular CBC retooling attended by the teachers in the Sub-County. However, the findings does not concur with those of classroom observation checklist and interview. Five teachers did not conduct assessment at the time of observation, a similar scenario with SCECDC who commented that teachers perceived formative assessment as so challenging. Additionally, the headteachers noted that the teachers still preferred summative assessment. Teacher attitude towards assessment is driven by both internal and external factors. Despite being somehow positive from the training attended as shown in the teacher overall mean, external factors such as learning environment which was culminated with high learner enrollment as was observed during lesson observation. Furthermore, inadequate practical assessment materials which greatly affects performance in mathematical activities was noted and since the learning area is practical in nature, this could have led to negative attitude. According to Saneewong (2020) and Wambua (2022), classroom environment significantly plays a role in teacher attitude towards formative assessment.

4.3.2 Ownership

To demonstrate the extent to which teachers can be autonomous in assessing learners and show ownership of the practice, a study was conducted. Table 4.12 presents the findings

Table 4.12 Teacher responses on Ownership towards assessment in the survey Questionnaire

No	Statement	Strongly Agree f (%)	Agree f (%)	Somewhat Agree f (%)	Disagree f (%)	Strongly Disagree f (%)	Mean $\bar{x}$
1.	After training, teacher able to independently assess learners	10(13.9%)	35(48.3%)	19(26.4%)	6(8.3%)	2(2.8%)	3.63
	Mean						**3.63**

Key: 5- Strongly Agree 4-Agree 3- Somewhat Agree 2- Disagree 1- Strongly disagree

The finding in Table 4.12 clearly shows that teachers in the sub-county have received effective retraining from their mean score of 3.63 hence ownership of the assessment practice. To triangulate the results, researcher further carried out classroom observation which showed that 6 out of the 8 teachers assessed learners though assessment comprised of verbal feedback equally demonstrating ownership. To find out on measures put in place to ensure teachers own the practice during the in-service training, findings of an interview with the SCECDC was presented on the theme below;

i) Ownership of the assessment practice

The SCECDC noted that teachers were actively involved throughout retooling period by practically creating assessment tools such as checklists, rubrics, observation schedules, and learner portfolios in groups and giving presentations, he responded in the interview;

"during the in-service training, we tried to ensure the teachers own the assessment process by encouraging them to create assessment tools in groups and presenting their work before fellow trainees which most of them did very well"

The SCECDC interview response correlates with the suggestion by Ahmad and Akbar (2020) that additional practical work in the program should be ensured to improve teacher's competence in implementation of curriculum and assessment for ownership.

The teacher responses, observation results and interview findings are in agreement that the training effectively prepared the teachers to own the formative assessment. Since the degree and capacity

of teachers' decision-making during classroom assessment correlates to ownership of the process, the practice of making teachers active participants should be emphasized during in-service training.

4.3.3 Social pressure and perceived control

Teacher efficacy in assessing learners with respect to freedom in making decisions when scoring learners in the learning area was looked into. Table 4.13 below is a summary of the responses from the teacher questionnaire.

Table 4.13 Teacher responses on Social pressure and perceived control towards assessment in the survey Questionnaire

No	Statement	Strongly Agree f (%)	Agree f (%)	Somewhat Agree f (%)	Disagree f (%)	Strongly Disagree f (%)	Mean $\bar{x}$
1.	Teacher has freedom to assess learners outcome in mathematical activities	8(11.1%)	38(52.8%)	23(31.9%)	3(4.2%)	-	3.71
2.	Teacher make assessment decisions without intervention of school administration	8(11.1%)	27(37.5%)	24(33.3)	13(18.1%)	-	3.42
	Mean						**3.57**

Key: 5- Strongly Agree 4-Agree 3- Somewhat Agree 2- Disagree 1- Strongly disagree

The teachers' mean of 3.57, demonstrated that they were well informed to make decisions during the practice. This implied that they had freedom to carry out assessment and exercise control in making decisions when teaching. Through classroom observation, the researcher confirmed the findings and the responses indicated that all the teachers observed were carrying out formative assessment in the learning area under investigation posing questions on why learners still

performed poorly in it. To find out teacher autonomy in conducting assessment practice, an interview was held with the SCECDC and response presented as below;

i) Teacher autonomy in making assessment decisions

The SCECDC noted that pre-primary teachers in the Sub-County were retooled on the subject matter and perceived to be autonomous when conducting assessment. He reported;

"our teachers are effectively conducting assessment, and I have noted this whenever I visit the various ECDE schools… this shows that they were effectively retooled in the area however, performance in mathematical activities is still very low…" he added.

The teacher questionnaire responses, classroom observation and SCECDC interview indicate that teachers are competent in providing feedback on their own. This conforms to the teacher responses that feedback topic was covered during training, a clear indication that they have control over the formative assessment practice. The results are consistent with those of Pollari et al. (2018) who remarked that teachers in Finish are prepared and have a lot of freedom in making educational decisions as opposed to Irish where the principal influences the decisions made by teachers. According to Bhushan (2018), having control over decision making during assessment make teachers work independently when developing learning experiences.

4.4 Effectiveness of in-service training of teachers on social factors to conduct Competency Based Formative Assessment

The third objective was to establish effectiveness of in-service training of teachers on social factors to conduct CBFA of mathematical activities. The researcher employed use of teacher questionnaire, classroom observation checklist as well as interview responses were obtained from headteachers and Sub-County ECD Coordinator. The findings from the teachers on collaboration between teachers and learner involvement were presented in frequency distribution tables, means and percentages while the SCECDC and headteacher interview were presented thematically.

4.4.1 Collaboration between teachers

The study determined whether teachers worked together in developing assessment tasks, creating assessment tools, and scoring learners' task in mathematical activities. Table 4.14 displays the responses of their questionnaire.

Table 4.14 Teacher responses on Collaboration between teachers during assessment in the survey Questionnaire

No	Statement	Strongly Agree f (%)	Agree f (%)	Somewhat Agree f (%)	Disagree f (%)	Strongly Disagree f (%)	Mean $\bar{x}$
1.	Teacher involve colleagues in formulating assessment tasks	4(5.6%)	20(27.8%)	38(52.8%)	10(13.9%	- -	3.25
2.	Teacher involve colleagues in designing assessment tools	-	-	7(9.7%)	17(23.6%)	48(66.7%)	1.43
3.	Teacher team with colleagues in scoring learners' task	-	4(5.6%)	22(30.6%)	27(37.5%)	19(26.4%)	2.15
	Mean						**2.28**

Key: 5 - Strongly Agree 4-Agree 3- Somewhat Agree 2- Disagree 1- Strongly disagree

The teachers' mean was 2.28 implying inadequate knowledge on collaboration with colleagues during assessment practice despite recommendation by KICD (2017) and significant to improve learners' performance in the learning area under study. To gather more information, classroom observation was done and findings are presented in Table 4.15 below;

Table 4.15 Classroom Observation Checklist on Collaboration between teachers during formative assessment

No.	Statement	Yes (f)	No (f)
1.	Teacher involve colleagues in formulating assessment tasks in mathematical activities.	1	7
2.	Teacher involve colleagues in designing assessment tools.	-	8
3.	Teacher involve colleagues in scoring learner performance in mathematical activities	-	8

Most teachers (7) did not involve colleagues in formulating assessment tasks. Similarly, none of the teachers neither involved colleagues in designing assessment tools nor scoring learners performance. The findings were majorly due to understaffing experienced in most of ECDE schools at the time of observation as most classes had only one teacher conducting assessment. Only one classroom had two teachers who worked together in formulating assessment tasks even though to a small extent since the assistant teacher majorly ensured learners concentrated during the lesson. In addition, after the lesson a one-on-one conversation with the two teachers indicated that only one had undergone retraining hampering collaborative efforts as the other was not conversant with the relevant prerequisites. Further information was obtained through an interview with the SCECDC on whether teachers worked together during assessment and reported in the below theme;

i) Teacher collaboration

In an interview with the Sub-County ECD Coordinator, the researcher found out that despite teachers having been trained on collaboration during assessment, it was not practical due to teacher shortage as most schools had only one teacher assigned per class with some, a teacher handling both pre-primary 1 and 2 levels. The SCECDC commented;

"*during the CBC in-service training our ECDE teachers were retrained to collaborate during assessment, however this is not practical in most cases due to serious understaffing affecting majority of pre-primary schools.*"

The findings on teacher responses concurs with the classroom observation results that the ECDE teachers are ill-trained to collaborate during assessment.

To realize positive performance in mathematical activities, teachers are supposed to provide individualized learner attention in order to build on their strengths and weaknesses. From the findings, staffing position in the sub-county is an issue of concern that need to be addressed for improvement in the learning area. Apart from understaffing in most schools where lesson observation was done, the researcher noted that even where two teachers were present they were unable to collaborate despite the SCECDC reporting that they received the necessary training.

According to Gebhardt, Heine and Mora-Ruano (2019); Rinehart, Schleifer and Yanisch (2017), working together among teachers have a positive influence towards learners performance, Nelson (2019) on the other hand, holds a different perspective and remarks that there is no positive relationship between collaborative formative evaluation and learner academic performance. The findings does not support the expectations of Schildkamp et al. (2020) regarding teacher collaboration, such as discussions about best practices in the classroom to improve learner achievement in various learning areas, but also serving as a wake-up call for various stakeholders in education more so the County Government in charge of hiring ECDE teachers to consider staffing positions in pre-primary schools.

4.4.2 Involving learners

The researcher found out on whether the in-service training prepared teachers to involve learners in informing them on lesson assessment goal and creating assessment tasks. Table 4.16 indicate summary findings.

Table 4.16 Teacher responses on Involving learners during assessment in the survey Questionnaire

No	Statement	Strongly Agree f (%)	Agree f (%)	Somewhat Agree f (%)	Disagree f (%)	Strongly Disagree f (%)	Mean $\bar{x}$
1.	Teacher inform learners on expected lesson goal during assessment.	1(1.4%)	7(9.7%)	43(59.7%)	20(27.8%)	1(1.4%)	2.82
2.	Teacher involve learners in designing assessment tasks based on individual need	-	-	19(26.4%)	32(44.4%)	21(29.2%)	1.97
	Mean						**2.39**

KEY: 5- Strongly Agree 4-Agree 3- Somewhat Agree 2- Disagree 1- Strongly disagree

The teacher's mean on ability to involve learners in CBFA of mathematical activities was 2.39, implying inadequately retrained on the subject matter. Further findings through lesson observation was done to triangulate teacher results in the survey questionnaire. Table 4.17 display findings.

Table 4.17 Classroom Observation Checklist on Involving learners during formative assessment

No	Statement	Yes (f)	No (f)
1.	Teacher inform learners on expected lesson goal during assessment of Mathematical activities	6	2
2.	Teachers involve learners in designing assessment tasks	1	7

According to the researcher's observation in Table 4.17 above, six out of the eight teachers' informed learners of the lesson goal during the assessment. However, seven out of eight forming the most did not involve learners in designing assessment activities based on need due to overcrowded classroom environment coupled with high learner enrolment. In an interview with the SCECDC and headteachers to respond on the matter, the theme below illustrates findings;

i) Learner involvement in assessment and areas of involvement

The SCECDC responded that teachers were retooled on involving learners during assessment to determine their strengths and weaknesses, but indicated that most teachers still failed to ensure learners are actively involved during the lesson.

The study also found out from the headteachers' interview that despite the in-service training, teachers are still not aware of the areas to involve learners during assessment. One of the headteachers stated;

"when it comes to involving learners in assessment practice, I can categorically respond that my teachers still lack awareness on this..."

Another headteacher added;

"*our teachers still need to be enlightened on the various ways to make learners partners in the formative assessment process in order to show improvement in mathematical activities"*

While scholars including Falchikov (2004); Fluckiger, Vigil, Pasco and Danielson (2010); Rinehart, Schleifer and Yanisch (2017) and Buyukkarci and Sahinkarakas (2021) are of the same school of thought that a number of benefits are realized through learner involvement such as improved instruction and making learners active participants in the lesson, the in-service training has not prepared the teachers on the areas of learner involvement, a true reflection of the questionnaire survey responses and interviews. Thus, in addition to other factors like overcrowded classrooms which might impede individual learner participation as observed during lesson, inadequate understanding of areas of involvement may provide a solid explanation for Sub-County learners' low performance in mathematical activities in spite of the recommendations by Jeanne and Mukamazimpaka (2020) and Asava (2021) that learners should be actively take in the lesson.

To determine teachers' overall responses on their perceptions of effectiveness of in-service training based on the prerequisites researched on, a summary of average rating was done.

Table 4.18 Summary of the teacher mean scores of the three prerequisites researched on

Prerequisite	Mean
1. Knowledge and skills	2.65
2. Psychological factors	3.43
3. Social factors	2.43
Overall Average Rating	**2.84**

The overall average rating of 2.84 implies that the ECDE teachers in Gem are ineffectively retrained to enable them conduct CBFA. This has a significant impact on assessment of mathematical activities, a key learning area that prepares learners to solve every day problems since the teachers lack the prerequisites to inform them on attainment of abilities for progression.

The implementation of the CBC necessitated a shift in the mode of assessment and in this regard, KICD in collaboration with KNEC organized in-service training targeting teachers at both levels of Early Years Education. The training sessions was intended to involve simulations and practical activities to refresh teachers' knowledge on among aspects including preparation and use of assessment tools, ICT integration and assessment feedback. However, the study's findings indicate that this has not been fully realized as indicated in the overall rating based on teachers' perceptions and opinions on their ability to conduct CBFA. The findings gives insight and contributes to the body of knowledge by enlightening various education stakeholders on the gaps in the prerequisites for formative assessment based on Schildkamp et al. framework. Despite the emphasis on equipping teachers with practical knowledge of assessment strategies (Izci, 2016; Govender, 2019; Mahlambi, 2021), there is still low utilization of the formative assessment strategies among Gem ECDE teachers. The teachers have negative attitude and considers the use of assessment tools as challenging, additionally, they cannot differentiate formative and summative evaluation when carrying out assessment even after receiving in-service training. Similarly, this has been noted in

the studies by Chemeli et al. (2019) and Isaboke et al. (2020) even though research by Kogo (2019) remarked that teachers have current pedagogical knowledge. This implies that the in-service training has not addressed teachers' needs and calls for intervention measures from the relevant education stakeholders to equip teachers with practical assessment strategies.

Subsequently, the learning environment is still an issue of concern in most of the Sub-County ECDE schools coupled with poor infrastructure, inadequate formative assessment materials, lack of ICT gadgets and laboratories as well as understaffing in most pre-primary schools. This has hampered teachers' efforts especially on collaborative approach when carrying out formative assessment even if they had received training on the assessment strategies. Further, the findings does not meet the demands of formative assessment strategies suggested by Schildkamp et al. framework and therefore the need to improve on the model to focus on the prerequisites that address teacher formative assessment aspects based on prior identification of their needs.

The identified concerns by the teachers especially on inability to differentiate types of assessment and use of ICT present opportunities for improvement in the manner in which in-service training is carried out as well as prior identification of teachers needs by relevant education stakeholders. This will be crucial in shaping acceptance of paradigm shift on CBFA in order to realize positive performance in mathematical activities.

CHAPTER FIVE
SUMMARY OF FINDINGS, CONCLUSIONS AND RECCOMENDATIONS

5.1 Introduction

This chapter provides summary of the findings, conclusions, recommendations and proposals for further research. The conclusions are based on issues highlighted by respondents in the questionnaire, interview as well as classroom observation findings which provide insight into the need to adequately retrain pre-primary teachers to conduct CBFA. The recommendations and suggestions for further study focuses on the topics covered during the in-service training based on Schildkamp et al. framework and in line with KNEC training manual on Competency Based Assessment. This follows need to address the challenges emanating from the in-service training in order to improve on teacher effectiveness to undertake formative assessment.

5.2 Summary of the findings

The purpose of the study was to assess effectiveness of in-service training of teachers on CBFA of mathematical activities in public Pre-primary schools in Gem. The study was guided by the following objectives: to establish effectiveness of in-service training of teachers on knowledge and skills to conduct CBFA of mathematical activities, establish effectiveness of in-service training of teachers on psychological factors to conduct CBFA of mathematical activities and to establish effectiveness of in-service training of teachers on social factors to conduct CBFA of mathematical activities in public pre-primary schools in Gem Sub- County. The research adopted descriptive survey design using mixed methods of data collection. The sample sizes consisted of eighty five pre-primary teachers, ten headteachers and one SCECDC. The data collection instruments included teacher questionnaire, classroom observation checklist, finally headteacher and SCECDC interview. The data from questionnaire and classroom observation checklist were

analyzed with the help of Statistical Package for Social Sciences (SPSS) version 16 while interview was analyzed thematically. Descriptive statistics involving percentages and means were presented using frequency distribution tables for analysis. The demographic data included teachers' academic qualifications. The following findings were made from the analysis.

5.3 Effectiveness of in-service training of teachers on knowledge and skills to conduct Competency Based Formative Assessment

The summary of the four prerequisites including pedagogical content knowledge, feedback, goal setting and use of ICT forming the first objective were made.

5.3.1 Pedagogical content knowledge

This involves understanding teaching and assessment strategies that are in line with lesson objectives which teachers should be conversant with, however, according to the summary findings, more than half of the teachers (58.3%) who responded, are ill-trained to provide learners with practical mathematical assessment tasks. When it comes to using CBFA tools including checklists, rubrics, and observation schedules, a higher percentage (62.5%) are inadequately retrained to use checklists. The teachers rarely use rubrics in actual assessment according to classroom observation findings despite (58.3%) of them indicating in the questionnaire that they are competent in using it. Even though the SCECDC stated in an interview that teachers were retooled and encouraged to regularly use observation schedule, there is low utilization during assessment practice and this has also been reported by nine headteachers forming the most in an interview. A similar case in the summary findings by a number of teachers (61.1%) in the questionnaire response and 75% of them during classroom observation.

5.3.2 Feedback

When assessing teachers' knowledge and skills to provide written feedback on mathematical activities, 44.4% of teachers agreed and 4.2% strongly agreed that they were able to do so even though this was not the case during classroom observation since most teachers (six out of the eight) did not. A bigger percentage (66.7%) of teachers strongly agrees on having ability to give verbal feedback as further substantiated during observation since 75% of them were doing so. Sixty-five teachers forming the majority out of the seventy-two responses falls between somewhat agree and strongly disagreeing on provision of feedback while teaching. It was noted by the researcher that more than fifty percent of teachers (59.7%) preferred giving assessment feedback after the lesson, nevertheless, even after receiving in-service training on CBC to refresh their knowledge of assessment strategies, 48.6% still cannot differentiate formative and summative evaluation.

5.3.3 Goal setting

Goal setting increases learner motivation and achievement levels, it should be short, clear and learner centered to make learning and assessment goal clear (KICD, 2017). A smaller percentage (5.6%) of teachers agree they are able to develop short-term assessment goals, despite the fact that this is a CBC requirement. During lesson observation, 5 out of the 8 teachers set assessment goals that meet learner need even though 55.6% of the teachers disagreed that the retraining prepared them to set mathematical activities assessment goals that caters for individual differences.

5.3.4 Information Communication and Technology (ICT) skills

It was evident that ECDE teachers in the Sub-County lacked the necessary prerequisite knowledge to use ICT as well as lack of the gadgets for use in most pre-primary schools. Only 4.2 % agreed they were retrained on using ICT to record learner outcomes during the lesson. In a similar vein,

all the teachers' who responded either somewhat agreed, disagreed or strongly disagreed on being trained to use ICT to record the assessment outcomes after lesson. More than fifty percent of teachers (62.5%) consented that they need to be acquainted on ICT use before they can report learner outcomes. Based on the 76.4% of the teachers' claim that ICT topic was not covered during the in-service training, the summary findings are in line with their response. Similar to this, none of the eight classroom teachers observed during lesson time used ICT to conduct assessment. Teachers were not trained to use ICT to undertake formative assessment, according to the summary findings of an interview with the SCECDC and headteachers.

5.4 Effectiveness of in-service training of teachers on psychological factors to conduct Competency Based Formative Assessment

The second objective was to establish effectiveness of in-service training of teachers on psychological factors to conduct CBFA of mathematical activities. The pertinent issues under research were teacher attitude/beliefs, ownership and social pressure and perceived control. The findings have been summarized.

5.4.1 Attitude/Beliefs

Out of the seventy-two teachers, only seven were positive toward using assessment tools, similarly 62.5% of the teachers forming a higher percentage were uncertain whether they liked assessing learners during teaching. Only 37.5% believe they are effectively prepared to understand the importance of the classroom environment in teaching and learning for effective assessment. According to observation summary, most teachers (five out of the eight) have a negative attitude towards assessing learners during the lesson while more than fifty percent (75%) prefer assessing learners after the lesson. Due to high enrollment and the fact that most classes were taught by a single teacher during observation, the teachers were unable to create a conducive environment for

assessment. In the interview summary findings, the teachers had a negative attitude towards formative assessment claiming it was so challenging especially when integrating formative assessment tools according to the SCECDC.

5.4.2 Ownership

Teachers' ownership of the assessment practice is evidenced from the summary findings with 62.2% (48.3% agreeing and 13.9% strongly agreeing) they have ability to assess learners independently. As a result of the measures put in place to actively involve ECDE teachers during the retooling, as stated by SCECDC during an interview. Similarly, 75% of the teachers observed were conducting assessment verbally, implying ownership of the practice.

5.4.3 Social pressure and perceived control

Above fifty percent (63.9%) are confident that they have freedom to assess learners in mathematical activities meaning they have control over it when it came to determining their autonomy to conduct formative assessment. All the eight teachers observed in the classroom independently and voluntarily carried out formative assessment. Interview findings showed teachers were adequately retrained and are perceived to be autonomous when conducting formative assessment.

5.5 Effectiveness of in-service training of teachers on social factors to conduct Competency Based Formative Assessment

The prerequisites aspects that were looked into in this objective included collaboration between teachers and learner involvement in CBFA of mathematical activities.

5.5.1 Collaboration between teachers

The study established that above fifty percent (52.8%) were uncertain on collaborating with colleagues in formulating assessment task. A higher percentage (66.7%) of teachers were not convinced that the in-service training prepared them to team up with colleagues in designing assessment tools. Very few teachers 4 out of 72 agree they are retrained to collaborate with colleagues in scoring learners' assessment. During classroom observation, none of the teachers involved colleagues when carrying out assessment. According to an interview with SCECDC, teacher shortage made it impossible for teachers to collaborate when assessing learners in class, even if they had been retrained on it. At the time of this study, most pre-primary schools in Gem only had one teacher assigned to each class, which made it difficult for teachers to collaborate.

5.5.2 Involving learners

Summary findings indicate that more than half (59.7%) could not determine whether they can inform learners on expected lesson goal during assessment or not, though it was not the case during classroom observation as 75% of the teachers informed learners on expected lesson goal to be achieved. Notably, only a smaller percentage (6.3%) being confident they can involve learners to design assessment tasks and evidenced during lesson observation as only one out of the eight teachers did so.

5.6 Conclusions

The study therefore concludes that pre-primary teachers in Gem are ineffectively retrained to undertake CBFA of mathematical activities as established in the overall mean of 2.84. This implies that the teachers are ill-skilled and a number of issues including use of ICT, formative assessment tools as well as their attitude still need to be addressed.

In respect to teacher knowledge and skills, the study concludes that the teachers are undertrained to formulate practical formative assessment tasks despite a requirement at ECDE level. There is

minimal effort by teachers to use formative assessment tools when teaching even though most teachers responding that they are competent in using rubrics. The use of formative assessment tools is necessary in tracking learners' progress and identifying their developmental challenges in order to put in place appropriate intervention measures. The study finds that the teachers are ill-trained to provide written feedback since most prefer giving verbal feedback during teaching, despite the importance linked to written feedback including reference purposes. Teachers are not competent to use ICT and has limited skills on its use for formative assessment therefore, there is need for in-depth retraining to develop teacher competency.

While focusing on psychological factors prerequisite, the study concludes that despite Gem pre-primary teachers having control over formative assessment of the learning area under study, most of them have negative attitude towards the practice. This is majorly when it comes to preparing and use formative assessment tools as well as assessing learners during the lesson as they perceive it as challenging and consuming a lot of time in the lesson.

On social factors prerequisite, the study concludes that pre-primary teachers in Gem have limited knowledge on collaboration with colleagues and areas of involving learners during formative assessment. Even though some pre-primary schools have more than one teacher handling a class during the lesson, most have only one teacher retrained on CBC posing a challenge on teacher collaboration and learner involvement since the rest lacks the necessary prerequisites suggested by Schildkamp et al. framework and assessment strategies outlined in the competency based assessment framework for early years education.

5.7 Policy Recommendations

Based on the findings of this research, the study makes the following recommendations

5.7.1 Recommendations to the Ministry of Education and County Government

1. Considering ICT gadgets were not availed by trainers for teachers to practice on their use during in-service training and subsequent lack of ICT assessment gadgets in the pre-primary schools, the study recommends that the gadgets should be availed during future training to ensure teachers are taken through their use as well as availed in the ECDE schools for assessment practice.

2. Given that pre-primary teachers in the Sub-County have negative attitude towards formative assessment practice, additionally, the in-service training did not involve all the teachers assessing learners in the pre-primary schools, there is need for the MOE in partnership with the County Government tasked with retraining of teachers to organize more regular in-service training on CBC to equip all the ECDE teachers on the relevant prerequisites.

3. To address concerns of understaffing in most public pre-primary schools in the Sub-County hampering teacher collaboration during assessment, it is recommended that the County Government should employ more ECDE teachers in order to improve teacher-learner ration for effective teacher collaboration and learner involvement during teaching and assessment.

5.7.2 Recommendation to the curriculum trainers - Sub-County ECD Coordinator

Pre-primary teachers in the sub-county still have challenges and are negative even after in-service training on preparation and use of formative assessment tools during teaching. The study recommends to the SCECDC who takes part during in-service training of teachers and supervises curriculum implementation at the school level to regularly check on teachers' formative

assessment practices and offer necessary guidance and support in order to improve on their attitude and knowledge of preparation and use of the formative assessment tools.

5.7.3 Recommendation to pre-primary teachers

Given that most of the pre-primary teachers still lacks knowledge on formative assessment strategies such as inadequate knowledge on preparation and use of formative assessment tools during teaching as well as not able to differentiate formative and summative evaluation, and to ensure their efficacy in conducting CBFA, the study recommends that they should continuously undertake Teacher Professional Development (TPD) training and be positive towards the new assessment strategies.

5.8 Recommendations for further research

1. ICT integration in the implementation of Competency Based Curriculum through assessment practice. The research will give valuable insight on the state of teacher possession of ICT skills and availability of the ICT gadgets for formative assessment practice.

2. Investigate the impact of in-service training on teacher attitude towards implementation of Competency Based Curriculum through formative assessment practice.

3. Exploring areas of learner involvement during assessment practice. The study can enlighten educators and result in improved instruction delivery to help close the gaps in attainment of mathematical abilities through assessment practice for learner progression.

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APPENDICES

APPENDIX I: QUESTIONNAIRE FOR PRE-PRIMARY TEACHERS

The purpose of this questionnaire is to collect information on effectiveness of in-service training of teachers on competency based formative assessment of mathematical activities in both levels of public pre-primary schools in Gem Sub-County. Any response you provide will be treated with a lot of confidentiality and strictly for academic purpose.

Please tick **(√)** appropriately in the box and write your response/comments in the spaces provided. Do not indicate your name anywhere in this questionnaire for the purpose of anonymity.

SECTION I: RESPONDENTS GENERAL INFORMATION

1. Gender a) Male { } b) Female { }

2. What is your highest level of academic qualification?

a) Certificate { }

b) Proficiency { }

c) Diploma { }

d) Degree { }

3. How long have you taught in pre-primary school?

a) 1 year { } b) 2 years { } c) 3 years { } d) 3 years and above { }

4. What level of pre-primary are you handling? a) Pre-primary 1{ } b) Pre-primary 2{ } c) Both Pre-primary 1 and pre-primary 2 { } d) Others (please specify) _____

5. Have you attended any in-service training on CBC? Yes { } No { }. If yes, how frequent did you attend.

a) once { } b) twice { } c) thrice { } d) more than thrice { }

6. Did the training cover Competency Based Formative Assessment? a) Yes { } b) No { }

7. Indicate by placing a tick **(√)** topics covered during in-service training that relates to Competency Based Formative Assessment.

Topic	**Yes**	**No**
a) Pedagogical content knowledge		
b) Feedback		
c) Goal setting		
d) Information Communication and Technology (ICT)		
e) Attitude		
f) Ownership		
g) Social pressure and perceived control		
h) Teacher collaboration		
i) Learner involvement		

8. Do you employ Competency Based Formative Assessment when teaching mathematical activities? a) Yes { } b) No { }

SECTION II

Objective one: Effectiveness of in-service training of teachers on knowledge and skills to conduct competency based formative assessment of mathematical activities in public pre-primary schools in Gem Sub-County

9. The following are statements on teacher perceptions on in-service training to effectively conduct competency based formative assessment of mathematical activities in pre-primary school. Please indicate by placing a tick **(√)** in the appropriate box to indicate extent of your agreement. Use the provided scale of 1-5 where,

5- Strongly Agree 4-Agree 3- Somewhat agree 2- Disagree 1- Strongly disagree

Statement	**1**	**2**	**3**	**4**	**5**
Knowledge and skills					
i) Pedagogic content knowledge					
a) I present mathematical activities assessment in practical activities					
b) I conduct assessment during teaching mathematical activities					
c) Effectively carries out assessment after teaching mathematical activities					
d) I use Checklist when assessing learners in mathematical activities					
e) I utilize Rubrics when assessing learners in mathematical activities					
f) Uses Observation schedule when assessing learners in mathematical activities.					
ii) Feedback					
a) I regularly give written feedback to inform learners on attainment of mathematical abilities.					
b) Informs learners verbally of their achievement of mathematical skills					
c) Gives assessment feedback to learners during teaching mathematical activities					

d) Provides assessment feedback to learners after teaching mathematical activities					
e) I can differentiate formative from summative evaluation when giving feedback					
iii) Goal setting					
a) I formulate short term mathematical activities learning goals that meet learner need					
b) Sets mathematical activities goal that caters for individual learner differences					
iv) Information Communication Technology (ICT) skills					
a) I use ICT to record mathematical activities assessment learner outcomes during the lesson					
b) I utilize ICT to record mathematical activities assessment learner outcomes after the lesson					
c) After capacity building programs and trainings, I can efficiently report learner outcomes in mathematical activities using ICT.					

10. Were you retrained on the use of formative assessment tools? Yes { } No { }. If yes, indicate by pacing a tick **(√)** the ones you were prepared on.

Assessment Tool	**Yes**	**No**
a) Checklist		
b) Rubrics		
c) Observation Schedule		
d) Others (specify)		

11. Were you retrained on using Information Communication Technology (ICT) gadget(s) during assessment? Yes { } No { } If yes, how do you use ICT during assessment. Indicate by placing a tick **(√)** in appropriate box.

ICT use during assessment	**Yes**	**No**
a) Recording		
b).Storing		
c) Reporting		

Objective two: Effectiveness of in-service training of teachers on psychological factors to conduct competency based formative assessment of mathematical activities in public pre-primary schools in Gem sub-county

12. The following are statements on teacher perceptions on in-service training to effectively conduct competency based formative assessment of mathematical activities in pre-primary school. Please indicate by placing a tick **(√)** extent which you agree. Use the provided scale of 1-5 where,

5- Strongly Agree 4-Agree 3- Somewhat agree 2- Disagree 1- Strongly disagree

Psychological factors	**1**	**2**	**3**	**4**	**5**
i).Attitude/Beliefs					
a) I Believe that using assessment tools is not engaging.					
b) I like assessment practice when teaching mathematical activities					

c) I am prepared to be positive towards formative assessment practice					
d) I am aware that school environment may possibly affect attitude towards formative assessment					
ii).Ownership					
a) I enjoy assessing learners in mathematical activities					
iii).Perceived pressure and control					
a)Have freedom to assess learner's outcome in mathematical activities					
b) I make assessment decisions when scoring learners in mathematical activities without intervention of school administration					

Objective three: Effectiveness of in-service training of teachers on social factors to conduct competency based formative assessment of mathematical activities in public pre-primary schools in Gem sub-county

13. The following are statements on teacher perceptions on in-service training to effectively conduct competency based formative assessment of mathematical activities in pre-primary school. Please indicate by placing a tick **(√)** extent of your agreement. Use the provided scale of 1-5 where,

5- Strongly Agree 4-Agree 3- Somewhat agree 2- Disagree 1- Strongly disagree

Social factors	**1**	**2**	**3**	**4**	**5**
Teacher collaboration					
a) I regularly involve colleagues in formulating assessment tasks in mathematical activities					
b) I do team up with colleagues in designing assessment tools					
c) Involves colleagues to discuss learner performance in mathematical activities					
Involving learners					
a) I Inform learners on expected lesson goal during assessment					
b) I Involve learners in designing assessment tasks based on individual need					

14. Comment on your general competence to conduct Formative Assessment of Mathematical activities.

_____

_____

_____

_____

Thank you for participating

APPENDIX II: INTERVIEW SCHEDULE FOR HEADTEACHERS

Introduction

This interview is meant to gather information pertaining effectiveness of in-service training of teachers on competency based formative assessment of mathematical activities in your school. Participation is voluntary and any information given shall strictly be used for academic purpose neither shall your identity be revealed to anyone nor in this report.

RESPONDENTS CONSENT

Do you accept to take part in this interview? Yes { } No { }

1. Competence in conducting CBFA can only be realized through effective in-service training. How regular have pre-primary school teacher(s) in your school attended CBC in-service training?

2. At what stage does your teachers conduct assessment? a) during the lesson, b) after the lesson

3. Would you list the ICT gadgets available in your school used for assessment?

4. Some of the assessment tools teachers are expected to use include rubrics, checklist, observation schedule etc. Would you list the ones your teacher(s) use during assessment if any?

5. During your interaction with the ECDE teachers, what is your opinion on their attitude towards formative assessment practice?

6. How do ECDE teachers in your school involve learners when carrying out assessment practice?

7. What is your take on the effectiveness of CBC training attended by the pre-primary teachers?

Thank you for cooperating

APPENDIX III: CLASSROOM OBSERVATION CHECKLIST

The purpose of this classroom observation checklist is to collect information on effectiveness of in-service training of teachers on competency based formative assessment and shall be undertaken during mathematical activities lesson from sampled public pre-primary teachers in Gem sub-county. The checklist will cover the three objectives under study. A tick (√) will be used to indicate point of agreeability in the appropriate box.

Name of School_____

2. Level of pre-primary being handled by the teacher. a) Pre-primary 1{ } b) Pre-primary 2 { } c) Both Pre-primary 1 and Pre-primary 2 { } d) Any other _____

NO	ASSESSMENT ACTIVITIES	Yes	No	Remarks
	Knowledge and skills objective			
	a) Pedagogical content knowledge			
1	Teacher presents mathematical assessment in practical activities			
2	Teacher assesses learners during mathematical activities lesson			
3	Teacher uses Checklist for assessment practice			
4	Teacher uses Rubrics for assessment of mathematical activities			
5	Teacher uses Observation schedule for assessment practice			
	b) Feedback			
6	Teacher provides written feedback during the lesson			
7	Teacher provides verbal feedback during the lesson			
	c) Goal setting			
8	Teacher set short mathematical activities lesson goal within the learner need			
	d) Information Communication and Technology (ICT) use			
9	Teacher record learner assessment outcome using ICT			
10	Teacher report learner assessment outcome using ICT			
	Psychological factors objective			
	a) Ownership			
11	Teacher independently assesses learners during the lesson			
	b) Perceived pressure and control			
12	Teacher has freedom to assess learners' during teaching			
	Social factors objective			
	a) Teacher collaboration			
13	Teacher collaborates with colleagues in formulating assessment tasks			
14	Teacher collaborates with colleagues in scoring learners' abilities			
	b) **Involving learners**			
15	Teacher informs learners of expected lesson goal during assessment			
16	Teacher involves learners in assessment practice			

APPENDIX IV: INTERVIEW SCHEDULE FOR SUB-COUNTY ECDE COORDINATOR

Introduction

This interview schedule is meant to elicit information on effectiveness of in-service training of teachers on competency based formative assessment of mathematical activities in public pre-primary schools in the sub-county. Participation is voluntary and any information given shall strictly be used for academic purpose neither shall your identity be revealed to anyone nor in this report.

RESPONDENTS CONSENT

Do you accept to take part in this interview? Yes { } No { }

1. How many in-service training courses have you organized for pre-primary teachers in the sub-county to prepare them on CBC since 2019?

2. Did the in-service training cover the topic on how to conduct formative assessment? If yes, list the topics covered related to assessment. If no, explain why formative assessment was not covered during the training.

3. Comment on state of teachers' effectiveness in the sub-county to use ICT gadgets for formative assessment of mathematical activities.

4. During the in-service training, were ECD teachers in the sub county prepared on using formative assessment tools like Checklist, Rubrics, Observation schedule? If yes, which of these tools were teachers prepared to use.

5. Give your view on ECD teachers' preparedness to independently provide assessment feedback to learners when assessing mathematical activities.

6. Comment on teachers' attitude towards formative assessment of mathematical activities after the trainings attended on CBC.

7. Were the pre-primary teachers in the sub-county prepared on involving learners during assessment practice? If yes, how do they involve them?

8. It is important that teachers be prepared to collaborate during assessment. Were teachers in the sub-county prepared and what were the areas prepared on?

9. One of the measures to ensure ownership of assessment is by actively involving teachers during training. What were the measures put in place to ensure teacher ownership of the practice?

10. What are the challenges being faced by pre-primary teachers in applying assessment in the classroom?

Thank you for cooperating

APPENDIX V: CONSENT FORM FOR PRE-PRIMARY TEACHERS

MASENO UNIVERSITY, MAIN CAMPUS

PRIVATE BAG

THE STUDY OBJECTIVE IS TO ASSESS EFFECTIVENESS OF IN-SERVICE TRAINING OF TEACHERS ON COMPETENCY BASED FORMATIVE ASSESSMENT OF MATHEMATICAL ACTIVITIES IN PUBLIC PRE-PRIMARY SCHOOLS IN GEM SUB-COUNTY, KENYA

Background of the study.

My name is Onyango O. Ezra, Admission MED/ED/00001/020, a student at Maseno University pursuing Master's Degree in Education Curriculum Studies at the Department of Educational Communication Technology and Curriculum Studies, School of Education. The goal of the above study is to gather data from pre-primary teachers, headteachers and Sub-County ECD Coordinator (SCECDC) on effectiveness of in-service training of teachers on competency based formative assessment of mathematical activities in Gem Sub-County.

The following ethical principles will be considered if you accept to take part in this study;

i) Your participation in this study is voluntary and without any coercion either, your rights and dignity will be highly protected throughout study period.

ii) The study will guarantee the anonymity of participants. No biographical information will be included in the data collection questionnaire beyond what is required for the study.

iii) Regarding CBC in-service training, your responses will not be used in any way to discriminate you from other respondents on the basis of your educational background or familiarity with particular CBC topics. Great respect to your opinions shall be taken into consideration.

iv) Any additional ethical guidelines that shield participants from injury during the study will be adhered to.

Kindly write your name and sign if you accept to take part in the research.

I……from my informed consent voluntarily accepts to take part in this research study and that I have read and understood the ethical principles guiding it. I am aware I can withdraw at any time during research or fail to respond to the questions without any consequences. I am aware of the study's goal and the benefits that will accrue as a result of it.

Respondent signature: …… Date: …….

I believe the respondent has accepted to take part in this research study out of free will and has not been coerced either.

Signature of the researcher: …….. Date: ……

APPENDIX VI: CONSENT FORM FOR HEADTEACHERS

MASENO UNIVERSITY, MAIN CAMPUS

PRIVATE BAG

THE STUDY OBJECTIVE IS TO ASSESS EFFECTIVENESS OF IN-SERVICE TRAINING OF TEACHERS ON COMPETENCY BASED FORMATIVE ASSESSMENT OF MATHEMATICAL ACTIVITIES IN PUBLIC PRE-PRIMARY SCHOOLS IN GEM SUB-COUNTY, KENYA

Background of the study.

My name is Onyango O. Ezra, Admission MED/ED/00001/020, a student at Maseno University pursuing Master's Degree in Education Curriculum Studies at the Department of Educational Communication Technology and Curriculum Studies, School of Education. The goal of the above study is to gather data from pre-primary teachers, headteachers and Sub-County ECD Coordinator on effectiveness of in-service training of teachers on competency based formative assessment of mathematical activities in Gem Sub-County.

The following ethical principles will be considered if you agree to take part in this study;

i) Your participation in this study is voluntary, your rights and dignity will be highly protected throughout study period.

ii) The study will guarantee you anonymity during and after the interview session.

iii) Your views will be treated with great respect and opinions shall be taken into consideration.

iv) Any additional ethical guidelines that shield participants from injury during the study will be adhered to.

Kindly write your name and sign if you accept to take part in the research.

I……from my informed consent voluntarily accepts to take part in this study and aware that I can withdraw at any time during research or fail to respond to the questions without any consequences. I further grants the researcher permission to proceed with data collection from pre-primary teachers and access to any material or resources which may be pertinent and further allows publication in part or full information concerning the area of research gathered from the school.

Respondent signature: …… Date: …….

I believe the respondent has accepted to take part in this research study out of free will and has not been coerced either.

Signature of the researcher: …….. Date: ……

APPENDIX VII: ETHICS APPROVAL LETTER

MASENO UNIVERSITYSCIENTIFIC AND ETHICS REVIEW COMMITTEE

Tel: +254 057 351 622 Ext: 3050
Fax: +254 057 351 221

Private Bag – 40105, Maseno, Kenya
Email: muerc-secretariate@maseno.ac.ke

REF: MSU/DRPI/MUSERC/01269/23 **Date**: 24th October, 2023

TO: Ezra Onyango Otieno
MED/ED/00001/2020
Department of Educational Communication,
Technology and Curriculum Studies
School of Education, Maseno University
P. O. Box, Private Bag, Maseno, Kenya

Dear Sir,

Re: Effectiveness of Teacher Training for Competency Based Formative Assessment of Mathematical Activities in Public Pre-Primary Schools in Gem Sub-County, Kenya

This is to inform you that **Maseno University Scientific and Ethics Review Committee (MUSERC)** has reviewed and approved your above research proposal. Your application approval number is MUSERC/01269/23.The approval period is 24th October, 2023 – 23rd October, 2024.

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by Maseno University Scientific and Ethics Review Committee (MUSERC).
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to Maseno University Scientific and Ethics Review Committee (MUSERC) within 24 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to Maseno University Scientific and Ethics Review Committee (MUSERC) within 24 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to Maseno University Scientific and Ethics Review Committee (MUSERC).

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely

Prof. Philip O. Owuor, PhD, FAAS, FKNAS
Chairman, MUSERC

ETHICS REVIEW COMMITTEE 24 OCT 2023

APPENDIX VIII: NACOSTI APPROVAL LETTER

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **534944**

Date of Issue**14/March/2024**

RESEARCH LICENSE

This is to Certify that Mr.. EZRA OTIENO ONYANGO of Maseno University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Siaya on the topic: EFFECTIVENESS OF TEACHER TRAINING FOR COMPETENCY BASED FORMATIVE ASSESSMENT OF MATHEMATICAL ACTIVITIES IN PUBLIC PRE-PRIMARY SCHOOLS IN GEM SUB-COUNTY, KENYA. for the period ending : 14/March/2025.

License No:**NACOSTI/P/24/33901**

534944

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

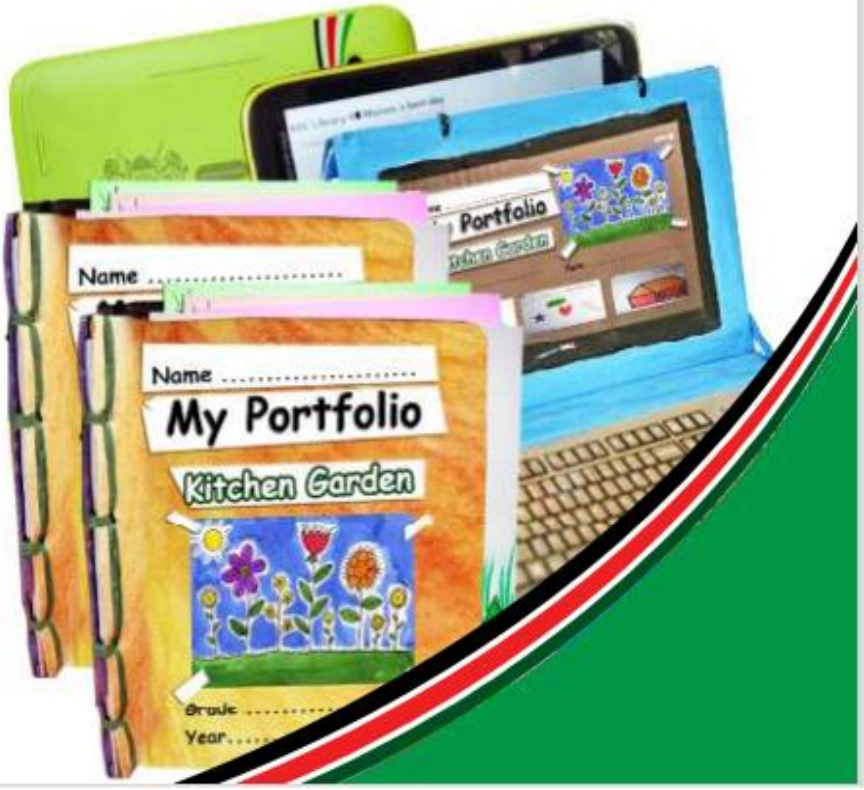
NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

APPENDIX IX: TRAINING MANUAL FOR COMPETENCY BASED ASSESSMENT

TRAINING MANUAL FOR COMPETENCY BASED ASSESSMENT

Early Years Education
Regular Pathway



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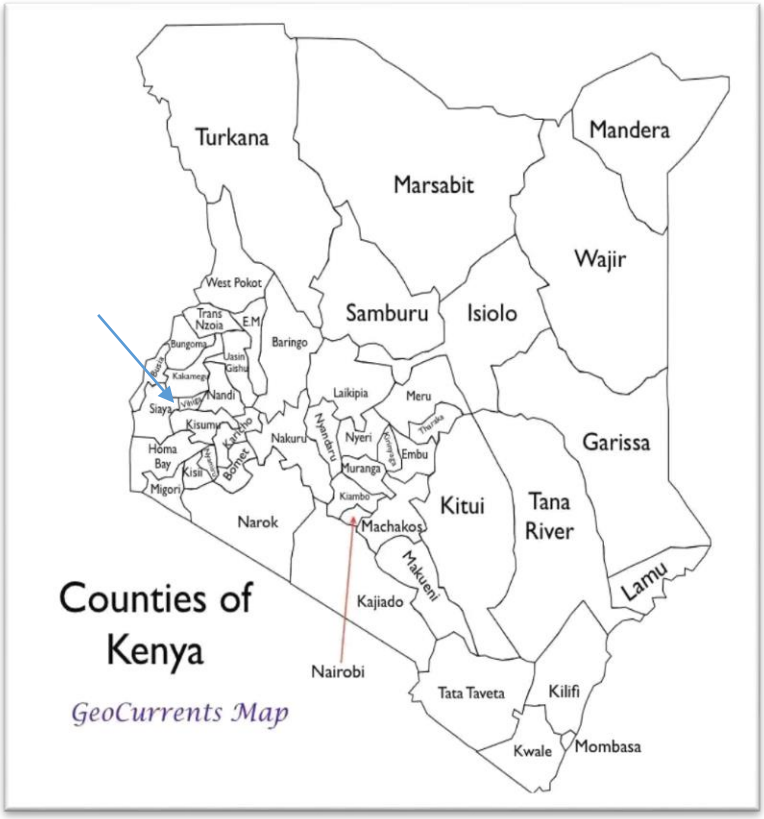
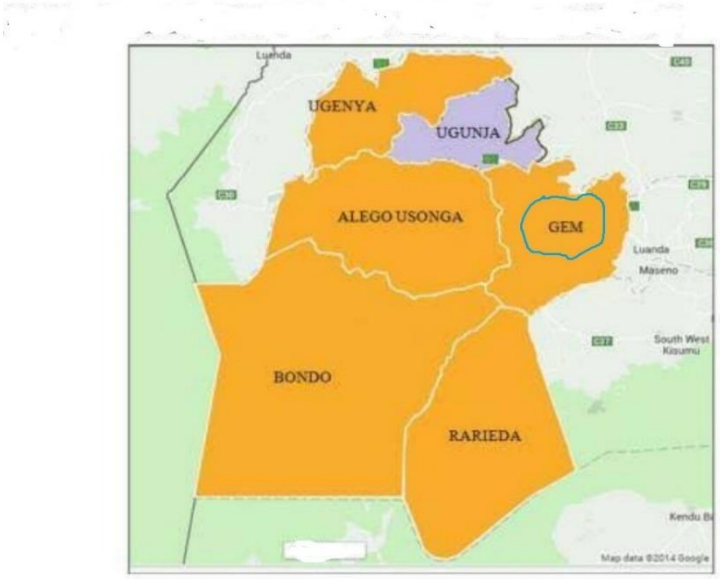
APPENDIX X: MAP OF STUDY AREA



Map of Kenya showing position of Siaya County (→ indicates the location)



Siaya County Map showing the study area (Gem sub- County)