EVALUATING THE EFFECTIVENESS OF THE ASSESSMENT PRACTICES OF PUBLIC

PRIMARY SCHOOL MATHEMATICS TEACHERS IN ABUJA, NIGERIA

Dissertation Manuscript

Submitted to UNICAF University in Zambia
in partial fulfillment of the requirements
for the degree of

Doctorate of Education (EdD)

By

Olufemi Olawale Folaponmile

July 2025

Approval of the Thesis

EVALUATING THE EFFECTIVENESS OF THE ASSESSMENT PRACTICES OF PUBLIC

PRIMARY SCHOOL MATHEMATICS TEACHERS IN ABUJA, NIGERIA

This Thesis by <u>Olufemi Olawale Folaponmile</u> has been approved by the committee members below, who recommend it be accepted by the faculty of Unicaf University in Zambia in partial fulfillment of requirements for the degree of

Doctorate of Education (EdD)

Thesis Committee:

Dr Chrispen Chiome, supervisor

Dr Olga Novokhatskaya, chair

Dr Evgenia Theodotou, external examiner

Prof Muraina Kamilu Olanrewaju, internal examiner

Abstract

EVALUATING THE EFFECTIVENESS OF THE ASSESSMENT PRACTICES OF PUBLIC PRIMARY SCHOOL MATHEMATICS TEACHERS IN ABUJA, NIGERIA

Olufemi Olawale Folaponmile

Unicaf University in Zambia

The central problem this study examined are the gaps in assessment practices of public primary school mathematics educators in Abuja, Nigeria. The study sought to evaluate the effectiveness of the assessment approaches adopted by the teachers, using mathematics as the focal subject. Purposive sampling was used to select 115 primary school mathematics teachers from 11 schools in Abuja. Nine of these participated in the interview stage. The research targeted to determine whether or not a formative assessment strategy had any significant influence on learners' learning outcomes. The study used a triangulation approach which is a single-phase design in which statistical analysis and narrative interpretation were conducted in about similar amounts within the same time frame. The qualitative approach was useful for collecting and understanding the views of the mathematics teachers on assessment. The quantitative approach helped in retrieving demographic data and collecting general views about assessment. Questionnaires and semi-formal interviews served as a means of collecting data for the study. Documentary evidence also helped to confirm the questionnaire and semi-interview data. Descriptive statistics was used in representing questionnaire data while content analysis was employed to interpret the qualitative data. The results revealed that while the assessment methods already in use by the primary school mathematics teachers yielded average to above average outcomes, there was room for improvement. Furthermore, the public primary school mathematics teachers rely almost exclusively on summative assessment practices and know very little or nothing about the implementation of formative assessment strategies leading to gaps in the assessment practices of these teachers. The study also confirmed that the application of a formative assessment approach can enhance student learning and learning outcomes. The study went on to recommend expeditious adjustments in the areas of teacher and student training, curriculum development, decision making, policy review and research. It also recommends a multifaceted assessment approach which integrates features of both summative and formative assessments.

Declaration

I declare that this thesis has been composed solely by me and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where stated otherwise by reference or acknowledgment, the work presented is entirely my own.

AI Acknowledgement Page

I acknowledge the use of artificial intelligence (AI) in this study, specifically the Meta AI Assistant, for syntax suggestions and language enhancements, including word order adjustments, verb tense consistency and proof reading. I affirm that AI was not used to generate or interpret data, draw conclusions, or write the thesis. The intellectual contribution and research integrity remain solely the responsibility of the author.

Copyright Page

I confirm that I retain the intellectual property and copyright of the thesis submitted. I also allow Unicaf University in Zambia to produce and disseminate the contributions of the thesis in all media forms known or to come as per the Creative Commons BY License (CC BY).

Dedication

I would like to dedicate this thesis to the glory of the one and only true God.

Acknowledgements

Table of Contents

List of Abbreviations

FGN   Federal Government of Nigeria

AfL   Assessment for Learning

AoL   Assessment of Learning

WAEC   West African Examination Council

NECO   National Examination Council

JAMB   Joint Admission & Matriculations Board

PISA   Programme for International Student Assessment

TRCN   Teachers Registration Council of Nigeria

ZPD   Zone of Proximal Development

TIMSS   Trends in International Mathematics and Science Study

WASSCE   West African Senior School Certificate Examination

DBDM   Data based Decision Making

UTME   Unified Tertiary Matriculation Exam

NCEE   National Common Entrance Examination

NAPLAN   National Assessment Program – Literacy and Numeracy

UBE   Universal Basic Education

FGN	Federal Government of Nigeria
AfL	Assessment for Learning
AoL	Assessment of Learning
WAEC	West African Examination Council
NECO	National Examination Council
JAMB	Joint Admission & Matriculations Board
PISA	Programme for International Student Assessment
TRCN	Teachers Registration Council of Nigeria
ZPD	Zone of Proximal Development
TIMSS	Trends in International Mathematics and Science Study
WASSCE	West African Senior School Certificate Examination
DBDM	Data based Decision Making
UTME	Unified Tertiary Matriculation Exam
NCEE	National Common Entrance Examination
NAPLAN	National Assessment Program – Literacy and Numeracy
UBE	Universal Basic Education

List of Tables

List of Figures

CHAPTER ONE: INTRODUCTION

1.0 Background to the study

The teaching of mathematics in schools plays a crucial role in shaping the academic success of learners, especially at the foundational levels. As a universally required subject, mathematics forms the bedrock upon which students develop logical reasoning, problem-solving abilities, and critical thinking skills. Whether at the elementary, middle or high school level, mathematics contributes significantly to a learner's confidence and performance in other disciplines.

Consequently, it is essential for governments, policymakers, educators, and stakeholders to ensure the effective delivery, comprehension, and evaluation of mathematics. However, teaching mathematics effectively cannot be divorced from how the subject is assessed. The assessment of mathematics, therefore, becomes a central indicator of teaching success. This is why this research is underlain by the thinking that how students are assessed in mathematics impacts their academic outcomes and achievements (Mazana et al, 2020) in the subject.

This study attempts to identify and fill the gaps in the assessment approaches employed by mathematics teachers in government owned (public) primary schools. The intention is to raise students' academic achievement whilst also preventing unwanted incidents such as high failure rates and exam malpractice. In Nigeria, public schools are mainly government funded schools at the state or federal level, often charging minimal or no fees. Although these schools are usually more affordable to lower income families, there is nonetheless a significant crisis in the teaching and learning of mathematics in these institutions of learning (Benebo-Solomon & Abaver, 2024).

The aforementioned crisis poses a huge challenge to several students because mathematics is not only a core and compulsory primary school subject but also a requirement in secondary schools and for certain programmes in higher institutions. As such, this challenge requires urgent attention and solution in order to mitigate a possible breakdown in the country's educational system. Furthermore, the mathematics learning crisis in public primary schools is evident in the poor learning outcomes of students. There

is widespread consensus that primary school pupils in Nigerian public schools are not meeting curricular standards, with many graduating without acquiring the foundational numeracy skills and knowledge expected of them (Abdulhamid et al., 2020; Obiakor, 2023). These pupils spend at least six years in the primary school and yet end up not achieving the set milestones for this level of education.

The learning crisis in mathematics is multifaceted and has been attributed to several factors such as students' gender, socio-economic background, prior ability, attitudes, aspirations, and learning beliefs (Adesoji & Yara, 2008). But these are not the only factors that are generating the problems witnessed in the teaching and learning of mathematics. There is also the problem of assessment. Assessment ought to be a tool for improving the quality of learning (Obilor, 2018; Sewagegn, 2019, Umar & Majeed, 2018). Sadly, this is not the case in many public primary schools. Existing assessment programmes in mathematics have shown limited effectiveness in addressing poor learning outcomes in public primary schools (Obiakor, 2023).

The limitations experienced in the existing assessment programmes can be attributed to gaps which include, the exclusion of alternative assessment practices (which include the use of feedback, peer assessment and self-assessment among others) from the methods of assessment, and the over dependance on summative assessment practices (such as graded midterm tests, end of term examinations, practical tests, assignments etc.) which do not address students' social and emotional needs. Others include an excessive focus on measurement as opposed to paying more attention to learning, an obvious lack of attention to the academic needs of low achieving learners and the overt exclusion of measures for developing soft skills (critical thinking, creativity, collaboration etc.) from the assessment process.

The dominant assessment methods used by government owned elementary school mathematics teachers in the current research are summative in nature. Research suggests there is a need for innovations in assessment because existing assessment strategies are inadequate (Obilor, 2018) for addressing students' psychological needs and learning challenges, especially in today's uncertain environment.

The inclusion of a formative assessment approach in assessment frameworks has been shown to be a best practice for closing not only gaps in how teachers apply assessment, but also shortfalls in educational outcomes (Hopfenbeck 2018). While this study does not canvass for the total overhaul of summative methods of assessment, a combination of both summative and formative assessment strategies is recommended to raise student achievement and educational outcomes. By implementing such a combination, the lapses in education, and more particularly in public primary school teachers' assessment practices can be addressed.

Several educational systems around the world are now seeing the need to review the nature and type of assessments deployed in 21st century classrooms (Hendrickson, 2012; Obilor, 2018; Sewagegn, 2019). This study believes that assessment as it is practiced today particularly in third world countries requires urgent attention, especially if the present day's economic, social, scientific and technological key performance indicators must be achieved.

This is why such third world countries who are yet to embrace these views need to look urgently into them in order to efficiently address the 21st century challenges in today's world. This is necessary particularly if our educational system seeks to deliver students and industry professionals who are equipped to succeed in today's fast paced and uncertain world.

For the purpose of emphasis, the fundamental premise of this research is that the nature and/or style of assessment teachers adopt impact the standard of student academic performance. Learning is a function of assessment. Thus, if an assessment framework is weak, learning and its outcomes will also be weak. On the other hand, if the assessment framework is strong, learning and its outcomes will be strong.

Therefore, it follows that to optimize student learning experiences, the quality of assessment will first need to improve. This explains why the place of assessments in the classroom, and in education broadly speaking cannot be over emphasized. Perhaps, this is why the subject of assessment has become an all-important topic for debate and discussion among researchers and other stakeholders in the education industry during the last 30 years or so (Nortvedt & Buchholtz, 2018).

Additionally, these discussions include how assessment is used by teachers and various examining bodies in diverse geographical regions. Researchers are now actively exploring how classroom assessments can be effectively designed to promote student academic growth and academic achievement (Black & William, 1998; Mazana et al., 2020). This is because they believe in the ability of solid assessment practices to increase student learning gains and academic attainment.

Against the foregoing backdrop therefore, the generally poor results posted in some major certificate exams raise fundamental questions about the nature and quality of assessment methods used by school teachers in Nigeria. Assessment holds varied meanings depending on individual experiences, backgrounds, contexts and perspectives. Most people tend to view assessment as a measure of the quantity of learning that has happened between two points in time. This explains why some schools assess student at planned times during each term. In a similar way, other schools evaluate students mainly at the conclusion of each lesson or body of work. This seems to be the case in many schools in Nigeria where teachers still prefer to apply a summative method of assessment to measure students' understanding of what was taught (FGN, 2014).

Furthermore, the use of graded tests and assignments has become an age long tradition in many classrooms across Nigeria, in view of the national educational framework and the rather lop-sided training educators are exposed to in this part of the world. Of course, while most forms of assessment have their benefits, research shows that not all assessments meaningfully improve students' learning and achievement (Umar & Majeed, 2018). Some assessments only measure how much learning has taken place per time, period! Such assessments pay no special attention to upgrading learning, understanding, critical thinking or even problem solving for that matter.

Against this backdrop, some authors argue that the use of summative tests alone can scarcely offer the high level of confidence and outcomes necessary for success in today's complex world due to their inadequacies (Obilor, 2018; Sewagegn, 2019). This study makes the profound argument that most paper and pencil or summative tests do not encourage or challenge students to engage in any serious thinking or problem-solving processes. Instead,

the core emphasis of such tests is on numerical scores or grades. When all teachers focus on is numerical grades, students tend to miss out on learning.

Suffice it to say, the type of assessment used by teachers affects the standard of students' work and achievement. In view of the foregoing, the relationship between assessments and student learning experiences and outcomes cannot, and must not be underestimated or taken for granted. This is why the author believes this study is not only timely, but also relevant. In Nigeria, many students spend years in school preparing for various certification exams in mathematics. Despite this, such exam results tend to leave much to be desired.

Worse still, the poor ethics of exam practices in some quarters is quite concerning, to say the least. Effective classroom assessment should subtly prepare learners for both external exams and the future. The implication of this is that the standard and pedigree of the assessment learners are made to savor goes a long way in setting the pace for the growths and developments (or otherwise) witnessed in a nation.

The truth is, any worthwhile assessment experience should by default raise students who display a sincere interest in learning without being cajoled or forced. Such students should also be able to shun exam malpractice in whatever form, and ultimately attain meritorious results in any certification exams. Moreover, they should be ready to contribute meaningfully to national development and be well-groomed for future education opportunities (Afemike & Omo-Egbekuse, 2011).

In simpler terms, teacher assessment practices should ordinarily engender better student learning, enhanced student academic achievement, positive attitude towards assessments and ultimately a strong foundation for further education and nation building. Therefore, when students witness prolonged struggles in their school work at any one level of their education, it is a good sign that there are lacunas in how they were assessed at earlier levels. Such struggles by students may serve as triggers for unwanted vices such as exam malpractice (Maeda, 2021), truancy, cultism and the likes. In some cases, it might even lead to instances of school dropouts. Effective assessment practices as administered by teachers do not only help to eliminate these vices, but also bring about improved student behavior in

general. Unfortunately, effective assessment practices are not the case in many parts of the world, Nigeria inclusive.

Therefore, there is an urgent need to identify and fill the gaps in teachers' assessment practices in order to increase students' academic achievement and also forestall the aforementioned vices across board. Furthermore, there is also a need to explore and exploit assessments that raise student confidence and enhance the degree of learning among students.

It is believed that formative assessment, when approached as a learning strategy, is able to yield not just considerable, but often dramatic advancements in the learning that students experience (Black et al., 2003). This perception of assessment resonates with the framework for both school based and external assessments in countries such as Finland where the rationale for all assessments is first and foremost to boost student confidence and learning (Hendrickson, 2012).

Teachers ought to identify and use assessment practices which are customized to meet the unique learning requirements of school children. The rampant style of assessment deployed in several Nigerian schools is the paper and pencil type of assessment commonly known as a test or exam. This framework is referred to as continuous assessment because it is supposed to monitor the student's progress throughout each school year. However, the sustained employment of tests and exams in many schools today has failed to provide sufficient room to enrich the learning process (Obiakor, 2023).

Teachers need to be more intentional about selecting assessment practices that work and which address the specific learning needs of school children based on their different personalities (Brookhart & Nitko, 2019). Such assessments must not be founded on a framework that treats every student the same way. In actual fact, assessment is really supposed to right the wrongs in each student's learning. Afterall, students' learning needs come in different shades and sizes. Effective assessments should not only seek to understand how students learn but should equally, and deliberately explore ways to cover each student's learning gaps or shortfalls. The use of continuous graded tests and exams by teachers for all

students is similar to a situation where a doctor attempts to treat all their patients with the same prescription.

The type of assessments teachers use largely depends on their ideologies and beliefs about assessments. Thus, the thinking and perceptions of teachers about assessment will need to change if the nature and forms of assessment they use must satisfy the exact learning requirements of the student.

Teachers need to be able to recognize assessment as a catalyst for learning enhancement and growth. They should not just view it as an instrument used only to rank students and fulfil statutory requirements. Additionally, teachers must reconsider the way they view and define assessment. First, they must change their views of learning because assessments should be tailored to students' learning strengths. The way teachers define learning will ultimately affect their assessment practices (James, 2006).

If teachers view learning as the main factor upon which assessments should be based, they are more likely to use more learning centered assessment practices. Unfortunately, some teachers' idea of assessment is that students must stress and compete very hard in tests and exams in order to outperform their classmates. Many teachers in this part of the world erroneously believe that heightening student anxiety and encouraging comparisons with higher-achieving peers will serve as a catalyst for improved learning outcomes among lower achieving students, seemingly motivating them to strive towards better learning outcomes (Chappuis & Stiggins, 2002) when instead, these teachers ought to build a caring and stimulating learning environment that focuses on individual progress, self-improvement, and intrinsic motivation. These values lead to more effective and sustainable learning outcomes.

In short, these teachers imagine that students must compete with their peers to pass graded tests and exams in order to succeed socially and academically. It therefore comes as no surprise that such teachers promote traditional assessment practices over more recent and innovative assessment approaches.

In early childhood education, assessment fulfills a pivotal role in preparing pupils for higher educational tiers such as secondary and tertiary levels of education. Pupils who

missed being assessed using effective methods of assessment in primary school are not unlikely to struggle with their school work as they progress through secondary and tertiary education. It would appear that many primary school teachers use a range of summative assessment methods without necessarily understanding the enduring consequences of such methods on students' learning and cognitive development (Korb, 2018; Raji et al., 2021).

In the author's view, this unselective or unintentional use of assessment practices may well be the reason for some students' dislike and phobia for certain subjects, including mathematics. It is also the rationale for these students' low attainment in the subject. It should be emphasized that the teaching, comprehension and evaluation of mathematics in schools, whether at the elementary or high school level, is crucial to the academic success of students as this subject is universally common to all.

Mathematics provides a foundation upon which students can build a secure learning experience as they rise through the various levels of education. It enhances student confidence as they approach higher levels in their educational journey. This is why governments and policy makers must do all to ensure there are no gaps in the delivery, receipt, and measurement of the subject right from the inception. Moreover, countries seeking to excel in all ramifications, must be willing to put a serious eye on the teaching, learning and assessment of mathematics as a subject (Mazana et al., 2020).

In simple terms, the instruction, learning, and assessment cycle for mathematics at all levels of education must be prioritized by all in any nation hoping to succeed in today's competitive world. Stakeholders including students, teachers, school administrators, researchers, policy makers, governments etc. must tirelessly work together to raise the bar in mathematics. As supported by Mazana et al (2020), science is the foundation of progress. Without scientific inquiry, we wouldn't have the innovative technologies that shape our world. And without these progresses, modernization as we know it would be non-existent (Mazana et al, 2020).

Mathematics is a core requirement in literarily all spheres of endeavour. It is absurd when students make petty statements such as 'I do not need mathematics' as this subject is critical to their success in virtually all other subject areas. Today, industries and fields

worldwide, including business, science, transportation, medicine, sports, military science, and information and communication technologies, depend heavily on scientific principles, which in turn are deeply founded in mathematical concepts and theories (Abuge, 2021).

Yet mathematics is one of the few subjects where students record their least performance in both school-based and external exams (Manzana, Montero & Casmir, 2020). There are huge gaps in the instruction, acquisition, and evaluation of mathematics and unless these gaps are identified and covered, this problem is not only likely to persist, but will also continue to undermine the overall growth and development of the countries concerned. Clearly, this is not just a national problem for the country. It also connotes a disaster waiting to happen if this trend is not urgently addressed.

It is noteworthy to mention that evidence abounds of a few studies which were carried out by researchers pertaining to the subpar mathematics performance of students, and the issues responsible for such poor learning outcomes, especially at the primary and secondary school levels (Adesoji & Yara, 2008; Maliki, Ngban & Ibu, 2017). However, data from studies relating the nature or type of teachers' assessment practices to students' performance in mathematics in Nigeria are quite uncommon.

Some of the reasons recognized as being responsible for students' discouraging outcomes in mathematics include (but extend beyond) the scarcity of qualified teaching professionals, insufficient equipment for the learning and teaching of mathematical skills, understaffing, undermotivated teachers, mathematics educators' weak subject knowledge, teachers' emotions in the classroom, poor examination environment, and shoddy preparation of the educators who are supposed to apply the curriculum (Mazana et al., 2020).

Considering all the factors raised thus far, there is a need to explore the impact certain methods of assessment are likely to have on students' performance in mathematics and the implications of this for Nigeria and other developing countries. This is the major basis for carrying out the present study. Across the globe, diverse assessment methods are employed to gather data that can inform decision-making in mathematics education. Such data cover

and address areas such as individual student needs, institutional improvement, and national policy reforms to mention but a few (Nortvedt & Buchholtz, 2018).

In view of this, it becomes important for policy makers, curriculum developers, decision makers in government and mathematics teachers in Nigeria to focus greater attention on how students are assessed, in addition to how they are taught. When teachers and other stakeholders in this clime focus on using the right types of assessment, examination results for students in school-administered and external tests are likely to become more encouraging.

Could it also be the case that applying specific types of assessment to certain mathematical concepts is likely to improve student understanding, and therefore achievement? Questions such as this one, and several similar ones would need to be explored through further studies so as to unravel the relationships between various types of assessment and students' achievement in mathematics.

But first, understanding the specific role of assessment in mathematics is paramount. It is believed that the most important function of assessment in mathematics is to produce data which can facilitate judgements that in turn lead to better learning outcomes in the subject (Nortvedt & Buchholtz, 2018). It means mathematics teachers should think along these lines when they use assessment in their work with students.

Therefore, this study is an attempt to study the various ways public primary school mathematics teachers in Abuja assess students in terms of their school work or learning. It means teachers must subject themselves to high levels of thinking in order to understand the assessment data so as to be able to make quality decisions that can impact on students' learning.

To right the records, this study highlights the need for assessment practices underpinned by several authors' work (Amua-Sekyi, 2016, Black & Wiliam, 1998, Guskey, 2003, Hendricks, 2012, James, 2003 etc.). For instance, the study believes that stakeholders need to focus their energies on supporting teachers to review their assessment approaches and the consequences of such approaches.

Furthermore, it suggests that teachers need to reevaluate the assessment strategies and techniques they employ in their work in order to ensure such assessment methods tally with the overall national targets and standards set for learning. As a matter of fact, when assessments are integrated into school teaching and learning frameworks, whether it be at primary or secondary school level, when assessments become the bottom line in schools' efforts to support students, the advantages derived from such frameworks have been shown to usually outweigh the disadvantages (Guskey, 2003).

The above comprehensive description of the use of assessment and its results provides the rationale and framework for this study. In simpler terms, although assessments play a crucial role in fostering good education, their true potential lies beyond mere ranking of schools and students. To uncover their power, we should guide teachers in transforming how they leverage assessment and its outcomes. By upgrading the standard of classroom assessments and aligning them with revised and standard learning goals, teachers can easily embed assessments in the learning and teaching cycle. The outcome of the forgoing? The uses and benefits of assessment extend lavishly to both students and educators.

What Guskey (2003) is suggesting is that when teachers give assessment its deserved place and attention in their work, the quality of students' learning would experience a notable shift for the better. One of the ways teachers can achieve this is to embed assessment in the instructional framework so as to maximise and fully reap its benefits. Assessment that is used merely as an add-on is unlikely to yield as much effective results as those built into the classroom teaching-learning framework. Studies show that formative assessment is not only embedded in the instructional process but also yields better learning outcomes compared to summative assessment (Yusron & Sudiyatno, 2021).

Formative assessment is not restricted to mere tests or quizzes conducted at the conclusion of a lesson or unit of work. It runs concurrently with learning and is embedded in the teaching process. The strong argument is made that when the process of assessment is intricately woven into the learning and teaching of mathematics in the classroom setting, teachers are better able to appreciate how students learn (Burtenshaw, 2023). This is so because genuine assessment is not only diagnostic, but also utilizes feedback to track

students' learning history and patterns. They are more likely to better appreciate students' understanding, or even their lack of such understanding (Gezer et al., 2021).

As a way of reexamining their views about the nature or types of assessment they deploy in their work with pupils, public primary school mathematics teachers can begin to explore how formative assessment can raise learning outcomes and achievement in the subject. In addition, it is important to mention the fact that there is a myriad of practices in educational assessment yet to be explored by most teachers and schools (Sewagegn, 2019). Making the most of any of these strategies would require proper training and orientation for teachers. The implication of this statement is that teachers sometimes use assessments inappropriately in their work with children. Such misuses are likely to lead to poor learning and ultimately, poor outcomes in mathematics.

The idea of *appropriate assessment* methods is a situation where assessment practices lead to the students' academic growth, leading to better overall learning results and grades. In Korb's view (Korb, 2018), the proper use of appropriate assessments tends to enrich learning experience better than the popular traditional assessment methods. Needless stating that mathematics teachers must first strive to understand formative assessment practices before ever they can successfully implement them in their work with children. Little wonder why in Finland, the emphasis is on formative assessment (Halinen, 2018). Finland is one of the leading countries in the Organisation for Economic Cooperation and Development (OECD) organised Programme for International Student Assessment (PISA) series.

Therefore, the present study explores the workability of a formative assessment strategy which resonates with Finland's framework within a Nigerian context. If formative assessment is anything to go by, the efforts to solve the age long problem of low achievements associated with mathematics in Nigeria would definitely receive a notable boost. The good news is that educational systems are gradually opening up to the needed change in how assessment and other aspects of education are being handled or carried out in schools.

According to the UNESCO IIEP Learning Portal (n.d.), there is evidence of the underuse of formative assessment approaches in sub-Saharan Africa. Unfortunately, Nigeria is guilty as charged, because it forms a part of sub-Saharan Africa. It should be noted that in the present day, educational systems worldwide are striving to evolve beyond the practices of the early 20th century. Conventional teaching and learning approaches often focus on measuring individual student learning. They emphasise the recollection of memorized information or the resolution of predetermined problems within the context of particular areas of learning (Price et al., 2011). There is an urgent need to move away from these approaches to practices that are less close-ended and ultimately lead to unrestricted learning outcomes.

To conclude the background to this study, many primary school mathematics teachers predominantly view assessment from a summative perspective, focusing on grades and numerical scores (Sewagegn, 2019). While existing assessment practices have yielded above-average outcomes for high-achieving students, there remains significant room for improvement for lower-achieving students. However, the integration of formative assessment practices, such as the strategic use of feedback, has the potential to enhance academic achievements for all students, particularly those with lower abilities, suggesting a valuable avenue for improving assessment approaches in primary school mathematics education (Goodburn et al, 2010).

Building on the existing literature, this study is unique in its focus on the intersection of formative assessment practices and student outcomes in primary school mathematics education. By examining the potential of constructive feedback to support low-ability students, this research aims to provide insights into how teachers can create more inclusive and effective assessment environments.

This study's findings will contribute to addressing the assessment gaps identified in the literature, including the over-reliance on summative assessments, insufficient teacher training, and marginalization of low-ability students, ultimately informing policy and practice in primary school mathematics education.

1.1 Statement of the problem

This study attempts to address the persistent poor performances posted by several students both in school-based and external exams in mathematics, through the use of effective classroom assessments. Evidence from previous but recent studies suggests that students have a tendency of either failing mathematics exams or performing poorly in them due to a myriad of reasons (Brookhart & Nitko, 2019; Maliki et al., 2017; Mazana et al., 2020). Some of these reasons include poor teaching skills, phobia for mathematics, poor assessment practices, poor student attitude to the learning of mathematics etc.

But alongside the failures itemized are also various other challenges such as the increasing wave of examination malpractice (Maeda, 2021) and the risk of nurturing a science- and technology-stunted economy (Abuge, 2021; Mazana et al., 2020). Moreover, there is also the challenge of students being unprepared for higher levels of education since proficiency in mathematics is essential for excelling in STEM fields (science, technology, engineering, and mathematics), as it provides the foundational skills necessary for creativity and problem-solving in these disciplines, ultimately preparing the next generation of professionals to drive technological advancements (Mazana et al., 2020).

Having mentioned the above challenges, it is good to note that not all the problems associated with poor assessment learning outcomes are teacher related. Some are indeed student related. For instance, gender, socio-economic context, prior ability, attitudes, aspirations, and cultural practices are all student related factors which influence student achievement in assessments (Adesoji & Yara, 2008). Suffice it to say, whether teacher or student related, there are problems associated with the assessment practices of teachers (Sewagegn, 2019).

The challenges associated with weak assessments in mathematics define a national problem (Benebo-Solomon & Abaver, 2024; Obiakor, 2023). The consequence of poor mathematics results is ultimately a failed state waiting to happen, since these challenges pose serious threats to the development and sovereignty of Nigeria as a nation. Therefore, there is an urgent need to address these challenges in order to mitigate the decline already being experienced in the country's economy.

In terms of significance, this study highlights the need to provide comprehensive training for both in-service and pre-service mathematics teachers in the area of assessment and its associated practices. The study suggests the need to reevaluate and strengthen policies related to alternative assessment practices in mathematics. The findings from this study have implications for the development of essential skills among all students, particularly the low ability ones, especially in the areas of mathematical and critical thinking.

The curriculum developers in mathematics can also leverage the findings of this study with regards to paying greater attention to the assessment aspects of the curriculum. Moreover, this investigation offers researchers seeking to study teachers' assessment practices in Nigeria a rich resource from which they can draw insights. Finally, the study suggests how to enforce its findings in schools in Abuja and possibly Nigeria.

In terms of its potential theoretical contribution to assessment research, the study reinforces the constructivist and sociocultural theories of learning, which emphasise the role of social interactions, feedback, and scaffolding in facilitating learning. It encourages a shift in assessment practices, prioritising a blend of summative and formative approaches that foster student growth and development.

By examining how feedback influences student learning, this study provides insights into the mechanisms by which SCT operates in assessment contexts. It extends the constructivist and sociocultural theories of learning by demonstrating their applicability in assessment contexts. In other words, the study enriches our understanding of these theoretical frameworks.

Its potential contribution to social justice is such that the study has implications for educators and policymakers seeking to reduce achievement gaps and promote social justice, especially for lower-ability and/or underserved learners. Thus, the study contributes to the development of assessment strategies that promote equity and inclusion.

However, because the researcher is a mathematics teacher of many years, a possible major limitation of this study was the researcher's bias which could have posed significant threats to the study's validity and reliability. Hopefully, these threats have been mitigated

by acknowledging this bias, triangulating data collection/analysis and peer debriefing via the Research Degree Committee (RDC) meetings.

In many developed societies, using assessments to optimize pupil learning and academic achievements is not only common practice, but also an accepted classroom tradition in these parts of the world today (Abejehu, 2016; Halinen, 2018; Korb, 2018; Sewagegn, 2019). Almost all schools in Nigeria use assessment practices but the effectiveness and capacity of such practices to reasonably enhance learning and academic achievements need re-evaluation. The use of inadequate assessment practices by public primary school mathematics teachers creates gaps in their assessment practices, leaving room for so much improvement (Black & William, 1998; Chappuis & Stiggins, 2002; Hendrickson, 2012).

Such gaps in turn breed poor learning and academic achievement on the part of students. Thus, this study is an attempt to fill the gaps in the assessment practices of the public primary school mathematics teachers in Abuja, Nigeria by evaluating the views of such teachers and exploring the workability of a formative assessment strategy.

To investigate the research problem, the researcher has identified the following key areas of focus:

A lot of teachers are unfamiliar with the modus operandi of providing constructive feedback to students. Osiesi (2023) stresses the place and value of effective feedback, a key component of effective assessments, for improving the quality of teaching and learning. One of the goals of assessment in Nigeria's educational policy is the improvement of learning (FGN, 2014). In this context, assessment ought to drive or promote learning in classrooms. Therefore, when assessment does not contribute to learning, there is a problem. Among other factors, the use of effective feedback in the classroom has been shown to be capable of improving the quality of learning (Harrison et al., 2015; Osiesi, 2023).

Unfortunately, the focus on grades tends to mask or shadow any concerns for constructive feedback or improvement. Teachers tend to place emphasis on numerical grades which lack any meaningful instruction as per remedying misunderstood concepts. Unfortunately, while grades may inform students about their success or failure in an exam,

they are rather silent about how the students can make progress or improve in terms of taking their learning to higher levels (Assessment Reform Group, 1999).

As a result, Nigeria's assessment practices need to rise above and beyond mere celebration of grades by paying greater attention to enhancing conceptual understanding and learning outcomes – this is quite germane to the aspiration of this work. When teachers and students shift their emphasis away from grades and scores, focusing rather on the process of learning, the outcomes are likely to have far more reaching effects for all. There is therefore a need to build a strong feedback culture in Nigerian primary schools in order to bolster the standard of teaching and learning (Harrison et al, 2015).

Secondly, a substantial proportion of Nigerian primary school teachers of mathematics have misconceptions about the meaning and purpose of assessment. A wrong conception about assessment is likely to lead to faulty assessment practices. Assessment in simple terms refers to the steps taken in order to compile, understand, and use the data collected from diverse sources by both educators and learners, and activities to foster effective teaching and learning environments (Raji et al, 2021).

From the definition provided above, it is worthy of note that assessment practices are viewed as an instrument for academic enhancement. They are also conceived as an ongoing process rather than a one-off event that happens only at the culmination of academic instruction.

To Korb (2018), a sizable contingent of educators in Nigeria tend to believe that the principal emphasis of any assessment at the school level is to boost children's competitiveness in the tests or examinations written at the conclusion of a lesson module. Basically, they think their only job is to get students to score good grades after completing a course or subject, even if such students lack a proper understanding of the concepts covered.

This is why assessments are sometimes rife with cheating or malpractices. Maeda (2021) discusses exam cheating which sometimes involves teachers. The reason for exam malpractice and other exam vices is simply because teachers, including some primary school mathematics teachers have a wrong conception about the meaning and purpose of

assessment. Assessments are not just examinations and tests to be passed. They ought to serve as a platform for improved learning first and foremost (Sewagegn, 2019).

If teachers have misconceptions about assessment, they are unlikely to make the most of it. Such teachers think that assessments are mere tools for ranking and promoting students. This is far from the truth. No wonder Guskey (2003) advises education systems on the need to pay greater attention to getting teachers to rethink their approach to viewing and using assessment and assessment results. We really need to help them to focus more on improving the quality of their classroom assessments.

We must support teachers to orient their assessment practices with acceptable learning goals and norms (Guskey, 2003). The purpose of assessment ought to go beyond only measuring learning. It should also promote or improve learning. Rather than being implemented as a culminating activity in the classroom, assessment ought to be embedded in the instructional process. A major aspiration of the present study is to point out the true purpose of impactful assessments especially in primary school mathematics.

Thirdly, there is also the challenge of policy and policy implementation, especially with respect to assessment practices. The National Policy on Education (FGN, 2014) notes that the assessment process will encompass two major components – paper and pencil tests and diagnostic assessment for learning improvement. These represent summative and formative assessments respectively. In line with the national policy, the purpose of assessment is to obtain an accurate picture of the skills and knowledge of students studying in Nigeria, bolster the competitive edge of the beneficiaries of the country's academic framework in international circles, enhance the worthiness of teacher assessment practices in Nigeria, bring the lingering challenges of conventional assessment practices to an end, and ultimately raise the standard of learning (FGN, 2014). The question is, to what extent and in what manner are these policy items been implemented?

Of course, from the foregoing, the central goal of assessment in this clime is to measure the abilities of students such that they can compete favorably with their peers in other countries. It is noteworthy that not only does the policy recognize that there are lingering challenges in assessment, it also aims to address such challenges. But of course,

overcoming the problems of conventional assessment practices is almost impossible without relevant reforms or introducing new approaches to assessing students (Hopfenbeck, 2018).

Furthermore, the national policy presupposes that teachers will use a range of assessment practices which are summative and formative in nature in their work with students. However, this does not appear to be the present case in many classrooms in Nigeria based on the author's educational experience of nearly 3 decades. For instance, Nigeria uses a continuous assessment system which involves a minimum of two written tests and an end of term exam (Faleye & Adefisoye, 2015). The emphasis of this method of assessment is on generating grades at intervals in the course of a term which comprises about 3 months. Thus, CA (or Continuous Assessment) has largely been reduced to paper and pencil tests.

It is no longer news that several teachers view continuous assessment to mean testing or more preferably, ongoing testing (Faleye & Adefisoye, 2015). Furthermore, although the policy aims at accurately measuring the abilities of students, the majority of continuous assessment methods utilize pen-and-paper tests as their main evaluation tool. Such tests, more often than not promote competitive numerical grades offering little or no meaningful feedback in the process. They fail to serve as a basis for reflection and improvement (Darling-Hammond, 2010 as cited in Halinen, 2018).

Furthermore, for assessments to enhance both local and international competitiveness of the beneficiaries of the system of education in Nigerian, the purpose and workability of such assessments must be clear and achievable to all the stakeholders involved, especially curriculum developers, school leaders and of course teachers who bear the responsibility of implementing such assessments in the classroom. This will not only improve the quality of such assessments but also their integrity. Sadly, this does not seem to be the case of the national policy on assessments in Nigeria (FGN, 2014).

Finally, many teachers are largely unaware of alternative assessment methods which are even more likely to boost children's learning and academic performance (Korb, 2018, Sewagegn, 2019). They continue to assess students' work without challenging the status quo or reviewing existing methods. Apart from raising learning outcomes, formative

assessment is able to improve students' critical thinking, problem solving and creativity skills which are all essential requirements for the 21st century world.

Research suggests that the use of summative teaching and assessment approaches alone undermine the development of these skills (Bhardwaj et al, 2025). Beyond academic measurement and improvement which are the order of the day, assessments ought to prepare students for real-world challenges and situations. This explains why the present study seeks to determine the viability of a formative assessment approach in public primary schools in Abuja.

1.2 Purpose of the study

The underlying basis of this mixed-methods investigation which is a single-phase design featuring both numeric and non-numeric data aspects, is to resolve the gaps in teachers' assessment practices by evaluating how public primary grade math teachers in Abuja, the capital of Nigeria, assess their students' learning, in order to check the effectiveness or otherwise of such assessment practices.

Put in a different way, the broad aim of the investigation was to measure the effectiveness or loopholes of the assessment practices in selected public primary schools in Abuja using mathematics as the basis for the research. By evaluating the effectiveness or weaknesses of the said practices, the study planned to identify and cover any gaps present therein by recommending judicious changes to teacher training, policy formulation, implementation and decision making in the area of assessment.

The reason for using mathematics as the basis for this study is because mathematics is an essential subject taken by all learners in both primary and high schools in Nigeria. Furthermore, mathematics serves as the entry point to other fields like science, technology and engineering (Manzana et al., 2020). Without it, it would be tasking to access these other fields of endeavour. Because assessment is essential for schools and teachers to inform their instruction and support student growth, an evaluation of the level of accomplishment in their assessment practices is likely to help identify and fill any potential gaps in their assessment competencies and understanding.

This study uses a mixture of qualitative and quantitative techniques to carry out its investigation. It used a survey for determining the demographic data and views of the participants about assessments. Semi-structured interviews were used for understanding why the mathematics teachers use certain assessment approaches.

1.3 Research aims and objectives

Generally, assessment should measure and promote student learning. When the purpose of assessment is well understood by teachers and properly applied in their work with pupils, learning and subsequent academic improvement are likely to be inevitable. By implementing well-designed and trustworthy assessment methods, educators can gain deeper insights into students' learning progress and challenges. When these assessments are paired with constructive, growth-oriented feedback, learners are better equipped to understand their own development and areas for improvement.

Therefore, this study hopes to arrive at findings which clarify the purpose of assessments, identify effective ways of using assessments, particularly, how assessments can inform and improve instructional strategies to promote better learning in mathematics. Assessment plays a vital role in enhancing learning outcomes. When applied effectively, it can spark students' interest in the learning process and help build their academic confidence, ultimately supporting steady progress and achievement.

On the contrary, a number of students have come to develop a natural aversion for schooling and learning in view of their apprehension towards graded tests. Current shifts in educational policy increasingly focus on reshaping assessment strategies to promote student confidence in learning. These changes aim to foster a mindset where learners feel motivated to engage with academic challenges. Such approaches help sustain effort and resilience throughout students' educational journey.

Today's teachers must focus more on using assessment practices which foster and stimulate students' learning. Such assessments are likely to raise student performance in both in-school and external exams ultimately. The use of effective assessment practices among other factors, contribute to addressing this challenge. No nation can rise above the level of its mathematical efficiency. Strengthening mathematical competence is a critical step toward national development and global competitiveness.

A significant link exists between teachers' views on learning and their approaches to assessment. As a result, the beliefs of teachers about learning are examined in this study, particularly in the light of how they affect their assessment practices. In other words, if one is able to understand how teachers perceive the meaning of learning, then it is possible to gain a level of knowledge about why they assess learning the way they do it. Thus, the premise guiding this inquiry is that if teachers' views on how assessment influences learning hold true, then enhanced academic performance and improved student outcomes will naturally follow.

Understanding teachers' views is essential, as these influence both teaching methods and assessment practices, which in turn affect how students learn. In addition to examining potential gaps in teachers' perceptions about assessment, this research also looks at potential gaps in mathematics teachers' assessment skills. For example, are there gaps in the teaching skills of elementary school mathematics instructors with respect to how they improve the quality of their own assessments whilst using a range of diverse types of assessment and analyzing students' assessment outcomes (Kitchen et al., 2019)?

Therefore, this research relies heavily on exploring the skills, views and thinking of mathematics teachers in Nigeria regarding assessment practices and learning. That's not all, the study also investigates other forms of assessment which mathematics teachers in Nigeria may not be aware of and the effectiveness or otherwise of such forms of assessments in promoting student learning and improvement.

Based on the foregoing, this study can be viewed from two broad perspectives. First, the research examines the views and beliefs of primary school mathematics teachers about assessment and learning with a view to covering any gaps in their beliefs and practices, and second, it evaluates the need for other assessment practices which are capable of producing superior learning outcomes for students of mathematics. Therefore, the following specific objectives are considered in the study.

- Explore the views of primary school mathematics teachers about assessment practices.
- Examine how effective the existing assessment strategies teachers use are in improving students' learning and academic achievement in mathematics.

- Evaluate the effect of formative assessment practices on learning outcomes in mathematics.

Ultimately, the study seeks to raise the standard of Mathematics educational practices in government owned primary schools and to build a stronger foundation for other disciplines such as science, technology and engineering in Nigeria. If gaps and misunderstandings in teacher views and assessment practices are filled in and corrected, teachers will do a better job of assessing students and helping them to learn better. This, in turn, would enhance students' engagement in STEM fields (science, technology, engineering, and mathematics), which are essential for cultivating innovative professionals and driving advancements in these critical areas (Mazana et al., 2020).

1.4 Nature and significance of the study

The methodology of the current research was instrumental in shaping its design selection. Research designs refer to the structured approaches used to collect, examine, interpret, and report data within a research study. The significance of selecting an appropriate design for research cannot be overstated. In this instance, the relevance of the investigative queries played a crucial part in determining the study design. As suggested in the literature, research questions offer valuable insights into selecting a research design that works (Wahyuni, 2012).

In this investigation, a triangulation approach was adopted to effectively tackle the research questions, which covered both numeric and non-numeric aspects of the phenomenon under investigation. However, research frameworks are influenced by research paradigms, hence this study is underpinned by a pragmatic paradigm. This paradigm places importance on identifying the most effective approaches to tackling the research problem. In the current research, a combination of numeric and non-numeric methods was deemed essential for achieving the research goals.

Over the course of the history of research, both statistical and thematic studies have evolved significantly and have been executed through diverse research methodologies. The objectives of this study and the characteristics of its research inquiries played a pivotal role

in determining the investigative framework, consequently influencing the investigation methods employed in the study.

Guided by the principles of pragmatism, this study emphasizes practical methodological choices while deliberately avoiding philosophical discussions about the nature of reality. In this wise, the so-called abstract values such as knowledge, reality and truth are not necessarily isolated from the specific beliefs, actions and experiences of the stakeholders which take place in a social context.

A methodology serves as a framework for conducting research, situated within the boundaries of a particular paradigm, providing a structured approach to investigation and analysis (Neuman, 2014). In other words, a methodology provides a structured model or framework for conducting research. It outlines the steps, procedures, and techniques that researchers should follow to investigate a particular topic or problem. Methodology operates within the context of a specific paradigm or theoretical perspective.

In summary, a methodology serves as a guide for conducting research within the framework of a particular paradigm, providing researchers with a systematic approach to gather data, analyze findings, and draw conclusions. A paradigm represents a group of accepted philosophies, assumptions, and values that shape how researchers understand and study the world. The pragmatic paradigm centers on practical research approaches aimed at addressing real-world challenges and finding workable solutions. It prioritizes outcomes that have tangible value, encouraging researchers to adopt methods that best serve the purpose of solving specific problems rather than adhering strictly to theoretical frameworks. From an inquiry standpoint of view, pragmatism lies somewhere in the continuum between post positivism and constructivism paradigms. This is because while constructivism supports the use of qualitative approaches, post positivism embraces the use of quantitative methods. Pragmatism spans a broad range of approaches, providing a flexible and adaptable framework for conducting research. This is why the present investigation takes up a combined methods arrangement, integrating features of both empirical and descriptive research methodologies.

A triangulation design involves a one-phase procedure where researchers implement both statistical and thematic methods in equal measure concurrently (Creswell et al., 2011). Triangulation designs are the most widespread variety of combined method designs. However, there are different forms of a triangulation design and it is important to select a design based on certain criteria. Researchers are advised to choose study designs by considering the specific advantages and limitations each one presents. In view of this, the convergence structure of the triangulation framework is implemented in the study under review.

Figure 1

Triangulation Design: Convergence Model
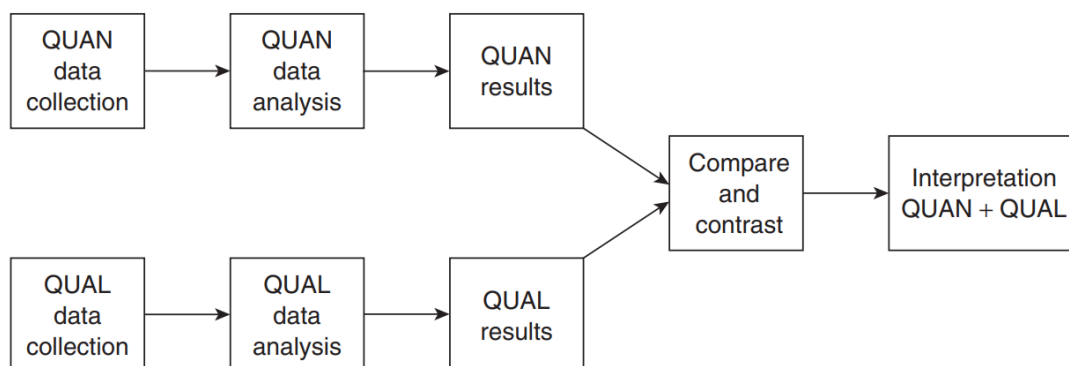
In the convergence model, data is gathered and analysed simultaneously using both quantitative and qualitative methods, aiming to validate or broaden quantitative findings through qualitative data (Creswell, 2006). A major strength of this model lies in the fact that both qualitative and quantitative tasks are carried out almost concurrently.

Regarding data collection, the methods employed in this research encompassed the use of questionnaires and semi-structured interviews. The questionnaire generated quantitative data, while the interviews produced qualitative insights. Numerical data from the questionnaire underwent statistical analysis, while non-numerical data from the interviews underwent thematic coding analysis.

The sample for this research comes from a population of primary school mathematics teachers in Abuja. Specifically, this sample was picked from 11 schools located in the

metropolis of Abuja. 115 primary school mathematics teachers completed and submitted their questionnaires. Nine teachers were however fully engaged for the interview.

Participants for the interviews were selected using purposive sampling, with careful consideration given to ensuring a representative sample. Thus, sampling took into account years of experience, qualification(s), course of study and registration with the Teachers Registration Council of Nigeria etc. Interviews have the potential to generate detailed insights that enhance and support the data gathered through questionnaires. The questionnaire data provided quantitative data for the research questions.

Research and data on assessment in education are essential, particularly regarding its efficacy in enhancing learning outcomes and academic performance. The importance of assessment, especially at a time when quality education for all is sacrosanct, cannot be overemphasised, especially in the developing world (UNESCO, 2020). Teachers, school administrators, policy makers and researchers must all combine efforts to promote and support appropriate assessment practices that meet the requirements for this ambitious goal i.e. the fourth sustainable development goal (SDG 4).

By using the appropriate assessment practices, mathematics teachers in primary schools can raise the caliber of student learning and academic achievement in mathematics, and hence provide a stronger foundation upon which other nation building disciplines such as engineering, science and technology, can be built. Students who face difficulties in mathematics frequently experience further challenges in subjects that rely on mathematical understanding, including science, engineering, and business disciplines, particularly as they advance in their education.

It is important for mathematics teachers most notably in early childhood education to help children develop their confidence in mathematics because their future and that of their country depend on it. Arguably, getting children to not only enjoy mathematics, but also excel in the subject at primary school level would require more than only teaching skills. This is particularly significant due to elevated failure rates observed in mathematics across primary and secondary education, notably in lower secondary schools.

Therefore, investigative studies are badly needed to bolster practices in this domain, especially concerning mathematics. Although assessment is widely studied, gaps remain in how teachers apply assessment strategies in practice. This highlights the need for continued exploration into how assessment methods are understood and implemented in everyday teaching. Therefore, the primary objective of this research is to help in covering up these gaps. Hence, the significance of this research can be attributed to the following factors:

It aids in bridging the gaps in assessment practices among primary school mathematics educators, aiming to offer recommendations on how to address these shortcomings. By reframing assessment not solely with the aim of measuring learning progress over time, but as a tool with broader purposes such as the improvement of learning, mathematics teachers can adopt a more informed perspective on assessment.

It will also help in addressing the wrong view that assessment serves only to evaluate students such that they can do well in public exams. The erroneous belief that assessments are meant for pushing students to score high grades is popular in many parts of Nigeria. Little wonder, some parents and teachers tend to focus only on grades and pay little or no attention to aspects of assessment such as the use of constructive feedback comments to drive deeper understanding of concepts. The present study hopes to correct this narrative.

Building on foundational ideas about assessment, this study offers deeper insight into its intended functions, moving beyond the limitations associated with ranking students. This is because studies have shown that effective assessments go beyond such levels of utility. For instance, assessment should concentrate mainly on enhancing the way students learn. This approach shifts the focus from grading to fostering deeper understanding and growth. This study hopes to present findings that address these misconceptions.

This study mentions other assessment practices which teachers may not be familiar with. There are other effective assessment tools that promote learning and academic achievement by raising the confidence of students. for example, the use of formative assessment strategies such as peer-assessment, self-assessment and feedback have proven to dramatically boost student academic performance and academic achievement.

Ultimately, effective learning is likely to lead to better grades, especially in national and regional exams such as the National Examination Council (NECO) and West African School Certificate (WASC) exams respectively. However, beyond better grades, a stronger foundation in mathematics also paves the way for a stronger economy because mathematics is a feeder to disciplines such as engineering, science, technology and business which are critical to any modern society.

Building on the preceding discussion, this study strongly addresses the need to provide comprehensive training for mathematics education professionals, both emerging and established, in the critical area of assessment and its associated practices. Such training would serve to broaden teachers' understanding of formative assessment practices, enabling them to harness the maximum impact of assessment on student learning outcomes and achieving optimal learning outcomes.

By equipping educators with enhanced training, they can be empowered to gain a more profound insight of the pivotal role assessment plays in fostering effective learning outcomes. This, in turn will provide the opportunity for teachers to:

- Develop a more nuanced appreciation of assessment's significance in informing instruction and promoting student growth
- Explore and implement innovative assessment strategies that embrace the diversity of learning needs
- Cultivate a growth mindset, recognizing assessment as a mechanism for continuous improvement instead of only measurement
- Create a more culturally responsive and inclusive learning setting, where assessment is leveraged to enhance student engagement and motivation etc.

Ultimately, this study advocates for a paradigm shift in teacher training, one that prioritizes assessment literacy and empowers educators to unlock the full potential of assessment in maximizing student academic achievements.

In addition, the findings of this investigation are strategically positioned to enlighten and influence the decision-making processes of policymakers, particularly in regards to

reevaluating and strengthening policies related to mathematics assessment. In this wise, this research aims to offer the following benefits:

– Inform policymakers about the requirement for a more in-depth and nuanced assessment policies that address the diverse needs of students

– Encourage policymakers to reassess existing policies and consider reviews that prioritise best practices in mathematics assessment

– Provide a foundation for crafting more effective and targeted policies that support teachers in implementing innovative assessment strategies

– Foster a policy environment that promotes a culture of continuous improvement, where assessment is valued as a mechanism for promoting exceptional learning activities

– Facilitate collaboration between policymakers, educators, and researchers to lay the groundwork for informed policy development through the latest research and best practices in mathematics assessment

The discoveries made in this research also have far-reaching connotations, for empowering students with vital skills and knowledge particularly in the realms of mathematical and critical thinking. By providing teachers with the skills and expertise to apply effective assessment strategies, this research enables students to cultivate a deeper comprehension of mathematical principles and the ability to build critical thinking skills. This, in turn, fosters a sense of confidence and competence among students, empowering them to tackle complex problems and think creatively.

Moreover, by prioritising the development of these skills, we can mitigate the risk of hindering the growth of a science- and technology-driven economy, which is critical for innovation, entrepreneurship, and sustainable development. Insufficient focus on mathematical reasoning and analytical thinking can lead to significant challenges, such as reduced global competitiveness and a decline in the availability of skilled experts in science, technology, engineering, and mathematics-related careers. By addressing this issue, this study contributes to creating a resilient and future-focused education system that empowers students for success in an increasingly complex and interconnected world.

Ultimately, the research findings presented here provide actionable intelligence for curriculum developers in mathematics, highlighting the importance of placing greater emphasis on the assessment aspects of the curriculum. Recognizing the pivotal role of assessment in influencing student learning outcomes, curriculum developers can adopt a more integrated approach to designing mathematics curricula. This involves not only covering fundamental content but also emphasizing effective assessment strategies.

By doing so, developers can create more comprehensive and balanced curricula that empower students with the necessary knowledge, skills, and competencies to excel in mathematics and other areas. Furthermore, a focus on assessment enables developers to tailor the mathematics curriculum to the needs of students, teachers, and the broader education system, ultimately fostering a more unified and effective learning environment.

Moreover, this investigation is significant as it offers researchers, particularly those seeking to study teachers' assessment practices in Nigeria a rich resource from which they can draw insights with which to do justice to their research.

1.5 Research questions

Research questions can provide access to designing and executing a successful research project, as suggested by Robson (2011). This study views research questions through the lens offered by Bouchrika (2020). A research question is formulated by a study or research project to address a specific issue or problem (Bouchrika, 2020). By leveraging data analysis and interpretation, the study is able to provide an answer to this question, which is then presented in the final analysis. Guided by this understanding, the research questions for this study were deliberately chosen and refined to ensure alignment with the research problem and purpose.

Notably, the initial research questions posed at the outset of this study underwent refinement as the thesis progressed, ultimately taking shape in their current form. Of course, such *evolutions* in research questions are common throughout the research process, particularly in flexible designs such as this one (Robson, 2011). Research questions ought to serve as the pivot or fulcrum in a research project and should be treated as such if the project must succeed. At the outset of this investigation, the researcher adopted a

perspective that emphasized the vital role of carefully formulated research questions in advancing the project's planning and methodology (Bell, 2010).

Indeed, the research inquiries in this study contributed immensely to advancing the project. The following reasons underpin the criticality of the research or inquiry questions considered in this research to the present study:

Research questions, particularly in studies involving both quantitative and qualitative play a crucial role in determining design aspects such as sample size, data collection tools and methods of analysis among others (Farrugia et. al, 2010; Robson, 2011). Figure 2 illustrates the role of research questions in designing the present research project.

Apart from helping to dictate the research design, the research questions in the current investigation also provided direction for the project. In other words, the questions prevented the study from derailing from the primary aim of the investigation. According to Ahlstrom and Wang (2020), research questions serve as a guiding framework, preventing topic drift and maintaining focus throughout the investigation. Thus, the research questions helped the author to stay on course throughout the study.

Each of the research questions aligns with the main goal of this investigation which includes evaluating the views of teachers on assessment and assessment practices (through descriptive statistics obtained from quantitative data) and exploring the effectiveness or otherwise of traditional assessment vs formative assessment practices (in terms of how these improve student learning outcomes).

The Research Questions in the present study provide a platform for achieving change in the way primary school mathematics teachers view and carry out assessments. Hence a major part of the findings from this study points to potential changes or at least improvements (Robson, 2011) in the way assessment practices should be conducted by primary school mathematics teachers. Such changes would of course have far-reaching recommendations for policy development and implementation.

Finally, the inquiry questions in the current research helped in addressing the theme and the research problem. It must be pointed out that developing a research question refines a broad topic into a focused area of investigation, providing clarity and direction

(Bouchrika, 2020). Generating the inquiry questions in the present investigation commenced with first, a central question that served as a basis for crafting the specific foundational research questions that informed the investigation. This feeder question was posed as follows: *Can the nature or type of assessment practices improve the quality of teaching and learning?* Building on the overarching research question, the following specific queries were formulated:

Q1. What are the views of primary school mathematics teachers about assessment practices?

Q2. How effective are the existing assessment strategies teachers use, in improving students' learning and academic achievement in mathematics?

Q3. What is the effect of formative assessment practices on learning outcomes in mathematics?

Having generated the above research questions, the next step was to determine how best to gather the data which would in turn provide answers to the questions. The specific research questions and a summary of the data collection strategies associated with them, are presented below:

Research Question 1 – What are the views of primary school mathematics teachers about assessment practices?

The purpose of this question is to gather insights into views and opinions of primary school mathematics teachers on assessment.

Research Question 2 - How effective are the existing assessment strategies teachers use, in improving students' learning and academic achievement in mathematics?

This question undertook to evaluate the success or otherwise of commonly implemented assessment strategies in improving student learning outcomes in mathematics.

Research Question 3 - What is the effect of formative assessment practices on learning outcomes in mathematics?

This question explored the effectiveness or otherwise of a formative assessment strategy in improving student learning outcomes in mathematics.

Data from the questions posed above were collected through questionnaires and semi-structured interviews. Furthermore, questionnaire data was studied through statistical analysis while interview data were tackled through thematic analysis.

Therefore, this study aligns with Robson's (2011) view, which suggests that research questions arise from the research purpose and conceptual framework of a study. In this case, the research questions stem mainly from the descriptive and exploratory nature of the present study. Research Question 1 aims to describe teachers views and perceptions about assessments while Research Questions 2 and 3 aim to explain the relationship between assessment practices and student learning outcomes, and the impact of a formative assessment strategy on student learning. The conceptual framework in this study gave rise to the feeder or generalised question from which the more specific research questions were subsequently crafted. In turn, the research questions helped to identify the research methods and the sampling strategy of the study (Figure 2).

Figure 2

The Role of Research Questions in a Research Design
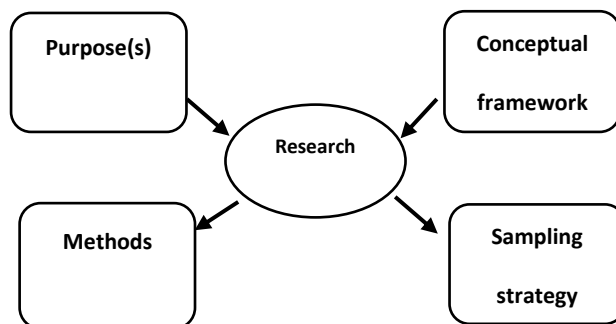
Consequently, the research questions led to the selection of a mixed-methods research design, which combined quantitative and qualitative data collection and analysis methods. They also helped in determining a sampling strategy for the study, a purposive sampling strategy in this case. The researcher selected the research subjects in alignment with the study's overall purpose.

Following Robson (2011), the research questions in this study adhere to key characteristics: they are clearly defined, effectively convey the study's objectives, are answerable with available data, are meaningful and relevant, and are logically sequenced to ensure coherence and focus.

1.6 Scope of the study

Regarding scope and boundaries, this study aims to investigate the assessment practices of public primary school mathematics teachers' and how such practices affect pupils' learning outcomes. The study excludes non-mathematics and non-primary school teachers, focuses only on teachers who teach mathematics to pupils in public primary schools and uses a mixed methods approach with a quantitative sample size of 115 participants and a qualitative sample size of 9 participants. The research only examines the effect of summative and formative assessment strategies on pupils' learning and learning outcomes. It does not bother about how other factors outside these areas affect learning outcomes.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

The main purpose of this study is to analyze the assessment practices of public primary school mathematics teachers and the impact of such practices on student learning outcomes. The study was carried out in Abuja, the capital of Nigeria. The idea is to be able to evaluate the effectiveness or otherwise of the assessment practices with a view to filling up any gaps in them. On account of this, this literature review chapter attempts to address central challenges connected to the stated objective. A major mantra in this study is that teachers can improve student learning and achievement by viewing and using educational assessments correctly.

There is a learning crisis in Nigeria (UNESCO IICBA, 2024). Mathematics education in public primary schools in Nigeria, faces several challenges that impact students' academic achievement. Some of the challenges faced by mathematics education in Nigeria include inadequate teacher training (John & Aliyu, 2024), teacher shortages (Okon, 2018), assessment issues (Harrison et al, 2015) and limited resources for teaching and learning (Benebo-Solomon & Abaver, 2024) etc.

Nonetheless, the government introduced various reforms in a bid to remedy the aforementioned crisis. For example, the 2014 introduction and implementation of curriculum reforms aimed at improving mathematics education through the Nigerian Educational Research and Development Council (Igbokwe, 2015). The upgraded curriculum was designed to promote critical thinking and problem-solving skills. The formulation of the National Digital Learning Policy in May 2023 is yet another reform aimed at addressing the learning crisis. This policy aims to adapt best practices in technology-aided pedagogies to improve learning outcomes for students (FME, 2023). The policy is part of the government's efforts to integrate technology into teaching and learning thereby closing the learning gap in Nigeria.

The purpose of this literature review is to examine the current state of knowledge on the impact of teacher assessment practices on student learning outcomes in public primary school mathematics education. The scope of this review includes empirical studies focusing

on teachers' assessment practices in mathematics education, especially in primary and secondary schools. This review aims to identify gaps in existing research and inform the development of effective assessment practices.

The review begins with a look at the theoretical frameworks which underpin the present study, followed by an examination of the historical background of assessments. Next, the review takes a detailed look at the concepts of assessment and learning and the relationship between both. This is followed by a review on summative and formative assessments. Next, the chapter examines the perceptions of assessment, first by teachers and then by students. This chapter also reviews the most prevalent and current assessment practices used in schools at home and abroad.

The discussion on the most prevalent assessment practices in Nigerian schools is complemented by a thorough examination of the existing body of relevant knowledge on the assessment practices in other countries apart from Nigeria, especially countries where children write the PISA (Program for International Student Assessment) exam. For example, the assessment practices of Finnish mathematics teachers were discussed. It is noteworthy to state that Finland has topped the PISA rankings for decades (Halinen, 2018; Hendricks, 2012).

Given the chief emphasis on public primary school mathematics teachers' assessment practices, many of the referenced articles derive from studies conducted in comparable educational settings. Nonetheless, some citations are drawn from research conducted in secondary and tertiary institutions. This was done in order to correlate cross-sectional and longitudinal views. One of the benefits of taking this review beyond the primary school setting is based on the belief that assessment issues are not limited to just primary schools alone – they extend to secondary and tertiary institutions too. The implication of this discovery is that it provides an area of focus for possible future studies, particularly in the area of assessments.

In writing this literature review, several peer reviewed articles were accessed and read. Most of the articles were found using UNICAF search engines, Google Scholar and through direct referral from the researcher's supervisors. Library databases accessed include

Research Gate, Science Direct, Sage, Educational Resource Information Centre (ERIC), SEAHI Publications and UNICAF library databases.

The search criteria used in finding the articles accessed include typing words or phrases which include 'assessment', 'assessment practices', 'formative assessment', 'summative assessment', elementary school, secondary school etc. The search returned several results related to assessment in general. From the results, articles related directly to the present study were then selected and reviewed accordingly.

A significant portion of the reviewed articles were limited to those published within the last five years to ensure relevance and currency, reflecting contemporary research trends during the preparation of this research. Of course, a few articles extend beyond this timeframe, with certain concepts having roots in earlier literature. For example, seminal works such as Black and Wiliam's (1998) groundbreaking study on formative assessment and James' (2006) exploration of assessment and theories of learning are foundational to the field. Black and Wiliam's publication, regarded as a cornerstone in formative assessment, boasts over 10,000 citations (Brandmo et al., 2020). This publication has earned a reputation as a globally respected authority on classroom assessment and learning, achieving a top-ten ranking among the most frequently accessed articles in a leading journal (Hopfenbeck, 2018). Therefore, it constitutes a key component of this study.

2.1 Theoretical frameworks

The theoretical framework serves as a guiding framework that integrates and informs every stage of the research process, including problem definition, literature review, methodology, data analysis, and conclusion (Adom et al., 2018). In other words, a sound theoretical framework is interconnected with every aspect of a research work. This segment of the research is crucial to the success or failure of the study. In a study, the theoretical framework comprises the underlying theories which underpin the research. The underlying theories do not only support the study; they also provide directions for the researcher.

Adom et al. (2018) believe that the incorporation of a theoretical framework facilitates researcher adherence to established theoretical paradigms, thereby enhancing the academic legitimacy and rigor of the contribution. This explains why a theoretical framework needs to be well grounded in the literature. In short, the theoretical framework

aims to present and explain the most relevant theories and models captured in previous studies by other researchers. It shows how your research is connected to previous theories and ideas in the area of study. The theoretical framework is rooted in a selected theory (or theories) that provide the theoretical underpinnings for comprehending and framing your research topic. Additionally, it incorporates pertinent concepts and definitions drawn from that theory (Grant & Osanloo, 2014).

Considering the aforementioned, the current study is rooted in a range of theoretical perspectives on learning, including behaviorist, cognitive, and sociocultural theories proposed by influential figures such as Noam Chomsky, Bruner, Jean Piaget, and Lev Vygotsky, among others. In short, the study draws upon theories of learning and the principles of assessment for learning (AfL), as delineated in the seminal work of Black and William (1998).

2.2 Theories of learning

The literature reveals a relationship between assessment and learning which underscores the fact that there is a connection between assessment and learning theories (Shepard et al., 2020). It means theories of learning have implications for assessment practices. Therefore, each assessment practice is underpinned by one or more learning theories.

There is a need for educators to draw upon this relationship in order to maximise the dividends of assessment. In a chapter which discusses the relationship between assessment practices and learning theories, James (2006) makes the point that Teachers need to have a shared understanding of what constitutes valuable learning outcomes and adapt their teaching and assessment methods to support student achievement of those outcomes.

In essence, teachers need to first understand the various models or theories of learning utilized by their students and subsequently align their teaching and assessment practices to these. A teacher's Comprehension of relevant theories of learning, and subsequent application of this understanding to their classroom practice will ultimately lead to unmatched learning outcomes.

But as long as teachers' views of how students learn are inadequate, their teaching and assessment practices are likely to remain inadequate. We cannot discuss the assessment practices of teachers in isolation from teaching and learning. Certain authors recognize classroom assessment as a vital ingredient in the teaching and learning process, essential for promoting student achievement, engagement, and academic success (Chappuis & Stiggins, 2002).

Theories of learning are frameworks which underscore how people view and respond to learning. Unfortunately, most teachers are largely unaware of these theories, let alone apply them in their work with students. Possessing a working knowledge of various educational theories can greatly affect the quality and effectiveness of teaching and learning, leading to more effective assessment practices that in turn, enhance academic achievement.

By understanding the intricacies of learning theories, educators can develop a more nuanced approach to assessment, moving beyond traditional methods and embracing a broader and more informed perspective on student learning and development. This allows teachers to pinpoint areas of difficulty for students and adapt their teaching strategies to meet individual needs, and create a more supportive learning environment. Consequently, students are better positioned to cultivate a more profound and lasting comprehension of the subject material, develop critical thinking skills, and achieve greater academic success.

Ultimately, a working knowledge of educational theories empowers educators to develop a learning environment that is responsive to the diverse needs of students, promoting inclusivity, engagement, and academic success which in turn fosters intellectual curiosity, creativity, and a lifelong love of learning. Based on this premise, James (2006) itemises three broad categories of learning theories. These include the constructivist, the behaviourist, and the sociocultural theories of learning. These three theories are examined one after the other in detail below.

2.2.1 Constructivist theories of learning

The constructivist theories of learning are based on the work of Noam Chomsky, Jerome Bruner (James, 2006) and Jean Piaget (Devi, 2019) among others. These perspectives emerge from a blend of philosophical influences, encompassing positivism,

rationalism, and humanism, which collectively shape their underlying principles and approaches (James, 2006). These theories assert that knowledge can and should be created or constructed, as opposed to being transferred from one person to another. Thus, the name 'constructivist'.

Going by Devi's (2019) lines of thought, constructivist learning supports students in developing a growth mindset and assuming responsibility for their academic progress, actively constructing knowledge and understanding through personal experiences. Departing from the traditional paradigm of teaching and learning, practitioners of the constructivist theories of learning do not view knowledge as a fixed body of ideas to be crammed or transferred from one person to another. Instead, they believe relevant knowledge ought to be created (James, 2006).

Constructivism is a learning theory that posits knowledge acquisition as an active, situated, and dynamic process, where individuals construct their own understanding through experience and social interaction (Shah, 2019). In other words, learning is never meant to happen passively but actively.

In the classroom, teachers who share this ideology use child-centered methods in their work with students. Usually, these students tend to participate more vigorously in classroom activities, especially those which involve learning and teaching. They usually become more proactive and invested in their own learning, taking greater initiative and responsibility.

Since students must construct new knowledge from prior knowledge and experiences, their minds are an important component for creating such knew experience. Indeed, constructivists contend that learners' minds are not empty vessels, but rather, they bring a wealth of prior experiences and cultural influences to the learning process, actively constructing new knowledge and understanding in context (Shah, 2019).

This is perhaps what makes the constructivist approach a rich method of learning because students with different ideas and experiences can create and exchange richer ideas. By adopting a facilitative role, the teacher in a constructivist classroom encourages students

to engage in collaborative problem-solving, critical thinking, and knowledge sharing, fostering a vibrant and inclusive learning community (Shah, 2019).

In a constructivist classroom, teachers facilitate students in cultivating new insights, and then connecting these insights and ideas with previous knowledge in order to solidify their learning. Hence teachers are facilitators of learning. The constructivist approach transforms the teacher's role in mathematics education, shifting from a traditional instructor to a facilitator or leader who guides and supports students in their active construction of mathematical knowledge and understanding (Vintere, 2018).

Thus, the teacher is a learning guide whose action supports the students to succeed in mathematics. Their role is not to spoon feed students, but to help them to become independent critical thinkers and problem solvers. In other words, through constructivist learning, students build upon prior knowledge, developing personalized understanding and rectifying misconceptions (Shah, 2019). The emphasis on previous or prior knowledge in a constructivist classroom cannot be overstressed in these theories. Learning only becomes possible and meaningful where there exists some prior knowledge to which new ideas can be connected.

According to Mary James, in these theories, learning is contingent upon active learner engagement and is shaped by internal cognitive processes (James, 2006). These theories specifically explore the interplay between the mind and the brain. A key aspect is how individuals construct meaning and organize information using mental models or schemas. As mentioned earlier, prior knowledge significantly impacts a student's ability to understand new material (James, 2006).

These theories naturally lean towards the principles of assessment for learning (AfL), which advocate for students to assume ownership or responsibility for their learning journey. Such AfL principles as peer- and self-assessment, linking to previous knowledge etc. are critical in a constructivist classroom.

Also prominent among the AfL principles is the use of constructive feedback which leads to notable learning gains among pupils. Multiple studies provide empirical research evidence that targeted interventions aimed at enhancing student feedback mechanisms can

lead to notable improvements in student learning and academic achievement (Black & Wiliam, 1998).

In recent times, neuroscientists have joined the constructivist community, contributing fresh perspectives to theories that gained momentum in the 1960s (James, 2006). There is an awakening to the fact that learning ought to be constructed by students, and not merely absorbed by them as was believed to be the case some decades ago (Akpinar & Ergin, 2020; Dökmecioğlu et al., 2020; Suhendi, 2018; Xu, 2019; Xu & Shi, 2018). This means rather than sit and simply absorb the *knowledge* the teacher imparts, the student should take responsibility for developing their own knowledge base using a combination of sources which include, information provided by the teacher, peers and/or other secondary sources.

Thomas (2023) asserts that constructivism repositions the learner as an active agent, rather than a passive recipient, in the learning process, fostering greater engagement, autonomy, and agency. This stance is also reiterated by Shah (2019). Unlike the traditional teacher-centered approach, the onus of constructing knowledge rests more on the student while the teacher serves as a facilitator. It is a fact that research grounded in constructivist learning theory indicates that learning is most successful when learners are actively involved, motivated, and invested in building their understanding (Rababah, 2021).

The major intent of the constructivist learning theory is the generation of *learning* which comes significantly from the student. When students participate in constructing their own learning or knowledge, they tend to perform better in tests and exams due to their deeper and personalized grasp of the subject matter. Instead of solely focusing on the outcome of class work or exercises, constructivists prioritize the entire teaching and learning process as much as possible.

Consequently, students devote more time to internalizing concepts by integrating existing knowledge with new insights. Rote memorization is discouraged within this approach to learning. Constructivism emphasises that the journey of learning, including the processes and experiences involved in acquiring new knowledge, is equally as valuable as the end result or outcome (Thomas, 2023).

Regarding constructivism, various assessment and evaluation methods are frequently employed in classrooms. These encompass formative assessment, alternative assessment, and authentic (or performance) assessment (Iofciu et al., 2012). It is crucial for this study to examine how the constructivist (and other learning theories) shape both assessment and assessment practices within the classroom setting.

In constructivism, the main goal of assessment is fundamentally to drive or foster learning. In other words, assessment should lead to better learning outcomes and student achievement ultimately. Specifically, the constructivist stance on assessment is more of formative than summative. Its goal is to improve the standard of scholarly learning and learning outcomes (Thomas, 2023). As if to underscore Thomas' (2023) views, James (2006) notes that several types of formative assessment are often related to the constructivist theoretical framework.

The constructivist theory of learning is premised on discoveries as it allows students to learn through making their own discoveries (Lessani et al., 2016). In a constructivist classroom, the teacher creates suitable environments which drive critical thinking and creativity. Therefore, the constructivist model is a learner centered approach. Ultimately, children become expert or self-directed learners through this learning experience (Lessani et al, 2016).

Furthermore, the following indicators are used to demonstrate the purpose of assessment from a constructivist point of view (Thomas, 2023):

- Assesses the learner's achievements.
- Evaluates the learner's process skills.
- Provides feedback to the learner.
- Utilizes feedback from the assessment process to guide further development.
- Assists teachers in planning and delivering tailored learning experiences based on individual learner needs.
- Diagnoses learner weaknesses and provides appropriate remedial learning opportunities.
- Evaluates the learner's creativity and problem-solving abilities.

- Monitors student progress and facilitates ongoing development.
- Promotes cognitive growth.
- Fosters social and emotional development in students.
- Enhances the development of the learner's psychomotor skills.

The indicators listed above suggest that constructivism positions assessment as a means to support and enrich the learning experience, rather than simply evaluate it, by providing feedback, identifying areas of weaknesses, promoting growth, and facilitating the development of various skills and aspects in learners. In short, the primary aim of assessment is to improve learning, and therefore raise students' learning outcomes.

In performance assessment which is one of the assessment approaches associated with a constructivist paradigm, mathematics teachers can observe and study how students attempt to solve problems rather than focusing only on testing knowledge and skills. Going by Rolfe's (2000) viewpoint, mathematics performance assessments employ authentic tasks, projects, or inquiries to evaluate students' mathematical literacy, problem-solving capacities, and communication skills (Rolfe, 2000). In this wise, the teachers should prioritise mastering students' behavior, building strong relationships with their students, listening to their concerns, and responding to their needs as they attempt to solve or navigate the challenge e.g. the methods the students choose to deploy and why this particular choice, how long it takes them to tackle the problem, body language etc.

The argument is that teachers who adopt this style of assessment are able to discover and address lapses in students understanding. Teachers who are adept at understanding their students' ways of thinking and responding to problems, based on observation, interviews etc. under relaxed conditions, can more easily track the students' areas of need and use their finding to shape the instructional process. In contrast, teachers who rely on formal testing to support students lack any concrete evidence base or information to rely on to better support student learning and success and modify their instruction.

It is imperative to note that performance assessments do not use tests or test scores to rank students. Instead, it uses tools such as observation, rubrics, interviews etc. to

determine what must be done to cover gaps in learning. Clearly, this kind of assessment is not common. Performance assessment is also known as authentic assessment. This type of assessment requires students to showcase their mastery of specific skills and competencies through meaningful, real-world applications, often in the form of oral or written presentations (Thomas, 2023).

Typically, an authentic or performance assessment presents a task for the learner to perform. The evaluation of their performance is done using a rubric, which is a table containing specific criteria for students' performance assigned to different levels of proficiency. The evaluation is not based on test scores or grades but on the processes involved in tackling the problem. Hence, performance or authentic assessment diverges from traditional testing methods. The emphasis is placed on the learning journey, rather than just the end result.

Central to this distinct approach to assessment is the aim for students to blend previous knowledge with new concepts and contents. Teachers who engage in authentic assessment practices have their beliefs rooted in the fact that assessments ought to go beyond mere test scores and grades, focusing more on prepping students for actual life conditions and scenarios (Shah, 2019).

Effective assessments do not focus solely on passing or scoring high grades in tests or examinations. Traditional multiple-choice and short-answer tests are no longer sufficient to fully capture students' mathematical achievements, progress, and proficiency levels, necessitating a more comprehensive approach to assessment (Rolfe, 2000). Grades, at most, offer surface-level insights into a student's learning capabilities, whereas performance assessment outcomes delve deeper into identifying the student's learning gaps. They also offer clues as to how these gaps can be addressed and closed.

The question then arises: Does constructivist teaching result in substantial student achievements compared to traditional mathematics instruction? No significant differences in student achievement have been found between those taught with constructivist methods and those taught with traditional mathematics approaches (Solso, 2009). However, it is also believed that the insignificant difference between the achievements of both groups of

students can be attributed to the poor experience of the teachers involved, especially in terms of teaching mathematics through a constructivist approach (Solso, 2009).

In a similar vein, another source expresses concerns about the correct implementation of a constructivist approach particularly in the studies which found insignificant differences in outcomes (Grady et al., 2012). For instance, regarding the studies, they note that no measures were implemented to facilitate the optimal and consistent deployment of the Everyday Mathematics curriculum across all grade levels.

Other factors that warrant consideration include the quality of professional development provided to teachers before, during, and after the initial implementation year, as well as ongoing annual follow-up professional development. Additionally, the crucial factor of teacher ownership is vital for successful execution of the Everyday Mathematics curriculum. Suffice it to say that unless teachers are committed to such programs, they won't succeed, no matter how seemingly innovative they may be.

They questioned the readiness of the teachers involved in the studies with respect to possessing the requisite training for implementing the constructivist approach effectively. They also questioned the willingness of some teachers to embrace the change imposed by the new approach. Nevertheless, other studies have refuted claims that the constructivist and traditional approaches present similar outcomes in terms of student achievements by affirming that mathematics teachers who apply a constructivist approach in their classroom practice record notable improvement (Grady et al., 2012; Rolfe, 2000).

These studies affirm that adopting a constructivist approach in the classroom achieves far better learning outcomes compared to the traditional teaching approach. For instance, Watkins and Montalvo (2012) report the fact that fourth-graders exposed to problem-centered math instruction outperformed traditionally taught students on standardized tests, demonstrating enhanced understanding and application skills.

This success could be attributed to students developing problem-solving skills based on their personal experiences or prior knowledge. This provides them with a stronger grasp of the mathematical concepts involved. Nevertheless, it is important to probe these opposing

claims further in other to address the argument between both constructivist and traditional approaches to teaching mathematics.

However, it is generally accepted that the primary impact of a constructivist approach on students' mathematical competence is that it prioritizes the development of students' personal mathematical ideas, encouraging them to utilize their own methods for problem-solving (Vintere, 2018).

Formative assessment employs various strategies such as peer-assessment, self-assessment, constructive feedback, and group discussions. These approaches prioritise the student as the central figure in the educational process. In peer-assessment, for example, students evaluate each other's work against a set standard, while in self-assessment, they evaluate their own work using the same criterion. In both scenarios, the teacher's responsibility is to ensure the evaluation process is conducted fairly and effectively.

Some of the tools used for assessment in a constructivist approach include concept maps, portfolios and rubrics (Thomas, 2023). Some assessment strategies in this approach are self-assessment, peer-assessment, projects, observations and journals (Thomas, 2023) among others.

One example of a constructivist learning theory is Jean Piaget's Theory of Cognitive Development. Piaget's theory proposes that learners construct their own knowledge by actively interacting with others and their environment. According to this theory, learners progress through four stages of cognitive development which include, Sensorimotor (0 – 2 years), Preoperational (2 – 7 years), Concrete Operational (7 – 11 years) and Formal Operational (11 years and above) stages. Piaget emphasizes that cognitive development occurs through an individual's active involvement in their own learning, highlighting the importance of self-formation and the creation of new schemas (Pakpahan & Saragih, 2022). It is noteworthy to mention that Black and Wiliam's (1998) foundational article aligns with Piaget's view that learning is most effective when instruction matches the learner's cognitive stage.

Furthermore, the mind develops through two main processes: organization and adaptation. Adaptation happens in two ways—assimilation and accommodation. When a

person learns something new, they either fit it into what they already know (assimilation) or change their existing ideas to include the new information (accommodation) (Piaget, 1936, as cited in Pakpahan & Saragih, 2022).

2.2.2 Behaviourist theories of learning

The behaviourist movement has received strong criticisms over the past few decades (especially from the proponents of constructivism). Therefore, it comes as no surprise that the theory of behaviourism has been under heavy attacks in terms of not being detailed or thorough enough when it discusses the concept and process of learning (Ng'andu et al., 2013).

Nonetheless, this approach to learning appears to have contributed substantially to much of what we have come to know in modern education today. According to research, the behaviourist theory has had a lasting and far-reaching impact on the field of learning theories, influencing the development of numerous other theories that build upon its foundational principles (Ng'andu et al., 2013).

Therefore, behaviourist theories are like the proverbial root from which other theories have inevitably sprung up. In fact, constructivism was birthed as a result of the criticisms meted to behaviourism.

The behaviourists believe that learners can be molded by their *environment* and that the *right environment* is necessary for learning to occur. The environment in this case may be physical or abstract. In a classroom, the physical environments may include the teacher, or the classroom itself, the furniture and how they are arranged, the lightings etc. whereas the abstract environment may include smell, ventilation, anxiety etc. These environments are responsible for stimulating or inhibiting learning as the case may be.

In other words, behaviourism is concerned with environmental influences (Muhajirah, 2020). Such environmental influences include the teacher, classroom setting, family dynamics etc. These also define the learning environment. The quality of the learning environment plays a critical role in determining students' educational outcomes, with a well-designed environment being essential for optimal learning and achievement (James, 2006). Thus, the environment of learning serves as a key factor that influences academic success

(James, 2006). The class, the arrangement of furniture, the teacher etc. determine to what extent learning will take place.

While this holds some level of truth, learning must not be totally dependent on external factors. In contrast to the behaviourist theory, the constructivist theories portray that learning is a function of the mind. Put in a different way, learning is generated from within the learner.

The behaviourist theories emanated from the works of Ivan Pavlov, John Watson, B.F. Skinner and Edward Thorndike (James, 2006) and Albert Bandura. The main thrust of these theories is that learning takes place in response to an external stimulus. Such learning then brings about an observable change in the behavior of the learner. To put this another way, learning cannot be said to have taken place without a corresponding change in behaviour. Such change in behavior is what behaviorist teachers try to measure through summative methods.

Behaviourist classrooms often feature a teacher-centered approach, where the instructor maintains significant control over the learning process. The onus of making learning take place rests squarely on this individual who plays an active role in the education process. The importance of the teacher's role is further accentuated by Skinner. According to Skinner, the utilization of operant conditioning in education is straightforward and clear-cut (Skinner, 1968 as cited in Ng'andu et al, 2013).

Teaching involves setting up reinforcement contingencies that guide students' learning process. While individuals naturally learn without formal instruction in their surroundings, teachers establish specific conditions that facilitate learning, accelerating the development of behaviors that might otherwise take longer to emerge or ensuring the manifestation of behaviors that might not occur otherwise (Ng'andu et al, 2013).

Therefore, the teacher is critical to bringing learning about in the classroom – the teacher is thus the first go to external factor in this context. In the behaviourist approach, learning is literally impossible without the teacher's presence and input. It is important to note that Skinner admits that although learning does occur without the teacher's input, the said input expedites learning when deployed through the arrangement of certain

contingencies which optimize the environment for learning. The teacher's role is seen as primarily focused on conditioning students to respond accurately and promptly to directives, emphasizing compliance and speed over critical thinking and creativity (James, 2006).

Unlike the constructivist paradigm, where the teacher's role is to stimulate and accelerate learning, rather than controlling it, the behaviorist paradigm views the teacher's role as going beyond that of a facilitator. In behaviorism, the teacher is seen as a key controller of the learning environment, designing and implementing specific contingencies and reinforcements to shape student behavior and ensure desired learning outcomes. There is a general consensus therefore that behaviourism is a teacher centered approach compared to constructivism which is student centered. The teacher uses or fosters the right stimulus or stimuli which in turn generate(s) appropriate responses or behaviours in the learners.

Therefore, the student is a passive individual in the behaviourist school of thought. His chief task is to grasp and understand the teacher's presentation of information, ideas and knowledge. Behaviourists view the learner's mind as a blank slate (tabula rasa), suggesting that their behavior is shaped solely by external factors, such as reinforcement, rather than by any innate thoughts, feelings, or experiences (Ahmad et al., 2020). The teacher as the all-knowing source helps to populate the learner's mind with ideas, skills and knowledge. Put differently, the teacher is the knowledge source who determines whether learning takes place and to what extent.

2.3 Some behaviourist theories

The behaviorist theories include classical conditioning, connectionism, and operant conditioning. These theories all favor a stimulus-response ideology, suggesting that behavior is shaped by external stimuli and reinforced through specific responses. Each theory provides insights into how environmental factors influence learning and behavior, and are discussed below.

2.3a Classical conditioning

Classical conditioning is the way in which behavior is taught through association. The theory of classical conditioning originated from the works of Ivan Pavlov, a Russian psychologist (Ng'andu et al, 2013). A number of authors have published their works on

classical conditioning (Ng'andu et al, 2013; Rehman et al, 2023; Vannak, 2012) as a behaviouristic theory. These authors offer their interesting perspectives about the theory of classical conditioning.

However, the work of Pavlov stands out among many of these publications (Rehman et al., 2023). Pavlov illustrated the concept of how a stimulus can evoke a particular response through his renowned experiment involving dogs, food, and a bell (Ng'andu et al., 2013). Based on the limits of this study, classical conditioning refers to the process wherein an automatic, conditioned response is linked with specific stimuli (Rehman et al., 2023). Subsequently, the conditioned response typically becomes elicited by the associated conditioned stimulus.

Pavlov's experiment

There are 4 important terms which are very critical to understanding Pavlov's experiment. These include unconditioned stimulus (US), unconditioned response (UR), conditioned stimulus (CS), and conditioned response (CR). Rehman et al (2023) discuss a fifth term Known as the 'neutral stimulus (NS) which is a stimulus that initially does not evoke any response. An unconditioned stimulus is usually a natural phenomenon. It is something that naturally and automatically triggers a response without any learning.

Examples of these include the smell of food, the smell of onion, a sudden blast or noise around you etc. An unconditioned response is a natural and unplanned response to an unconditioned stimulus. For instance, the smell of food (unconditioned stimulus) may naturally lead to hunger (unconditioned response). An unconditioned response does not need to be learned. It just happens naturally.

On the contrary, a conditioned stimulus is a stimulus which is intended to bring about a conditioned or specific learned response. In the classroom, these may include routine activities such as a fun math game, a favorite subject, a bell rung to indicate break time etc. A conditioned response is a response which is associated with a particular conditioned stimulus and which has been learned over time. In Pavlov's experiment, the response of the dogs to the sound of the bell is a conditioned response because the dogs have learnt to associate the bell sound to the likely arrival of their food and so they salivate. In classical

conditioning, the neutral stimulus eventually becomes the conditioned stimulus. In short, Pavlov's experiment can be described as follows:

> Before conditioning, ringing the bell caused no response from the dog. Placing food in front of the dogs enabled them to salivate. During conditioning, the bell was rung a few seconds before the dogs were presented with the food. After conditioning, the ringing of the bell alone produced salivation (Dembo, 1994 as cited in Ng'andu et al, 2013, p. 3).

In the classroom, teachers may take advantage of the Pavlovian theory of classical conditioning if they help students to learn by associating the learning with a conditioned stimulus. The chart below attempts to explain Pavlov's experiment further.

Figure 3

How Classical Conditioning Works (Mcleod, 2023)
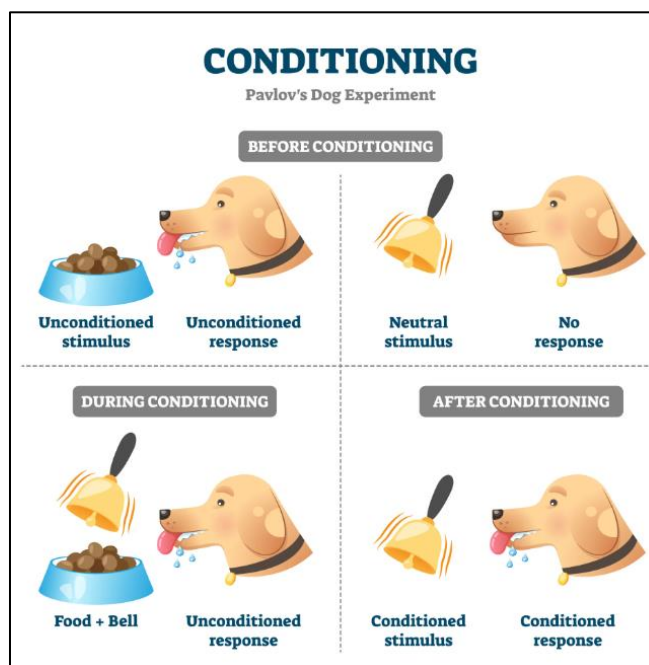
Furthermore, there are a number of phenomena associated with classical conditioning. These phenomena are listed below as follows:

– Acquisition: Acquisition is a fundamental concept in classical conditioning, a psychological phenomenon first demonstrated by Ivan Pavlov in his groundbreaking experiments with dogs. The process of acquisition unfolds when a neutral stimulus transforms into a conditioned stimulus, ultimately eliciting a conditioned response.

In Pavlov's renowned experiment, he systematically paired the ringing of a bell (initially a neutral stimulus) with the presentation of food (an unconditioned stimulus), leading the dogs to associate the bell with the impending meal. Over time, through repeated pairings, the bell alone came to evoke a salivary response in the dogs, even in the absence of the actual food. This transformation, where the neutral stimulus attains the power to elicit the conditioned response, exemplifies the concept of acquisition. In essence, it signifies the learned association between the previously neutral stimulus and the subsequent response, showcasing the adaptive nature of classical conditioning in shaping behavior and establishing connections between stimuli and responses in the realm of psychology.

- Extinction: It is very possible for a conditioned response to go extinct or to disappear. After a while, the triggered conditioned response made fade out without an unconditioned stimulus (despite the presence of the conditioned stimulus). This is known as extinction.

- Spontaneous recovery: Spontaneous recovery happens when an extinct response suddenly returns after a period of time. However, if the unconditioned stimulus is not associated with the conditioned stimulus again, the recovered response may soon go back into extinction.

- Stimulus generalization: This is the likelihood of similar conditioned response to trigger the same conditioned response (Sharanya, 2021).

- Stimulus discrimination: Sometimes, the subject is able to tell the difference between two or more conditioned responses. According to Sharanya,

> Discrimination is the ability to differentiate between a conditioned stimulus and other stimuli that have not been paired with an unconditioned stimulus. For example, if a bell tone were the conditioned stimulus, discrimination would involve being able to tell the difference between the bell tone and other similar sounds. Because the subject is able to distinguish between these stimuli, he or she will only respond when the conditioned stimulus is presented (Sharanya, 2021, p. 14).

The 5 principles described above underpin the theory of classical conditioning and Pavlov's work.

2.3b Connectionism

Connectionism, now recognized as an approach in artificial intelligence, cognitive psychology, cognitive science, and the philosophy of mind, involves modeling mental or behavioral phenomena through networks of simple units. It does not conform to the principles of behaviorism; however, it predates and has a substantial influence on the behaviourist school of thought. The idea represents psychology's first comprehensive theory of learning.

Connectionism as a learning theory originated from Edward Lee Thorndike (1874-1949). The theory of connectionism holds that all mental processes such as memory, perception, thinking, emotions, reasoning, imagination, recognition and grammatical competence, can be described as the reactions of acquired bonds between stimulus and response. It's a theory that proposes that all learning consists primarily of the strengthening of the relationship between the stimulus and the response (Taneja, 2017).

Put in another way, connectionism is a learning theory that explains learning as a result of connections between stimuli and responses. A stimulus is a specific occurrence that spurs action, and a response is a reaction. In connectionism, learning is often visible and apparent. In connectionism, learning happens when a connection is made between a stimulus and an appropriate or rewarding response through trial and error.

Thorndike's connectionism theory posits that learning occurs through the establishment of a direct link between a stimulus and a response, where the two become associated when a specific stimulus triggers a predictable response (Dembo, 1994 as cited in Ng'andu et al, 2013).

Thorndike's experiment

Thorndike conducted experiments with various animals, but his most famous one involved a hungry cat as the subject, a piece of fish as the reward, and a puzzle box as the apparatus for studying trial-and-error learning (Taneja, 2017).

Thorndike pioneered early laboratory investigations into animal intelligence, employing a puzzle-box scenario with a cat (Taneja, 2017). In this setup, the box's door was secured by a basic latch, while a tempting piece of fish sat just beyond the cage. Initially,

the cat explored the cage, detecting the fish and attempting to reach it unsuccessfully through the bars. After various attempts, the cat shifted its focus to the latch, eventually discovering that nudging it open allowed for an escape and access to the fish. Through repetitive trials, the cat refined its behavior, demonstrating a learned, efficient sequence of movements to open the latch.

Thorndike's theory posited that the cat acquired its escape strategy through a process of trial and error. This involved the cat engaging in various responses until it stumbled upon an effective action that freed it from the puzzle-box. Thus, Thorndike introduced the concept of Trial-and-Error learning to explain the observed behavior in the cats. In this case, the learning takes place only when the response is appropriate.

Thorndike, often regarded as a prominent figure in connectionism, encapsulated his thoughts on learning in three laws as follows (Ng'andu et al, 2013):

− Law of exercise: This law is also known as the law of repeated use or practice. It holds that stimuli-response (S-R) bonds are strengthened with repetition or frequent practice. Connectionists therefore encourage frequent practice, especially in subjects such as mathematics.

− Law of effect: The aftermath of a situation-response event has the potential to either enhance or diminish the link between the situation and the response. When an event is succeeded by a positive reinforcing stimulus, the connection is reinforced, and conversely, it weakens when followed by a negative outcome.

− Law of readiness: The process of learning is enhanced by the learner's readiness, encompassing emotional and motivational aspects. Failure to fulfill this learning potential can result in frustration. In the classroom, teachers can prime students for a main lesson by having them engage in revision activities or watch a video which provides a foundation on which the main lesson is built.

A critical take away from the above laws is that learning takes place when the bonds between stimulus and response are formed (Ng'andu et al, 2013) into patterns of behavior and these bonds are strengthened through repeated practice. Thus, behaviourist rely on regular drills or practice to get children to learn the material.

2.3c Operant conditioning

This behaviouristic theory of learning originated from B.F. Skinner (1904-1990), an American Psychologist. According to the theory, operant conditioning, also known as instrumental conditioning, is a learning theory that posits behavior is shaped by its outcomes or consequences (Mcleod, 2023). In essence, a behavior which leads to desirable outcomes is likely to be reinforced by such outcomes whereas a behavior which ends in unwanted outcomes is likely to be weakened by such outcomes. For instance, students who finish their tests with good grades are likely going to keep repeating the actions or behaviours that brought about those grades – this is an example of operant conditioning. Such actions may include, repeated practice tests. The good grades are the reward for this action or behavior.

Therefore, learning occurs through rewards and punishments for behavior. As a behaviouristic theory, operant conditioning is also based on the stimulus-response ideology. It is noteworthy to mention that operant conditioning functions on the premise that behavior or action may lead to either reinforcement, which increases the chance of that behavior to be repeated or punishment, which reduces the chance of the same behavior to be repeated in future (Ng'andu et al, 2013).

Skinner perceived his theory as an improvement over Pavlov's theory of classical conditioning. This was based on his reasoning that Pavlov's classical conditioning was rather too naïve to explain human behavior. In Skinner's mind, the best way to study and gain insight into behavior is by not only examining the conditions which brought about an action, but also the consequences of such an action. According to Skinner, this process is called operant conditioning (Mcleod, 2023).

In terms of alignment, Skinner's work tends to lean towards Thorndike's work on connectionism. Put differently, the foundation of Skinner's theory drew significant inspiration from the research of psychologist Edward Thorndike, whose formulation of the law of effect greatly impacted his thinking (Cherry, 2019). Skinner also listed three response types which can influence behavior as follows: neutral operant, reinforcers and punishers.

Skinner's experiment

Using a Skinner box (otherwise known as an operant conditioning chamber) which was similar to that used in Thorndike's experiment, Skinner studied operant conditioning using rats and pigeons. A Skinner box is an apparatus designed to precisely measure animal behavior over a condensed period, allowing researchers to reinforce or discourage specific actions, such as pressing a lever in rats or pecking a key in pigeons, through rewards or punishments (Mcleod, 2023). The levers or buttons in the box controlled whether food was released into it (reinforcement) or whether the rat received mild shockwaves (punishment). When the lab rat presses the blue button, it receives a food pellet as a reward, but when it presses the red button, it receives a mild electric shock. Through this process, the rat learns to associate the blue button with a positive outcome and the red button with a negative outcome, leading it to repeatedly press the blue button while avoiding the red button (Cherry, 2019). Thus, the outcomes of the behavior of the rat either reinforced or weakened such behavior.

Skinner thus demonstrated that learning takes place through rewards or punishments of behavior. It is noteworthy to state that like other behaviourists, Skinner also thought that it was not important to x-ray a person's mind or intentions in order to describe how people behave. Rather, we could focus on the outside factors responsible for human behavior. Such factors can be more easily viewed and observed (Cherry, 2019). This believe perfectly aligns with the behaviourist thinking that learning is a function of the learner's external environment.

Impact of behaviourist theories on (mathematics) assessment

In terms of how operant conditioning has influenced school mathematics and education in general, Skinner notes that teachers ought to create learning environments which reinforce and elicit desirable behaviours or discourage unwanted ones in students. According to Skinner,

> …the application of operant conditioning to education is simple and direct. Teaching is the arrangement of contingencies of reinforcement under which students learn. They learn without teaching in their natural environments, but teachers arrange

special contingences which expedite learning, hastening the appearance of behavior which would otherwise be acquired slowly or making sure of appearance of behavior which otherwise would never occur (Skinner, 1968 as cited in Ng'andu et al, 2013, p. 8).

Such contingencies then serve as a catalyst for learning and at the same time, a deterrent for unwanted behaviours. Therefore, this application can be viewed as a behavior modification intervention. Behavior is mostly modified through positive and negative reinforcers.

However, Eisenberg (1975) believes that a behaviouristic framework is more skill oriented and hence should be viewed more as a model for training as opposed to one for teaching. He argues that the behaviouristic model ought not to have been used in developing today's mathematics curricular because school mathematics as a subject is better off embedded within a teaching framework. He therefore calls for the complete reevaluation of the objectives of school mathematics.

In effect, Eisenberg's view questions how mathematics is taught and assessed in many modern classrooms. It also ratifies the belief that many mathematics teachers use a behaviourist approach to teach the subject as opposed to using other non-behaviourist methods such as constructivism.

Corroborating Eisenberg's stance, another source expresses concerns as to why stakeholders in school mathematics continue to hold on to behaviourist tendencies. The author in the aforementioned source reasons that the unwillingness to let go of behaviourist assessment ideologies may in fact be responsible for slowing down the advancement of school mathematics education and narrowing beliefs around success (Burtenshaw, 2023).

Slowing down the advancement of mathematics education is a polite way of describing the high failure rates that presently attend mathematics exams in many classrooms around the world. She concludes by noting that traditional behaviourist ideologies persist in shaping assessment beliefs, influencing mathematics education and promoting behaviourist practices in classrooms (Burtenshaw, 2023).

Lessani et al. (2016) lent their voice to the discussion on the nexus between behaviourism and the teaching and learning of mathematics. These authors view the

behaviourist classroom as a teacher dominated setting where the students think, talk and do less. Additionally, they related the phobia and anxiety which some students develop for the subject to how it is taught (Lessani et al, 2016). In the case of a behaviourist setting, the teacher depends mainly on drills and practice to get students to learn mathematical concepts. Thus, students have to follow prescribed steps presented by the teacher in order to learn. While drills and practice are crucial to learning, children also need to taught critical thinking and problem-solving skills in order to be able to tackle real life problems and create viable solutions to present day challenges.

2.4 Sociocultural theory of learning (SCT)

The main emphasis of this theory is that learning does not happen in isolation (Daneshfar & Moharami, 2018; Danish & Gresalfi, 2018; Newman, 2018). It requires some form of student interaction with their environment. The environment in this case could refer to the teacher, peers or the learner's physical surrounding. The work of Vygotsky is quite notable in this regard.

Language development, essential for thought, emerges through social interactions, making relationships a prerequisite for learning (James, 2006). Learning does not happen in isolation. The better such relationships, the stronger the bonds among the participants in the group. Put another way, social interactions are perceived as being critical to student learning. For instance, students working together in small groups to complete projects and assignments best exemplifies the SCT framework. This is because according to the Sociocultural model, such students get to learn from each other in the process of working together.

More importantly, the Sociocultural Theory (SCT) highlights the connections between social, cultural, and biological factors in shaping learning outcomes, emphasizing the pivotal role of socio-cultural contexts in shaping learning and human cognition (Rahmatirad, 2020).

Moreover, the concepts of zone of proximal development (ZPD), mediation and scaffolding (Pathan et al., 2018) are some of Vygotsky's prominent contributions to the sociocultural theory of learning. Worthy of further exploration is the connection between

ZPD and the sociocultural theory of learning. Perhaps, Vygotsky's Zone of Proximal Development (ZPD) validates the idea of cooperative learning and in effect, the sociocultural learning theory. According to Vygotsky,

> What we call the Zone of Proximal Development is the difference between a child's actual developmental level as determined by independent problem solving and the child's potential development level as determined through problem solving under adult guidance or in collaboration with more capable peers (Vygotsky, 1978, p.86).

In education, this means that ZPD is really the gap between what a child can do independently (without support) and what s/he can do with guidance or support. This support may come from an adult or a peer who is more knowledgeable in the concept being taught. Thus, cooperative or group learning provides a platform for less capable peers to collaborate or interact with their more knowledgeable counterparts in order to achieve more challenging learning goals.

Therefore, the Vygotskian model suggests that children are able to perform better when faced with more challenging tasks provided some level of guidance is offered to them from their more knowledgeable peers or teachers. The learning which takes place when children are guided often leads to their cognitive development.

This is illustrated in Figure 4 below, which shows three layers of cognitive ability namely, what the child is able to do independently, can only do with support and cannot do or attempt. This is why the sociocultural theory views learning as a collaborative and social process where students, teachers, and peers co-construct knowledge and understanding through shared interactions. (James, 2006).

Figure 4

Zone of Proximal Development
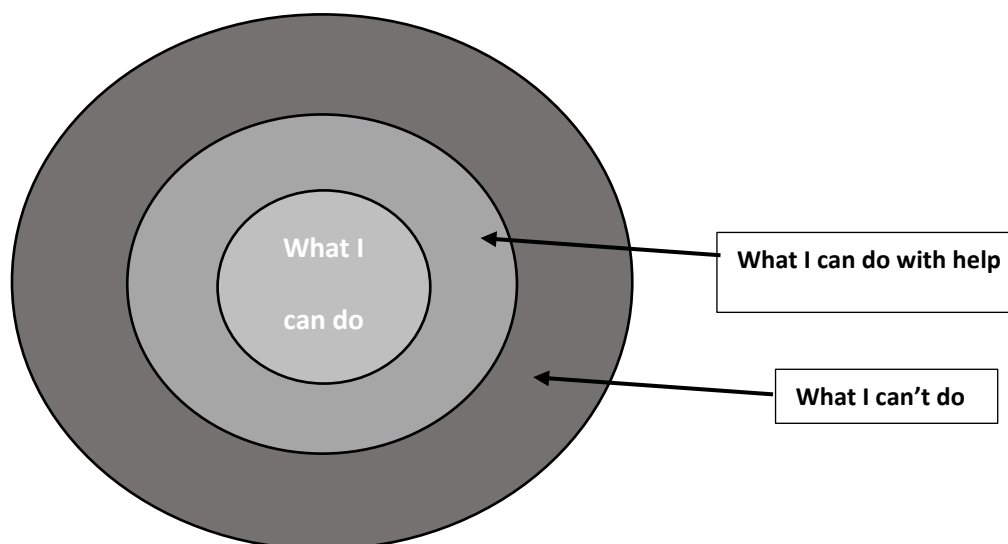
ZPD emphasises the interactions necessary for the cognitive development of children. It points to the gap between where the child is at and where they ought to be. It also portrays the importance of the novice – expert relationship (Rahmatirad, 2020) which ultimately guides and drives the novice to greater achievements. At the same time, the concept of ZPD demonstrates the importance of the role the adult plays in a child's cognitive development.

2.4.1 Impact of sociocultural learning theories on (mathematics) assessment

The sociocultural theories of learning have important implications for effective assessment practices. This is why the SCT framework is critical to the present study. For instance, some of the principles embedded in the sociocultural theory of learning share similar traits with those found in *formative assessment*, which are mainly geared towards closing gaps between present learning and intended learning through a variety of activities such as the use of collaborative (peer) activities. Without a doubt, the SCT teaching model encourages interactions and communications among students. Such communication is critical to the construction of meanings which in turn is a crucial requirement for understanding mathematical concepts (Steele, 2001).

To construct meaning, children will need to relate mathematical terms to their own layman's language and by so doing, they internalize such mathematical terms. This

internalization process is done under the supervision of a knowledgeable adult which could be a teacher or other students and it happens in the ZPD. The zone of proximal development refers to the learning space situated between a child's current level of understanding and their potential level of understanding (Vygotsky, 1978 as cited in Steele, 2001).

Thus, the knowledgeable other literally enters into the ZPD of the less knowledgeable child in order to facilitate the construction of mathematical meaning. From the author's personal experience while growing up as a student, one of the best ways to develop better mathematical skills is by working directly with someone who understands the concept better.

Willis (2009) attempts to paint a picture of what assessment might look like in a sociocultural context as can be glimpsed from Table 3. She compares this picture with what is obtainable in the behaviorist and constructivist settings using assessor metaphor, assessment task and requirements, assessment purpose, student motivation to achieve and success/failure as the criteria for her comparison.

Table 1

Assessment Across Theories of Learning

	Behaviourist	Constructivist	Sociocultural
Assessor metaphor	Fair Judge	Window into child's mind	Master participating with apprentices to check progress towards independence.
Assessment task and requirements	Controlled conditions, individual. Content validity. Often tests occurring at end of instruction.	Authentic problem solving. Central and powerful concepts. Can be a learning activity occurring anytime in unit.	Activities situated in authentic interactive contexts. Interactive, dynamic. Language and behavioural changes within an interaction (e.g. portfolio conversation) as an indicator of developing expertise.
Assessment purpose	Focus on outcomes, measurement, and differentiation of curriculum. Historically used for selection for high status occupations, maintaining social order and control	Helping students learn. Focus on process of learning not just outcomes. Identifying conceptions and misconceptions and depth, richness of understanding. Self-assessment central.	Opportunity to show themselves as active, independent learner. Use of tools & support to produce best performance to investigate the learner's strategies and processes, and how these can be enhanced. Measure degree of aid needed – Vygostky's ZPD
Student motivation to achieve	External motivation, reward and punishment, positive feedback.	Peers have privileged role as without social	Has an identity within a community. Learning apprentice.

		imperative, there is no cognitive conflict	
Success/failure	Can be attributed to beliefs of innate ability & fixed intelligence.	Property and responsibility of individuals.	Shared through interaction between teachers & students who can change contexts and tools if unsuccessful.

Each of the criteria used for comparison is briefly discussed below from a sociocultural standpoint of view.

 – Assessor metaphor: The assessor is viewed as a master whose intention is to ultimately raise independent learners. In other words, the assessor's intention is not to only judge or measure the student's learning but to promote his/her learning. This assessor is also the knowledgeable person who works with the learner in order to close the ZPD.

 – Assessment task and requirements: The set tasks in in an assessment are authentic, engaging and collaborative. Assessment is intentionally geared towards promoting learning and improvement. Thus, keen attention is invested into identifying evidence for such improvements. Furthermore, assessment activities are embedded into the teaching and learning process and not after it. This last view resonates with Eisenberg's (1975) and Burtenshaw's (2023) stance about embedding mathematics assessment within the instructional framework.

 – Purpose of assessment: Assessment aims at observing how well students develop as active and independent learners. It investigates the learner's critical thinking, creativity and problem-solving skills among other things. The emphasis of the assessments is not about testing or grades but on developmental learning.

 – Student motivation to achieve: Students are motivated by their zeal to carve a niche for themselves within a learning community by becoming worthy contributors to problem solving. Their motivation is intrinsic, not extrinsic. Whilst students may have little or no control over extrinsic factors, they certainly have sufficient control over intrinsic factors.

 – Success or failure: Success or failure is the collective responsibility of all the members of the learning community. Thus, the lower achievers are not left to wallow

alone in their *failure*. On the contrary, they are offered reliable support to close their ZPD gap.

In general, assessment within a sociocultural framework could mean investigating how well students are able achieve learning goals through group efforts. It means monitoring the development of the skills required to function effectively in a learning community. A case is also made for assessment through immersive cultural research (James, 2006). The aim of such an assessment would primarily be to gather the data needed to make informed decisions about closing any gaps within the ZPD.

Thus, this type of assessment focuses on authentic contexts which have implications for real life situations. This is not surprising considering the fact that this theory rests on the principle of learning through interactions with the environment. Relevant assessment tools here would include the use of portfolios and rubrics which lie well within the scope of alternative assessment practices.

However, there is no doubt that more studies would still be required to identify more assessment practices which align with the socio-cultural theory of learning. The implications of using assessment practices domiciled in the affective domain of Bloom's taxonomy of learning are also worth exploring in such future studies. Presently, the connections between the sociocultural learning theory and assessment are noticeable in group activities which involve project-based learning. Basically, the focus in such activities is on how well students exercise the hallmarks of agency which include autonomy, self-regulation, reflection etc. in terms of how they use intellectual, human and material resources or tools with which they are provided to engage problems, work productively and evaluate their efforts (James, 2006).

In summary, understanding of the sociocultural theories of learning will influence how teachers view and use assessment practices in the classroom. Teachers who are familiar with these theories will use assessment practices which give students autonomy, agency and greater control over their learning process.

Similarly, such teachers will also promote the use of sociocultural activities such as peer-assessment and group discussions to enhance the quality of learning under their watch.

The setting and sitting arrangement in socio-culturally inclined classrooms promote group activities and peer efforts. In short, the aim of assessment within the sociocultural paradigm is to promote the learner's progress towards achieving autonomy in their learning through a social process rather than a purely cognitive one.

2.5 Formative assessment

The concept of formative assessment is yet another principle that underpins the present study. As noted in Section 2.2.1, there is an important nexus between formative assessment and constructivist theories of learning such as Piaget's theory of cognitive development (Black & Wiliam, 1998).

Formative assessment is well documented in the literature (Elmahdi et al., 2018; Granberg et al., 2021; Ozan & Kincal, 2018; Xiao & Yang, 2019; Yan et al., 2021). The work of Black and Wiliam (1998) titled 'Assessment and Classroom Learning' particularly drew attention to this aspect of education since its epic publication several decades ago. The study which was a review of the literature on formative assessment was carried out against a background of the massive faith reposed in the ability of an improved assessment system to meaningfully impact and raise the quality of learning in the classroom (Black and Wiliam, 1998) in line with the conceptual framework of the present study.

These expressions of faith suggest that all was not well with assessment and learning at the time (and even presently). In other words, formative assessment was viewed as a sort of game changer which could turn the poor situation of assessment and learning around for the better. By implication, such improvements would also close the gaps in students' achievement in school-based and national exams. However, other studies have since continued to build on that all important review (Bhat & Bhat, 2019; Buyukkarci & Sahinkarakas, 2021: Hopfenbeck, 2018).

Formative assessment encompasses a range of strategies, formal and informal, to monitor student progress, identify areas for improvement, and adjust instruction accordingly (Bhat & Bhat, 2019). This implies that formative assessment comprises various techniques employed by teachers throughout a lesson to adapt teaching and learning methods with the goal of enhancing learning and student achievement.

The ultimate objective of formative assessment is to facilitate ongoing learning refinement, empowering students to take ownership of their academic development. Nevertheless, it's worth noting that Schildkamp et al. (2020) maintain that doubts still exist as per a universally agreed definition for the concept of formative assessment, although they acknowledge its value as a beneficial classroom practice for teachers.

This suggests that formative assessment encompasses a range of approaches adopted by classroom teachers throughout a lesson to adjust teaching and learning methods, aiming to enhance learning and student achievement. Therefore, the purpose of formative assessment goes beyond merely measuring learning; it actively seeks to promote and improve it.

Again, it's important to note that despite its recognized value as a beneficial classroom practice, there is still no unanimous agreement on the exact definition of formative assessment (Schildkamp et al., 2020). This contradicts the behaviourist approach where the interactions between the student and their teacher are quite minimal and formal.

In specific terms, Assessment for Learning (AfL) is an aspect of the practice of teachers and their students in the classroom where they gather information form dialogues, observations etc. in a bid to improve learning. The information gathered is on student learning and is useful in improving the same through constructive feedback. The information referred to in this definition is often compiled from various assessment strategies, including, but not limited to, traditional tests, peer evaluations, and teacher observations (Schildkamp et al, 2020).

Consequently, a range of assessment strategies are employed, including observational assessments, portfolio evaluations, practical exams, written tests, peer reviews, self-assessments, and verbal discussions. Contrary to assessment of learning, these forms of assessment are interactive which makes AfL practices also crucial to the sociocultural theory of learning.

The second aspect of formative assessment is data-based decision-making (DBDM). DBDM, or Data-Based Decision Making, involves leveraging specific data, including standardized assessment results, to foster academic excellence and promote deeper learning

(Schildkamp et al., 2020). As with all types of data, central to the effectiveness of the data collected on student learning is the ability of teachers to not only analyze such data but also to correctly interpret it. Unfortunately, many mathematics teachers are unfamiliar with ways to unlock the potential of data to optimize teaching practices and drive student success.

In another study however, some authors seem to believe that the term assessment for learning (AfL) is preferrable to formative assessment since AfL is heavier on descriptive feedback, possibly because of its association with data base decision making (DBDM) than formative assessment (Broadfoot et al. 1999 as cited in Brandmo et al., 2020). In DBDM, data is required for quality decision making and also for providing rich feedback.

The term 'formative' is inherently flexible and can encompass a range of meanings, often simply implying that assessments occur regularly and are embedded in the teaching process. However, such assessments may not inherently possess all the qualities conducive to facilitating learning. While they may aid teachers in pinpointing areas requiring additional explanation or practice, they might not offer students guidance on how to progress in their learning. Instead, marks or comments on their work might only inform them of their current level of success or failure, without offering insights into avenues for further progress in learning (Broadfoot et al, 1999 as cited in Brandmo et al., 2020, p. 320).

The usage of the term formative assessment or assessment for learning in this review therefore carries Broadfoot et al.'s connotation of assessment for learning. Notwithstanding, both terms are sometimes used interchangeably elsewhere and in the present study also.

2.5.1 Impact of formative assessment on (mathematics) education

It is also noteworthy to mention that there are claims that the correct use of formative assessment practices (as opposed to summative assessment practices) raises student achievement, an idea which if true, raises significant interest, especially with regards to the present study. Perhaps this is a major reason why Finland has continued to top the mathematics chart in the Programme for International Student Assessment (PISA) ranking for some time now.

Finland came either first or second place in mathematics in four of the previous tests conducted by the PISA with all the scores from the various participating schools falling

within a narrow bracket, which indicates that the performance gap in the Finnish students' tests scores is quite small (Hendrickson, 2012). The secret to this achievement is not unconnected to the use of Assessment for Learning (AfL). Finnish education pays a great deal of attention to the use of formative assessment and especially self-assessment in the classroom. The aim is to raise learners who can assess and monitor their own learning for the purpose of achieving better learning.

Therefore, teachers' assessment feedback to students is geared towards helping students to self-evaluate their own learning in order to facilitate improvement. Furthermore, assessment feedback enables learners to evaluate their performance, set goals, and reflect on their learning journey, fostering self-directed growth and improvement (Henrickson, 2012).

In a study aiming to assess the effectiveness of Assessment for Learning (AfL) in enriching both the standard of learning and learning outcomes in mathematics in elementary schools, the results of the statistical analysis showed a substantial difference in mean scores between the post-tests of the experimental and control groups. Specifically, the average score in the post-test for the experimental group was about 73%, compared to about 65% in the control group. This contrast indicates that the outcomes of learning with AfL differ significantly from those of traditional assessment methods, with AfL resulting in substantially higher average results (Yusron & Sudiyatno, 2021). Consequently, the study concludes by highlighting that incorporating Assessment for Learning (AfL) methods can foster improved learning outcomes and increased student success in mathematics compared to the implementation of traditional summative assessment strategies. This outcome underscores the potential impact of formative assessment on learning outcomes, particularly in primary schools.

Furthermore, in a study conducted in Khartoum comparing the scores of students instructed through summative assessment to those instructed using assessment for learning, the students taught with assessment for learning strategies achieved higher grades. This outcome also confirms the significant impact Assessment for Learning (AfL) has on student learning and achievement compared to assessment of learning or summative assessment (Umar & Majeed, 2018).

In another case study, the researchers sought to investigate how promoting reflection, resourcefulness, and resilience skills via a peer assessment task impacts the caliber of work generated. The results showed a notable enhancement in the quality of work after the implementation of the peer assessment activity (Goodburn et al., 2010). Moreover, it revealed that students with the lowest ability demonstrated the most notable degree of improvement (Goodburn et al, 2010).

Assessment for Learning is strengthened by peer assessment, where students engage in reciprocal evaluation and feedback using established criteria. Such criteria may be presented in the form of a rubric. Needless saying that, also critical to assessment for learning is the practice of providing active feedback to students about their learning.

Hattie and Timperley (2009 as cited in Schildkamp et al, 2020, p. 2) outline feedback as "information provided by an agent (e.g., teacher, peer, book, parent, self, experience) regarding aspects of one's performance or understanding". The bottom line for offering feedback is improvement.

Peer-assessment is different from self-assessment. In self-assessment, the student is given a voice and further autonomy and is allowed to make a substantial contribution in his/her own assessment process. Similarly, the teacher's critique and comments are used by the student to advance his/her understanding of taught concepts. This is why in developed worlds such as Canada, educational assessment policies now prioritise formative assessments, providing ongoing feedback to support student learning and inform instruction (Cheng et al., 2018).

Sharing learning goals is yet another important characteristic of assessment for learning (AfL) (Assessment Reform Group, 1999; Black & Wiliam, 1998; Yusron & Sudiyatno, 2021). The essence of doing this is to prepare and align the thinking of students toward the right direction. This approach empowers pupils to understand and internalize the expected standards, fostering a notion of direction and agency in their learning (Assessment Reform Group, 1999). Commencing lessons by sharing learning objectives, articulated in language tailored to children, and periodically revisiting them throughout the lesson, can establish a foundation for questioning and feedback during class discussions.

Teachers can then assess this feedback with regard to the attainment of the learning objectives, enabling them to make informed adjustments to forthcoming lessons. As with other subjects, previewing lessons objectives provides mathematics teachers an immense opportunity to provide rich and targeted feedback during and after the instructional process.

One of the beliefs which motivated the present study is that using the right assessment practices correctly can improve learning and raise the academic achievements of students in mathematics in both low- and high-stakes tests. Therefore, it follows that the gaps created by the absence of appropriate assessment practices can be filled simply by introducing such practices in the classroom and using them correctly. The assessment that will lead to any significant improvement in mathematics must be effective and done correctly.

As strongly advanced by Nortvedt and Bucholtz (2018), the primary goal of assessing mathematics is to *provide feedback* grounded in evidence in order to refine instructional practices and upgrade student success. Herein lies the rationale for using the selected theoretical frameworks as the baseline for the present study.

2.6 Social learning theory (SLT)

This theory was propounded by a psychologist known as Albert Bandura. According to Bandura, learning takes place through observation of what goes on around them and not only through conditioning as proposed by the behaviourists (Cherry, 2019). Put another way, learning takes place through observation, imitation, and modeling, and is shaped by factors such as attention, motivation, attitudes, and emotions. This theory elucidates how the interplay between environmental stimuli and cognitive processes influences the learning process.

In other words, learning is a function of both environmental and cognitive factors. The understanding of the social learning theory combines the attributes of both behaviourist and cognitive theories of learning. Behaviorism underscores a particular view of learning, focusing on altering external behavior through reinforcement and repetition, often linked with rote learning. In contrast, cognitive learning theory argues that comprehending different learning mechanisms necessitates the analysis of mental activities and processes.

Despite the above combination, Bandura views his theory as mainly cognitive and hence the name social cognitive theory. According to Bandura, learning is also a mental process. Bandura notes that there are 3 major concepts which underpin the social learning theory. These include learning through observation and learning through mental processes. The third concept is that not all learning leads to a change in behavior. To express it differently, people may learn without necessarily practicing or implementing what has been learnt.

Furthermore, Cherry (2022) notes that certain factors are critical to the success of the social learning theory. These include:

- Attention: Whether the learning is taking place through observation, modelling or imitation, learning will only effectively take place when the prospective learner is attentive.
- Retention: Learning needs to be retained in order for it to be effective.
- Reproduction: Learning should be applicable to new situations and possibilities. When learning is applied, it becomes easier to recall.
- Motivation: Learning is facilitated through some form of motivation. While behaviourists are motivated through external rewords such as praise and rewards, motivation in the social learning theory is largely intrinsic. This means it comes from within. Examples of intrinsic motivation include pride, a commitment to succeed etc.

2.6.1 Bandura's famous experiment

This pioneering experiment consisted of three groups of children and was conducted in 1961 (Hollis, 2019). Each of the groups was given the opportunity to witness the activities of an adult around a doll named Bobo Doll. The first group of children witnessed Bobo Doll being abused, beaten and battered by an adult with various aggressive tools.

The second group of children were made to see another adult who was non-aggressive with Bobo Doll. The third group of children also witnessed an adult being aggressive and mean to the doll. However, this adult got reprimanded by another adult for

being aggressive to the doll. Subsequently, the three groups of children were given the opportunity to play in a room containing Bobo Doll along with other toys.

The first group of children repeated the mean and aggressive behavior of the adult they had observed towards the doll. The second group of children exhibited no mean or aggressive behavior towards the doll. The third and final group of children also exhibited no mean or aggressive behavior towards Bobo Doll.

This experiment illustrates the impact of observation on behavior and learning. Bandura's research illustrated that children have a propensity to learn and emulate behaviors they observe in others (Cherry, 2022). It goes without saying that great teachers model great behaviours to their students.

2.6.1 Impact of the social learning theory on (mathematics) assessment

The social learning theory posits that individuals can develop understanding through deliberate observation, imitation, and modeling. This implies that students can enhance their learning by observing and imitating role models in various academic domains. In a study investigating the impact of mentorship and role modeling on students' learning and academic achievement, Ahn et al. (2020) conducted a literature review and presented an overview of research on role models in education.

It must be taken into account that learning through observation is anchored upon Bandura's 4 important components: attention, retention, reproduction and motivation (Ahn et al., 2020). These four important components are critical to whether observation culminates in learning or not. Bearing this idea in mind, it has been reported that the phenomenon of role modelling has resulted in significant improvement for students, especially in the areas of self-efficacy and achievement in certain quarters (Ahn et al., 2020).

One such study featured students reading about the successes and failures of famous scientists. In this study, high school students were presented with anecdotes focusing either on how renowned scientists overcame obstacles and achieved success, or anecdotes notably focusing on the scientists' accomplishments. The authors noted that students exposed to the initial anecdotes exhibited enhanced performance in science class compared to those who only read about the scientists' achievements.

In essence, observational learning, exemplified by modeling reinforcement (i.e., learning from observing others' successes achieved through perseverance and setbacks), boosted students' individual performance (Ahn et al., 2020). Therefore, teachers can use this aspect of the social learning theory to raise student achievement.

In another study, the level of confidence of some female students was studied. The aim was to determine the impact of motivation on level of confidence. According to the study, female students were instructed by professors of either gender. To assess confidence level, students indicated their anticipated course assessment score at the start and conclusion of the semester. Female students taught by female professors reported higher levels of confidence at both assessment points compared to those taught by male professors. Interestingly, the perceived affinity of female students with their female professors correlated with their elevated confidence level. Additionally, women instructed by female professors exhibited greater spontaneous participation in class discussions by the semester's end, such as responding to a greater number of professor-posed questions in comparison to students instructed by male professors (Ahn et al., 2020).

Based on the forgoing, the confidence levels of students can be raised when they feel adequately motivated to succeed. Educators and other stakeholders can leverage this line of thinking in educational and childcare contexts. In particular, a teacher's confidence level can play a significant role in challenging students to review and build their own self-confidence.

Another study which focused on Grade 5 pupils and their ability to learn mathematics used hypothesis testing to show an increase in student learning from about 17% to about 27%, and then to about 46% (Zain et al., 2021). However, this study does not identify any specific aspect of Bandura's work with respect to its findings.

Critics of the social learning theory question why the theory acknowledges the environment as the chief influencer of human behavior. They note that the relationship between nature (genetics, biology) and nurture (environment, experiences) interacts to shape behavior (Koutroubas & Galanakis, 2022).

2.7 Types of assessment

Given that this research focuses on appraising the assessment methods employed by primary school mathematics instructors, it becomes pertinent to examine the principal types of assessment practices outlined in existing literature. Depending on the type of assessment, each of these assessments has its unique purpose and role in education. The essence of this review is simply to present the various types of assessment used in education.

2.7.1 Summative assessment

Summative assessment or assessment of learning is assessment which measures how much learning has taken place. It is viewed as the traditional method of assessment because it is as old as education itself. Added to this, summative assessment has become an entrenched standard in the education system, widely accepted by students, parents, educators, and stakeholders (Obilor, 2018) and particularly in the mathematics classroom. Commonly, it is delivered through paper-and-pencil tests or exams at the culmination of a unit of study or a specified timeframe.

According to Obilor (2018), summative assessment aids teachers in attaining the following objectives:

a) Assessing the degree to which learners have attained their learning objectives.

b) Identifying both the capabilities and limitations of learners.

c) Gauging the effectiveness of instructional methods.

d) Inspiring learners to engage in further study.

e) Facilitating the selection, certification, and placement of learners.

f) Supplying feedback to learners, teachers, parents, and other involved parties.

Echoing the previous perspective, Amua-Sekyi (2016) characterizes summative assessment as an evaluation done at the culmination of a unit or module of school work to either evaluate program effectiveness or student progress or both. Usually manifested through graded exams or tests which could be in-house or external, this approach is commonly referred to as assessment of learning. Students frequently dedicate a substantial chunk of their class periods to perfect the knowledge and skills necessary for this assessment through drills and practice, ultimately mastering them through this process (Amua-Sekyi, 2016).

Put in a different way, this type of assessment does not seem to improve on the child's previous learning experience as its core emphasis is about passing examinations and tests, and not necessarily on learning. Substantiating this view, Barnes observes that the efficacy of summative assessment is questionable, as it often prioritizes measurement over meaningful learning outcomes (Barnes, 2007). Barnes believes that today's child ought to be educated using a cross-curricular approach because man's experience of the world itself is cross-curricular and everything around him could be better understood from multiple perspectives. Indeed, there are studies suggesting that due to the prevalence of summative assessment strategies in schools, the failure rates in mathematics are increasing among students (Olaoye et al., 2021).

However, since many teachers were taught using summative assessment, it is almost natural for them to want to adopt this style of assessment in their modern-day practice. For example, in a study which was conducted to investigate teachers' assessment methods as well as the difficulties they experienced in trying to assess learning at an Ethiopian university, Sewagegn's (2019) findings indicates that majority of the 166 teachers surveyed use summative assessment methods to assess students.

The research indicates a significant reliance on traditional written assessment methods among teachers, which may limit the evaluation of students' creative and higher-order thinking skills (Sewagegn, 2019). The coinage *written assessment methods* here refer to exams, group works, assignments, mid-semester tests etc. which are all summative in nature. Table 4 below, summarises the findings from the study.

Table 2

Assessment Methods Used by Teachers in Descending Order of the Mean (Sewagegn, 2019)

S/No	Assessment methods/techniques	Mean (approximated)
1	Terminal exams	5
2	Collaborative works/assignments	4
3	Tests	4
4	Presentations	3
5	Verbal questioning	3

6	Assignments	3
7	Mid-semester tests	3
8	Practical tests	3
9	Observations	3
10	Projects	3
11	Lab tasks	2
12	Writing reports	2
13	Seminars	2
14	Portfolios	2
15	Self-assessment	2
16	Peer-assessment	2

From the information in the table above, it is clear that formative assessment methods such as the adoption of portfolios, self-assessment and peer-assessment are the least used in the investigated schools. The study concludes by suggesting that teachers should use both summative and formative assessment methods. This view is corroborated by Obilor (2018) who stressed the need for teachers to find the balance between summative and formative assessment practices.

However, other authors such as Barnes (2007) altogether call for the abolishment of the use of summative assessment. For instance, according to Barnes, summative assessments, by their very nature, are inconducive to promoting ongoing learning and development (Barnes, 2007).

A particular type of summative assessment involves large scale or external exams. These are usually high-stakes tests which students take at the end of an academic program with a view to being promoted, gaining admission to a higher program, getting a certificate etc. Thus, a major aim of such exams is to measure student learning accomplishments at the conclusion of the program of study, course or unit of work. This makes large scale or external exams summative by nature (Olaoye et al., 2021).

Their main emphasis is on the cognitive domain of learning. According to Stevens and DeBord (2001 as cited in Ajayi & Gbenga-Akanmu, 2018, p. 28), "scholars have emphasized that using [exams] for children under the age of eight for grade placement or

school retention is … harmful for children". Furthermore, it is contended that [exams] often prioritize the outcome of learning rather than the learning process itself (Ajayi & Gbenga-Akanmu, 2018).

Examples of large-scale tests include the Program for International Student Assessment (PISA), West African School Certificate Exams (WASCE), Unified Tertiary Matriculation Exams (UTME) and the Trends in International Mathematics and Science Studies (TIMSS). The TIMSS framework was designed with a specific focus on conducting comprehensive assessments to compare students' mathematical achievements across diverse cognitive domains and subject areas. Its objectives encompass identifying patterns in student performance and offering evidence-based insights to improve educational policies and practices globally.

From the foregoing, the rationales for using large scale tests are to compare students' achievements in mathematics and to improve policy and practice. In other words, these exams focus more on measuring and comparing *performance* as opposed to improving learning. The danger in these types of testing is that they have the tendency to influence how teachers conduct their own assessments – even in the classroom. For instance, in China, public examinations have exerted significant influence on teachers' grading practices, despite not being directly integrated into teachers' grading criteria.

Nevertheless, teachers' classroom assessment and grading approaches often closely mirror the methods and formats utilized in these examinations (Cheng, 2010). Here in Nigeria, teachers often set their school based exams from past public exam questions. The proliferation and sales of past exam booklets for mathematics and other subjects validates this claim.

Hence, the prevalence of large-scale testing significantly shapes teachers' classroom assessment methods. It's valuable to investigate the validity of this assertion in Nigeria. For instance, do large-scale tests like the Unified Tertiary Matriculation Examination (UTME), taken by students aspiring to enter Nigerian universities, impact how teachers conduct assessments in the classroom? If true, could such influence partly be the basis for the purported gaps in assessment practices? Can the use of such high stakes testing formats

alone, focus on the achievement of high grades to the exclusion of deeper learning and understanding in the classroom? Or is there a need for a reform in Nigeria's assessment system as submitted by Olaoye et al (2021)? Hopefully, data from further research and findings from the present study will offer some promising responses to these and other questions.

It is also significant to emphasise the interest large-scale summative tests such as TIMSS have in assessing students across various cognitive domains. Depending on the assessed year levels, the cognitive domains might include number, geometry, measurement and data, biology, chemistry, physics and so on. But despite these seeming benefits, studies have reported that large scale assessments have untold side effects with far reaching negative consequences (Emler et al., 2019).

The side effects have contributed to the large-scale criticisms of high stakes large scale assessment. Moreover, these tests suggest that the primary purpose of education is just testing. This is not only misleading but also reduces the basis for education to a barest minimum. Another study reported ample proof of educational setbacks due to high stakes large-scale assessments (French et al., 2023).

In a paper which attempts to outline the effect of formative assessment practices on the quality of education around the world, Light and Pierson (2013) advocate for a departure from the overuse of standardised or large-scale assessments, calling on researchers and policy makers to instead consider classroom-based assessments instead. It should be noted that Light and Pierson are not alone in this campaign. Jensen (2005) posits that large-scale standardised tests are incongruent with the principles of quality education, neglecting essential skills such as the ability to think critically, solve problems and be creative (Jensen, 2005).

In effect, Jensen recognizes the need for assessments that foster problem solving and creative thinking skills, as engendered in various formative assessment strategies such as peer-assessment and self-assessment. As already noted in the present study, Nigeria uses a number of large-scale tests. Two of these tests are the Unified Tertiary Matriculation Examination (UTME) and the National Common Entrance Examination (NCEE). Both tests

are written annually by millions of final year students in secondary and primary schools respectively. While the UTME is conducted by the Joint Admissions and Matriculation Board (JAMB), the NCEE is administered by the National Examination Council (NECO). Each year, final year secondary school students are required to take and pass the UTME (in addition to having 5 relevant O' level credits) to qualify for post UTME exam which must be passed in order to secure a place in a Nigerian university. Similarly, pupils in Primary Six are expected to pass the NCEE to be admitted into one of the nation's unity schools which are located across the country.

However, the inadequacies of these exams to evaluate students' competencies have been highlighted in educational research (Aribisala et al., 2018; Busayo, 2010). These inadequacies are largely based on the inability of some candidates who 'passed' the UTME for instance, to defend their scores in subsequent post-UTME tests administered by universities. The Post UTME screening policy by universities was formulated since 2005 (Busayo, 2010). In a study which compares the UTME and post UTME admission models at the Lagos State University, the authors argue that admission criteria into universities in Nigeria should be based largely on post UTME assessments (Aribisala et al., 2018).

A major basis for this recommendation is founded on the fact that the UTME which is a large-scale test does not test certain relevant skills required in a university setting. Research indicates a significant discrepancy between JAMB scores and post-UTME essay performance, highlighting concerns regarding candidates' writing proficiency and academic preparedness (Busayo, 2010). There may therefore be a need to review the effectiveness of large-scale summative assessments.

Do large scale tests which are summative in nature really develop the essential skills needed to make headway in today's complex world? The strong argument is made that summative assessments are not really the best indices for checking whether students are succeeding or failing in their school work especially when one considers the school reports of popular personalities like Whoopi Goldberg, Richard Branson, Susan Hampshire and Agatha Christine (Barnes, 2007). This implies that these personalities and several more might have done better if they were assessed using other forms of assessment which encourage problem solving, critical thinking and creativity.

2.7.2 Formative assessment as a type of assessment practice

Formative assessment can be described as the sum total of the events practiced by teachers, and/or by students, which help to generate data from which constructive feedback can be derived and applied with a view to creating the desirable caliber of education in the classroom (Black & Wiliam, 1998). This definition underpins classroom assessment practices in Finland, which according to the author resonate with Kulm's 5 purposes of mathematics assessment: raising the standard of class work, measuring the progress recorded by students, giving feedback which helps students to monitor their learning, sharing learning goals with students upfront and helping them to develop the right attitude to mathematics (Hendrickson, 2012).

In a publication titled 'Assessment in Finland: A Scholarly Reflection on One Country's Use of Formative, Summative, and Evaluative Practices', Hendrickson (2012) viewed assessment as a tool for evaluating and modifying pedagogy based on the needs of the student. This means that assessment should mainly be a student centered phenomenon and not otherwise. In other words, students should have a voice in their own assessment.

After all, they are the main objects of the process. Santiago, Donaldson and Herman (2011) reiterate this fact by reporting that a student-centered approach is a necessary condition for harnessing the potential of formative assessment. It is worthy of note that a student-centered approach to assessment is compatible with the constructivist theory of learning. In Finland, all assessments are presented in a manner which promotes or supports learning and not as mere tools for measuring learning.

It is pertinent to mention that some authors however reason that summative assessment can be put to use in a formative sense. This idea of trying to use summative strategies in a formative manner is considered in James' (2006) study. She notes that in some summative settings, students' progress is assessed through timed tests featuring unseen questions drawn from various levels within a skill hierarchy. Typically, performance is evaluated in binary terms—either right or wrong. In cases of underwhelming performance, remediation often involves additional practice on the incorrect items. Sometimes, this process entails breaking down the problematic items further and revisiting even more fundamental skills.

Consequently, this approach represents the sole practical interpretation of formative assessment within this framework (James, 2006). In Nigeria, the practice of continuous assessment is viewed as formative assessment (FGN, 2014). However, assessment cannot be said to be formative when it lacks certain qualities such as the use of quality and constructive feedback and being integrated in the teaching and learning process (Hendricks, 2012). Identifying and knowing the purpose of an assessment can help to avoid such mix ups.

The distinction between formative and summative assessments must be made clear. While summative assessment assesses learning that already took place, formative assessment provides a basis for *improving learning*. Put in another way, the improvement drive takes place only after the student fails or performs poorly in summative assessments. This is in sharp contrast to formative assessment where the improvement drive happens to forestall or minimize failures. This means that while summative assessment evaluates previous progress in learning, formative assessment sets future goals for learning (Nweke, 2025).

The use of numerical grades in summative assessment is rampant among teachers. Research suggests that traditional grading systems lack the specificity and depth required to provide pupils with actionable feedback, hindering their ability to encourage informed educational advancement (Assessment Reform Group, 1999). In some climes, numerical grades are not used on children's work. Rather, they are usually graded or ranked very good, with a high level of achievement to *requires practice* with a subpar work (Hendrickson, 2012). Formative assessment is founded on the application of regular and descriptive feedback (in place of numerical grades) from teachers to students on how they are making progress in their learning. Good feedback practices can produce confident learners. Supportive and affirming comments have been demonstrated to enhance both academic achievement and students' perception of their capabilities.

The above insight is amplified by Black and Wiliam's (1998) research. This view of feedback is similar to what is obtainable in Australia where students are proud of the focused and constant feedback which they receive in order to help them attain standard learning goals (Santiago et al., 2011). Whether frequent, yearly of half yearly, all feedback is geared

towards helping students to develop their ability to engage in successful learning and become more self-directed in their learning.

Based on the literature, the absence of descriptive feedback appears to constitute another gap in teachers' assessment practices in Nigeria. In a paper which discusses the role of formative assessment and supportive feedback in the Nigerian education system, the importance of integrating formative assessment techniques into teaching practices, the need to provide regular feedback in their work with students and undergo continuing professional development (CPD), particularly in the area of offering constructive comments to students were highlighted (Akomolafe, 2021).

The use of parents, and their role in formative assessment practices is equally noteworthy. Formative assessment offers both parents and students an opportunity to play a significant role in the assessment process. In Finland for example, teachers share student progress with students and their parents with a view to improving students' growth, study and self-assessment skills (Hendrickson, 2012).

However, formative assessment cannot succeed or thrive without the involvement of all stakeholders. There is therefore a need for schools and policy makers to arm teachers with the relevant gadgets required to deploy formative assessment strategies in the classroom was reiterated (Akomolafe, 2021).

Formative assessment is data-driven because teachers must use the data they collect on each student to improve the learning and instruction cycle (Hendrickson, 2012; Santiago et al., 2011) through useful feedback. Specifically, research highlights the effective use of formative data by Australian teachers to inform instruction, identify student learning needs, and promote subsequent progress. (Santiago et al., 2011, p. 58).

Another significance of formative assessment is its clarity in terms of the learning expectations for students. Practitioners of this type of assessment leverage these expectations in order to promote student learning. In Australia, both teachers and students are aware of these expectations and work collaboratively towards their attainment. Effective teaching practices involve articulating clear learning objectives and delivering ongoing,

formative feedback to support students' cognitive and metacognitive development (Santiago et al., 2011).

In Sweden, students are taught to manage their own improvement, a practice which is made possible through what is known as Individual Development Plans (IDPs). The Swedish Individual Development Plan exemplifies a holistic approach to education, integrating goal-setting, self-assessment, and targeted support to foster student growth (Santiago et al., 2011). Students are in effect encouraged to assume responsibility for, and be accountable for their own learning outcomes. The above qualities of formative assessment make it significant to modern day education.

Moreover, Light and Pierson (2013) list other benefits of formative assessment which include:

- Insightful Modification of Instruction: Formative assessment allows teachers to gain insights into students' strengths and weaknesses. This understanding empowers educators to adapt their instructional methods and content focus accordingly. Teachers who are attuned to their students' interests, needs, strengths, and weaknesses can tailor their teaching strategies to optimize student learning.

- Comprehensive Evaluation of Skills and Abilities: Unlike summative assessment, which may primarily emphasise lower-order thinking skills, formative assessment encourages cultivating critical thinking and complex problem-solving abilities. Moreover, the integration of self- and peer-assessment fosters collaborative learning, communication skills, and self-reflection among students.

- Personalised Feedback for Student Improvement: Formative assessment differs from summative assessment in its direct provision of feedback to students. By offering feedback on both successful efforts and areas for improvement, formative assessment empowers students to refine their learning techniques and attain better results.

- Empowerment of Students in Assessment: Involving students in the assessment process grants them agency and fosters control and responsibility for their own learning outcomes journey. When students participate in assessment activities, they become more accountable for their educational progress and strive for improvement in subsequent tasks (Light & Pierson, 2013).

2.8 Assessment practices in mathematics education

The importance of assessment in mathematics education cannot be overstressed. Mathematics assessment helps teachers, schools and governments of countries to achieve a wide variety of goals. These goals include accountability, selection and comparison (Emler et al, 2019), promotion to higher grades etc. In Nigeria, primary school teachers use an array of assessment strategies in their work with pupils.

Additionally, mathematics serves as a foundation for the technological growth and advancement of any country (Auka, 2014; Mazana et al, 2020). Other purposes of assessments in mathematics education include grading pupils, national, system monitoring, resource allocation to states, student placement and monitoring, determining interventions etc. (Benebo-Solomon & Abaver, 2024).

Given the significance of the mathematics therefore, its assessment requires a substantial attention from all stakeholders. Assessment is a tool for compiling and describing information from a number of sources in order to gain in-depth knowledge, insight and understanding into what students have learnt, understood, and can do with the knowledge and skills they have acquired (Osiesi, 2023). It means teachers, schools or other systems are expected to use assessment to retrieve and analyze relevant data so as to determine what students are able to do, or unable to do on their own in order to make judgements and take steps that foster learning.

In an Ebonyi state study, Azuka (2014) notes that virtually all the primary school mathematics teachers sampled use written tests in their assessments (100%), most of the teachers also use assignments (88%) and group work (76%) to assess pupils. However, he notes that very few of the teachers use methods such as observation (30%), oral examination (6%) and peer assessment (8%). This shows that majority of teachers in this study use paper and pencil tests as their No. 1 assessment tool, be it a group or individual assessment. It also means that only a few teachers assess learners using formative assessment strategies such as peer assessment and observation.

This view is supported by Osiesi (2023) who reports that the assessment tools used by primary school teachers in Nigerian include tests, homework, class work, observations,

reports, questionnaires, rating scales etc. While these are the prevalent assessment practices in mathematics education in Nigeria, it is important to bear in mind that they are summative in nature (Umar & Majeed, 2018). The dominance of summative assessment practices in Nigeria is underscored by other prominent studies (Modupe & Sunday, 2015; Raji et al., 2020). These practices align with the behaviourist learning theory.

The use of summative assessment practices alone comes with its limitations (Obilor, 2018, Sewagegn, 2019, Umar & Majeed, 2018). For instance, they are primarily concerned with teaching to the test and unable to foster deep learning or understanding. They focus mostly on grades and fail to provide actionable feedback, leaving struggling learners behind in the class (Chappuis & Stiggins, 2002). There is definitely a need for assessment practices that cater to the learning needs of each learner in the mathematics classroom. Addressing this challenge will most likely improve the learning outcomes in mathematics education.

2.9 Linking learning theories to formative assessment practices

Mary James (2006) attempts to describe formative assessment through the lenses of 3 clusters of theories of learning. These include the behaviourist, constructivist and sociocultural theories of learning.

Behaviourist learning theories view assessment as the measurement of learning through repeated practice of questions, especially where such questions or concepts have to be broken down into more basic parts for easier assimilation. As already noted, the behaviourist theories of learning are summative in nature.

The constructivist theories of learning resonate very largely with formative assessment principles. Again, Section 2.2.1 illustrates the nexus between a constructivist theory and formative assessment in that the latter focuses on a child's stage of development per time (Black & Wiliam, 1998). These theories are geared mainly towards closing the gaps between present and intended learning outcomes by incorporating a range of approaches, like building on existing understanding, descriptive feedback, self-assessment etc. Moreover, to enable incremental understanding in students' comprehension of knowledge structures and afford them authentic experiences that demand the integration of concepts and skills in fresh contexts, it is imperative to gain insight into students' thought

processes. Finnish teachers are well known for applying the principles of formative assessment, particularly in mathematics education (Hendrickson, 2012).

Formative assessment strategies can be achieved in the classroom through diverse methods, such as facilitating classroom conversations, assigning open-ended questions, utilizing think-aloud protocols, and creating concept maps. Within this framework, teaching and assessment seamlessly merge to advance the objectives of learning, especially the objective of bridging the disparities between students' existing knowledge and the targeted learning objectives (James, 2006).

Lastly, according to Shepard et al. (2020, p. 3), assessment in the sociocultural context is based on the platform of the sociocultural learning theory. This theory believes that children's cognitive and affective capabilities among other factors are built as they mingle with their peers, teachers and learning environment. Therefore, the nexus between formative assessment and sociocultural theory lies in their shared emphasis on learning as a socially mediated, interactive process—where feedback, dialogue, and collaboration drive development.

However, a socio-cultural perspective on learning necessitates a paradigm shift in assessment, emphasizing contextualized, collaborative, and culturally responsive evaluation methods (James, 2006).

Notwithstanding, assessment in this context could mean measuring how well students are able achieve through group efforts. This view resonates with Modupe and Sunday's (2015) call for teachers to be trained on how to assess students' affective and psychomotor skills, rather than focusing only on their cognitive abilities. It also resonates with the sociocultural theory of learning. Project-based learning which is likely to cut across multiple subject areas (cross curricular) and require collaborative efforts might also require this assessment approach.

The impact of formative assessment strategies in mathematics and education in general is widely reported across continents (Sewagegn, 2019, Umar & Majeed, 2018, Xiao & Yang, 2019, Yusron & Sudiyatno, 2020). Specifically, the effectiveness of a formative assessment model in primary school mathematics is well underscored by Yusron and Sudiyatno

(2020). These authors concluded by noting that "learning with the application of [formative assessment] in mathematics…in elementary schools can improve student learning outcomes (Yusron & Sudiyatno, 2020) in the subject area.

2.10 Implementing formative assessment in the classroom

Assessment, tailored to its type, should involve specific activities targeted towards encouraging children to accept increased accountability for their academic progress. For example, formative assessment in a classroom setting encompasses activities such as fixing learning targets, devising plans, utilizing feedback, engaging in peer-assessment, and practicing self-assessment.

Peer assessment involves learning through pupil interactions such as discussions, questioning and academic coaching/mentoring. Furthermore, a different study views formative assessment strategies as the various learning and instructional activities used daily in the classroom to close learning gaps. Such activities usually include holding various levels of discussions, using a questioning approach, providing useful feedback, teacher – student supervision regarding how to navigate learning gaps, and self-assessment (Santiago et al., 2011).

It is significant to note that these assessment strategies are relatively uncommon in many classrooms, especially in the developing countries, including Nigeria. What is more common are the summative assessment strategies mentioned earlier in this review. For instance, in their study on the possible use of 'portfolio' as a diagnostic instrument. Simobi & Anikeze (2019) observe that in Ebonyi, a south eastern Nigerian state, the evaluation of students' learning outcomes primarily relies on traditional assessment tools.

Conventional assessment methods typically consist of teachers administering regular tests, assignments, and examinations, primarily aimed at assessing students' cognitive learning outcomes. However, these methods often overlook the affective and psychomotor domains of learning (Simobi & Anikeze, 2019).

The results of the above study demonstrate that teachers in Ebonyi state rarely use assessment strategies such as portfolio assessment, peer- and self-assessment. Instead, they rely on the more traditional assessment strategies such as tests, assignments and

examinations when in fact the alternative assessment strategies tend to offer a more comprehensive educational outcome which cuts across the cognitive, psychomotor and affective domains of learning.

It is confirmed that teachers prefer the conventional classroom evaluation methods compared to more recent and innovative approaches of assessment which are able to tap into the learner's ingenuity and expertise (Sewagegn, 2019). In other words, the use of written assessments offers students fewer opportunities to be innovative compared to the use of alternative assessment strategies.

Recently in China, teachers were urged to broaden their assessment methods and sources of evidence used to make grading decisions, shifting away from relying solely on test-based assessments to incorporate other indicators of student performance (Cheng et al., 2018). These other measures include multifaceted methods of assessment which include authentic or performance-based assessments. The developed countries now realize the importance of alternative assessment strategies as tools for developing and sustaining innovation and creativity in a modern world. Generally, in the present study, the research questions tend to ascertain if primary school mathematics teachers should consider using assessment practices such as portfolios, peer-assessment and feedback in their work with learners.

Light and Pierson (2013) outline five key assessment approaches as well as suggestions for implementing formative assessment strategies. The approaches include (1) portfolios (2) performance-based assessments or PBAs, (3) rubrics, (4) peer-assessment, and (5) self-assessment. Each of these approaches is discussed below.

Portfolio assessment is a method of evaluating student learning through a compilation of their work which showcases what has been learnt over a period of time. Studies indicate that thoughtfully incorporating portfolios into teaching practices can enhance student learning outcomes, promoting cross-disciplinary understanding and reflective learning (Light & Pierson, 2013).

The use of portfolios in assessment has received wide acknowledgement in the educational literature (Jenson, 2009; Sewagegn, 2019). For instance, Jensen views the

growing adoption of portfolio assessment as a positive evolution, deeming it a superior method for gauging student progress since it evaluates a range of skills longitudinally (Jensen, 2009, p. 153). Furthermore, portfolios offer increased flexibility in the assessment process, affording students the chance to demonstrate their learning via an array of ways (Jensen, 2009).

Performance-based assessments, also referred to as authentic assessments, serve as instruments for evaluating students' understanding and ability to implement learned knowledge in real-world contexts. These assessments necessitate learners to produce a final product, guiding them through a comprehensive process. This process often entails analyzing and synthesizing ideas, transferring knowledge to produce an innovative outcome in a fresh or challenging environment. Authentic assessments prompt students to engage both lower and higher-order thinking skills. In essence, students are tasked with completing an authentic assignment that mirrors real-world experiences and presents practical difficulties (Wiggins & McTighe, 2005).

Although performance-based assessments (PBAs) are used in some summative assessment strategies (Light & Pierson, 2013), they are also used in formative assessments. They are effective tools for measuring the essential knowledge and abilities required by students to carry out real-life tasks. Research indicates that Performance-Based Assessments (PBAs) are uniquely suited to evaluate key skills for the modern era, including critical thinking, creativity, and collaboration, due to their student-centered and authentic design (Light & Pierson, 2013).

Rubrics are important assessment tools for learning. They are able to measure students' knowledge, skills or abilities beyond how summative assessment could. Rubrics offer a nuanced evaluation framework, enabling teachers to assess students' mastery of nuanced competencies, critical thinking, and creativity, beyond the limitations of standardized testing (Light & Pierson, 2013). Table 5 is an example of a simple rubric.

Table 3

Simple Rubric

Criteria	Description	Rubric			
Project Work	• **Organisation of project components: e.g.** arrangement of slides, pictures, items etc. • **Coherence of submitted work**	**Below Average** Most features of the project work are improperly arranged and submitted work is largely incoherent 1	**Average** Up to three of the features of the project are shabbily arranged although submitted work is somewhat coherent. 2	**Above Average** All or most features of the project are neatly arranged. The submitted work is coherent to a large extent. 3	**Excellent** All features of the project are neatly arranged. The submission is presented in a coherent format. 4
Knowledge	• **Degree of understanding of concepts in work** • **Connections:** How a child is able to show the interrelationship among areas e.g. English, Science and Social Studies	**Below Average** 1	**Average** 2	**Above Average** 3	**Excellent** 4
Appearance	• **Neatness:** nature and manner uniform, how it is worn; elegance • **Boldness:** composure/confidence	**Below Average** 1	**Average** 2	**Above Average** 3	**Excellent** 4
Diction	• **Clarity of speech:** how articulate or coherent a learner's speech is • **Choice of words:** use of concept-appropriate words/vocabulary	**Below Average** 1	**Average** 2	**Above Average** 3	**Excellent** 4
Time Management	• Ability to manage time or conclude presentation in allotted time.	**Below Average** 1	**Average** 2	**Above Average** 3	**Excellent** 4

Rubrics provide feedback to students and show them how to make progress and take their work to the next level. Teachers and students can work together to develop rubrics. This kind of collaboration is also able to help students hone their self- and peer-assessment skills. Engaging in the creation of rubrics empowers students to cultivate analytical reasoning skills that can be applied across various domains of activity (Light & Pierson, 2013).

Also, a rubric may be conceived as a set of standards delineating intended learning outcomes and describing varying measures of excellence across a spectrum (Wiggins & McTighe, 2005). Beyond merely sharing learning objectives with students, rubrics provide a framework for delivering narrative evaluation and facilitating impartial scoring or rating of performance.

The use of rubrics enables learners to effectively monitor their own learning and assessment progress. Moreover, Andrade et al. (2009) suggest the efficacy of rubrics in assessing performance, particularly in fostering meaningful post-assessment discussions among students. Additionally, several studies have underscored the effectiveness of rubrics in supporting learners with exceptionalities in inclusive educational settings (Lee & Lee, 2009).

Peer-assessment is a reciprocal evaluation process where students review each other's work against standards provided by the teacher. The main aim for leveraging peer-assessment in the classroom is to generate feedback for students, from students. Student feedback is considered as a rich source of learning because naturally students tend to spend more time with each other than teachers can spend with them (Light & Pierson, 2013). In other words, peer-assessment maximizes learning opportunities by leveraging on student time in the classroom.

Therefore, teachers must teach students to peer-assess in order for this approach to be successfully deployed by students. Research indicates that, when the rules are followed to the letter, a peer-assessment approach can raise students' learning outcomes to a point comparable to the outcomes achieved via assessments by teachers (Light & Pierson, 2013). This also suggests that students learn better from their peers.

Light and Pierson (2013) studied the way some Chinese learners who, of course hail from a high stakes testing environment perceived and responded to such assessment approaches described above. These authors made some very stunning discoveries – the Chinese learners viewed peer-assessment as a viable way to prepare for tests and exams. When students peer-assess each other's work, they learn in the process and become better in the areas of assessment.

They also develop greater confidence and mastery in such areas. Another study in Botswana also discovered that the understudied students appreciated peer feedback on their group projects because their peers possessed greater insight into the project details than the professor, enabling them to offer more comprehensive feedback (Light & Pierson, 2013).

Self-assessment is another important approach to formative assessment. The central aim of self-assessment is to allow students to discover their own areas of strength and weakness, and to utilize various strategies in their work so as to achieve improvements and meet appropriate criteria (Light & Pierson, 2013). Students who can self-evaluate their own work are better able to develop a greater sense of agency over their learning.

Self-assessment can be done through a number of tools such as checklist, rubrics and registers, questionnaires, interviews, and student-teacher conferences (Light & Pierson, 2013). This assessment strategy is not to be mixed up with summative assessment which focuses on final grades. The goal is to enable students to manage their learning independently (Light & Pierson, 2013).

For this assessment approach to be effectively implemented in the classroom, students will need to be trained to apply its tenets correctly. Research in Barbados showed that students in secondary education trained in self-assessment methods not only reported increased confidence but also achieved superior results in external examinations compared to their counterparts without training (Light & Pierson, 2013). Therefore, training students in self-assessment skills holds promises for better learning and academic performance.

In a review of 76 empirical studies, Andrade (2019) admits the difficulty in trying to define self-assessment. However, he lists the following as examples of self-assessment: applying a joyful or sorrowful facial expression to narrated stories, predicting the number of math problems solved correctly, charting points achieved in a round of darts, expressing comprehension (or the absence of it) of a scientific concept, utilizing a rubric to determine the effectiveness and shortcomings of a persuasive essay, crafting thoughtful reflection records, and similar activities (Andrade, 2019).

Andrade went on to critique a number of other authors' definitions of self-assessment as not being purposive. Therefore, he views self-assessment from a purposive perspective. According to him, the fundamental purpose of self-assessment lies in its capacity to promote learner autonomy, self-regulation, and reflective practice, ultimately enhancing academic achievement and lifelong learning noting that such self-assessment is formative in nature (Andrade, 2019). He also distinguishes between formative and summative self-assessment

but makes a case for the former stressing that it holds better promises since the key purpose of self-assessment is learning.

Successful classroom implementation of self-assessment necessitates four conditions to be fulfilled: first, self-assessment criteria should be jointly established by teachers and students; second, students need to be educated on the procedure for applying these evaluation criteria; third, students should receive feedback on their self-assessments; and fourth, teachers should support students in developing a strategic plan from assessment data (Light & Pierson, 2013). Consequently, the ability of students to assess themselves plays a crucial part in the education and academic success of all learners, regardless of their learning capabilities.

2.11 Alternative assessment practices

There is growing evidence in the literature making the case for innovative or alternative assessment methods in education (Ahmad et al., 2020; Blonder, 2018; Burnell, 2019; Cong-Lem, 2019; Ilany & Shmueli, 2021). Alternative assessment practices are also called non-traditional assessment practices. Some alternative assessments not already mentioned in the present study include ipsative assessment and cognitive diagnostic assessment. As with assessment for learning, these other types of assessment are not commonly addressed in the literature on assessment practices in Nigeria. Neither are they as recurrent as summative assessment practices in many classrooms.

Martinez-Arboleda's view of ipsative assessment in education as fits this view: Evaluating a student's performance by measuring it against their own prior performances, rather than comparing it to the performance of others in the group (norm-referenced assessment) or against predefined standards based on program objectives (criterion-referenced assessment) (Martinez-Arboleda, 2021).

In other words, the emphasis in ipsative assessment is improvement over time and not final scores. It is much more concerned with the learning process as opposed to the product of learning. This form of assessment therefore seems to share more similarities with formative assessment than summative assessment.

While ipsative feedback has been in existence since as early as 1944, its comprehensive implementation in the realm of education is relatively recent (Martinez-Arboleda, 2021), especially in primary and secondary school settings. Moreover, there exists insufficient evidence regarding the influence of ipsative assessment on learning outcomes (Hughes, 2014). An *inconclusive* attempt was made by Penn and Wells (2018) to implement the model using a group of Psychology students. These authors note that preliminary reactions to the use of ipsative assessment in schools are quite encouraging (Penn & Wells, 2018).

A cognitive diagnostic assessment (CDA) is one which pretests students' strengths and weaknesses before teaching takes place. The Cognitive Diagnostic Assessment (CDA) offers in-depth insights into students' mastery levels of specific attributes, providing detailed information on their what worked well, as well as opportunities for development (Sun & Suzuki, 2013). These researchers argue that this method of assessment has the potential to provide useful information capable of improving how teachers teach.

By the same token, cognitive diagnostic assessment (CDA) serves as an assessment strategy which is able to offer worthwhile feedback regarding a learner's mental abilities and learning deficiencies (Sia & Lim, 2018). In other words, a CDA reveals how strong or weak students are cognitively with respect to a specific subject domain. Unlike summative assessments, one of the advantages of the CDA lies in its ability to determine the next steps in students' learning.

Diagnostic assessments are often aligned with targeted instructional strategies, integrated within specific curricula, to inform teaching adjustments. (Darling-Hammond et al., 2020). This makes the CDA quite similar to formative assessment which provides information to students on how they can advance their learning. A CDA also differs from a summative assessment in that it happens before teaching and learning, not after it. Perhaps, this explains why some authors tend to regard the CDA as a form of formative assessment.

One source argues that a diagnostic assessment is a specialized variant of formative assessment and is geared towards aiding educators in identifying students' unique competencies, skills, and understanding to address individual strengths and areas needing

enhancement more effectively (Darling-Hammond et al., 2020). Thanks to their specific focus and personalized structure, diagnostic tools provide more precise insights for curriculum planning compared to the broader approach of many summative assessments.

Millar and Hames (2003) demonstrate the effectiveness of this assessment practice in a study which sought to enhance the interface between research and practice and which involved 10 schools. According to these researchers, a group of science teachers were provided with a bank of diagnostic assessment materials from the onset with the intention of determining the effectiveness of cognitive assessment practice. 23 teachers provided feedback on their use of the diagnostic assessment materials, from which 16 were interviewed in depth (Millar & Hames, 2003). The feedback from the participants revealed the practicability of the assessment method. Interestingly, cognitive diagnostic assessments are common in some quarters in Nigeria.

While these relatively newer forms of assessment look promising, experience shows that when new insights into learning emerge, assessment tools and technology need time to adapt (James, 2006). This seems to be the case in many developing countries, schools and classrooms. Assessment skills, practices and technology are still trailing far behind the recent developments in the education system. The developments in learning vis-à-vis the developments in assessment seem to be out of sync. Hopefully, the present study should be able to present findings which proffer answers to this challenge as well as those posed in earlier research questions.

2.12 Evolution of educational assessment

It is imperative to provide some historical context for assessment in general. Over the years, the field of student assessment has achieved widespread recognition. The integration and use of various assessment strategies in the classroom have come a long way. Of course, teachers have also taken advantage of these strategies in their practice for a long time (Tabuena, 2019).

Over time, the perception and importance of educational assessment have undergone significant transformations. Traditionally, assessment was primarily viewed as a means of advancing students to the next level or measuring their acquired knowledge. However,

contemporary perspectives emphasize assessment as a driver of holistic learning experiences (Black & Wiliam, 1998; Hopfenbeck, 2018).

Additionally, there's a growing belief that assessment should be authentic to maximize its benefits for students (Inayah et al., 2019). Furthermore, some scholars have distinguished between assessment of learning and assessment for learning, aiming to underscore the diverse roles and potentials of assessment (Assessment Reform Group, 1999). As anticipated, this transformation which has unfolded gradually yet steadily has not only come a long way but also influenced how assessment practices enjoy widespread acceptance and are often applied in various fields, particularly in more developed countries. For instance, Hume (2009 as cited in Light & Pierson, 2013) observes that "[formative assessment] strategies are becoming increasingly common in the richer countries of Europe, North America, and Australasia".

Numerous educational systems are increasingly acknowledging the necessity for a shift in the nature of assessment to respond to the pressures and demands of the today's fast-paced world. Nigeria and other nations that have not yet embraced these changes must rise to the challenge, particularly if they aim to equip learners and professionals capable of thriving in today's rapidly evolving world.

The introduction of Western education in Nigeria can be traced to the mid-19th century, when Christian missionaries employed education as a vehicle for evangelism. Based on Ndubueze et al.'s work, European schooling approach was introduced to Nigeria through the activities of the then Christian evangelists sometime in 1843 (Ndubueze et al., 2015). Nonetheless, the earliest beginnings of Western education in Nigeria probably emerged in the 15th century with the arrival of Portuguese missionaries on Nigerian shores (Ajayi, 2006).

Nevertheless, Western education did not gain significant traction until the mid-nineteenth century. It's crucial to bear in mind that the introduction of Western education to Nigeria was closely tied to the development of an assessment framework, predominantly summative in nature. This form of assessment was considered crude because its main focus was on certification.

It was therefore a survival of the fittest ritual. Research critiques the assessment for its inability to provide timely, constructive feedback, instead adopting a solely judgmental stance that hinders learner growth (Ndubueze et al., 2015). Summative assessment pertains to the evaluation of student learning typically carried out through high-stakes tests caried out following the conclusion of a study program.

Usually, Summative assessments are created in order to help reach an ultimate decision about how much a student has been able to learn or achieve during a period of time within a particular subject or course area (Amua-Sekyi, 2016). This method of assessment is considered inadequate due to its limited contributions to holistic learning. Unlike formative assessment, it didn't give students ample opportunity to learn or close achievement gaps.

Formative assessment helps students by motivating them to want to learn since the students are vigorously engaged in the process of assessment. Moreover, it allows students to take responsibility for their own education. For instance, in a study on students' educational achievements using formative assessment, the authors observed that the students admitted that implementing formative assessment strategies fired up a desire in them to want to learn, supported them to enhance their outcomes in English, and offered them greater flexibility and latitude to engage better in their learning. It also inspired them to manage their own learning process (Umar & Majeed, 2018).

Summative assessment merely serves as a mechanism for deciding student progression to the next grade level. It would seem like the most obvious challenge educational assessment posed during the colonial era was that it comprised just a one-time end of the year examination (Ndubueze et al., 2015). Upon completion of Primary Six, students from different schools in Nigeria were obliged to write the National Common Entrance exam, this was followed by the Secondary School Leaving Certificate examination at the conclusion of their 5-year secondary school program.

The reliance on two one-time external exams was seen as unfair by many, who believed that it didn't provide a comprehensive picture of students' knowledge and skills.

They also thought these exams examined mainly lower-order thinking skills and worse still, were conducted by unknown examiners.

The overall cultural climate in Nigeria favors community and collaboration, respect and, hard work and perseverance (Macaulay, 2021). These cultural traits provide a fertile environment for the introduction of formative assessment. This is because formative assessment fosters community-oriented learning through peer and group activities. Formative assessments can also help to build on the cultural value of respect when teachers provide guidance, feedback, and mentorship to students. Finally, in terms of hard work and perseverance, formative assessments can encourage students to develop a growth mindset, embracing challenges and viewing failures as opportunities for growth. The foregoing cultural aspects explain why this form of assessment is likely to thrive in the Nigerian context.

2.13 Teachers' use of continuous assessment in Nigerian schools

The use of continuous assessment practices was adopted into the Nigerian education system, marking a new approach to evaluating student performance (Ndubueze et al., 2015; Osadebe & Abebi, 2018). This form of assessment as its name implies was designed to be continuous in nature and was based on a series of evaluations of the student's work. Ezewu and Okoye (1986 as cited in Osadebe & Abebi, 2018) view and characterize continuous assessment as a methodical and impartial process for ongoing evaluation of students' performance, tracking their behavioral development from the initial stage of a course.

In other words, it entails systematically collecting all pertinent information for this purpose, with the intention of leveraging it to steer and enhance the student's academic development, and to serve as a critical reference point for decision-making regarding the child's education (Ezewu & Okoye, 1986).

Moreover, the rationale behind the introduction of the continuous assessment system in Nigerian schools was to provide a more holistic, fair, and developmentally appropriate method of evaluating student learning—moving beyond one-time examinations to a system that supports ongoing feedback, learning improvement, and accountability. It was integrated into schools subsequent to the adoption of the 6-3-3-4 system of education with the objective

of improving the reliability, validity, objectivity, and comprehensiveness of learner assessment. In light of the present-day stress on promoting learners' intellectual, emotional, and social development, it has become imperative to include assessments that consider all facets of learning (Osadebe & Abebi, 2018).

The use of such words as reliable, valid, objective and comprehensive portrays the likelihood that the erstwhile assessment system was largely inappropriate hence the introduction of the present system. However, despite the good intentions of the continuous assessment system, and as admitted in some quarters, challenges persisted in evaluating students' learning in a holistic manner as a consequence of unclear definitions regarding the purpose of continuous assessment among many teachers (Ndubueze et al., 2015).

In the light of the above, Esere and Idowu (2013) question the limit to which continuous assessment in Nigerian schools take account of 4 important principles which according to them form the basis for modern continuous assessment practices. These include offering regular feedback to both students and educators to inform improvement in the student's learning outcomes or adjust the what, where and how of instruction; feedback also contributes to helping stakeholders in education to reach various other decisions (Esere & Idowu, 2013).

Research findings on continuous assessment also indicate a disturbing trend: 70% of participants neglected to engage in regular performance discussions with students, underscoring a critical gap in teacher-student communication (Esere & Idowu, 2013). This means that the majority of the studied teachers did not bother to furnish their students with any descriptive feedback for the purpose of optimizing learning outcomes. The study therefore concludes that the continuous assessment routines of the majority of the teachers did not reflect the necessary comprehensiveness, nor guidance needed especially by the students for their adequate learning (Esere & Idowu, 2013).

Moreover, continuous assessment, initially designed to address all facets of a child's learning—cognitive, affective, and psychomotor—largely concentrated on cognitive testing, thereby diminishing its scope to that of summative assessment in some respects. It comes therefore as no surprise that some authors recommend that the government ought to

arrange Continuing Professional Development (CPD) opportunities for teachers (Modupe & Sunday, 2015; Sewagegn, 2019). Such opportunities include professional learning communities, workshops, seminars and conferences for teachers, which show the right ways to implement a continuous assessment model in classrooms. Such endeavors should also indicate the appropriate instruments to leverage when deploying assessment models. Furthermore, the endeavors should include how to evaluate the affective and psychomotor skills of the learner. This is in addition to their cognitive skills (Modupe & Sunday, 2015).

Such inadequacies in assessment as the ones highlighted above create unwanted gaps in teachers' pedagogical strategies and ultimately, pupil progress. Evidently, the dimensions of assessment focusing on higher-order skills such as critical thinking, problem solving, teamwork, communication, and time management were notably absent. In essence, the continuous assessment system fell short of fostering deeper learning and cognitive development in students.

As a result, it not only fell short of fostering the desired learning outcomes but also failed to narrow the achievement gaps among students. It is safe to conclude that gaps in assessments will lead to learning gaps, which ultimately impact learning outcomes negatively.

Based on the author's nearly three decades as a practitioner in the classroom, it's clear that numerous learners in Nigerian schools excel primarily when presented with straightforward, factual questions that demand minimal thought. Therefore, teachers will need to improve upon their assessment skills such that they are able to develop assessments which produce critical thinkers and problem solvers. Schools must do more with the aim of cultivating critical thinking in students and lifelong learning skills if they must acquire the attributes needed for professional excellence (Esere & Idowu, 2013).

Assessment should empower learners to cultivate independence by assisting them in monitoring their progress and identifying their preferred learning methods, while also pinpointing areas where they can potentially improve. Therefore, in spite of the continuous assessment system, there is a need for forms of assessment that are able to result in all the

aforementioned capabilities and more, in today's child, especially if he/she is expected to cope with emerging global demands.

2.14 Integrating assessment into the learning process

Assessment is inextricably linked with learning. Studies in the literature attest to their inseparability (Lee et al., 2019; Yan & Boud, 2021). The purpose of assessment is manifold – it could be to raise the level of learning, measure learning or even test the effectiveness of a teaching program among other purposes. A number of studies in the educational literature suggest various reasons for carrying out assessment for students (Ajayi & Gbenga-Akanmu, 2018; Al-Tayib, 2018; Bhat & Bhat, 2019; Black & William, 1998; Brown, 2019; Jensen, 2005; Korb, 2018; Lindquist, Philpot, Mullis & Cotter, 2019 in Demosthenous et al., 2021; Schildkamp et al. 2020; The Assessment Reform Group, 1999; Umar & Majeed, 2018).

For instance, the rationale for the Trends in Mathematics and Scientific Studies (TIMSS) is based on the need for a framework for large-scale assessments to measure student mathematics achievement, facilitating comparisons across cognitive domains, content areas, and countries, while identifying performance trends and informing evidence-based decisions to improve educational policies and practices globally. TIMSS was created in 1995 (Demosthenous et al., 2021). In this wise, governments of the various countries subscribing to TIMSS use this assessment as an instrument for measuring the effectiveness of teachers and school leaders, as well as for improving policy.

Eric Jensen views assessment as attempting to decipher the contents in a child's mind (Jensen, 2005). As humorous as this definition sounds, it resonates with the school of thought that perceives assessment as a tool for measuring how much information or knowledge students have *taken in* or grasped. In this regard, assessment is viewed as an event that happens after learning.

However, there is a growing demand in the literature for the nature and purpose of assessment to be redefined to some extent that reflects the improvement of learning rather than just the measurement of it (Assessment Reform Group, 1999; Black & Wiliam, 1998; Umar & Majeed, 2018). This movement advocates for assessment to be integrated into learning rather than detached from it. In other words, assessment ought to be primarily for

learning and part and parcel of it. When assessment is treated in this way, it is better able to help the student and the society in which they live to grow and develop. In a study aimed at showcasing the potential influence of assessment on global education, and which pushes for developing nations to explore how emerging assessment strategies could contribute to educational reform endeavors within their contexts, Light & Pierson (2013) suggest that greater energy needs to be directed towards assessment practices which greatly improve how students learn.

Additionally, the authors critique the limited attention given to assessment practices in developing countries, highlighting the consequent impediments to educational progress and the need for targeted interventions (Light & Pierson, 2013). In other words, assessment in most developing countries is not on the same page as assessment in the developed world.

The study therefore underscores the need for developing countries to review how assessment practices are viewed and used by teachers in such contexts. Hence, the initial two research inquiries in this study aim to uncover the perspectives and practices of primary school mathematics educators in Nigeria regarding assessment, along with exploring how these perspectives, among other factors, influence students' mathematics performance.

In a related study (Umar & Majeed, 2018) which attempts to explore how formative assessment influences the academic performance of Sudanese students in English, the authors argue that the prevailing accentuation of summative assessment in education neglects the complexities of the learning process, underscoring the need for a more holistic evaluation approach. These authors went on to portray assessment for learning as a tool for *enhancing* the learning process. In other words, assessment for learning or formative assessment is essentially a learning tool.

The Assessment Reform Group outlines five key factors that form the foundation of formative assessment and contribute to enhanced learning. These factors encompass delivering constructive feedback, engaging students actively in learning, refining instructional methods based on assessment data, acknowledging assessment's significant impact on motivation and self-esteem, and cultivating students' ability to self-assess and identify avenues for growth (Assessment Reform Group, 1999). While these factors are

closely intertwined and reliant on each other, they collectively serve a significant purpose in formative assessment, enriching the learning experience profoundly.

In particular, the final factor emphasizing students' ability to self-assess underscores the vital function of self-regulation in their learning journey. This factor resonates with the stance of Lau and Sou (2018) who posit that the crucial contribution of formative assessment is to promote self-regulated learning, enabling students to assume agency over their academic trajectory. In their study, Lau and Sou (2018) attempt to summarize this type of learning by defining formative assessment as a procedure seamlessly integrated into curriculum design and the learning assessment process (Lau & Sou, 2018).

Furthermore, its primary objective is to assist schools in comprehending students' learning advancements and requirements, along with identifying their areas of proficiency and areas needing improvement. This understanding aids in curriculum planning, teaching methodology design, and the creation of internal school evaluation to optimize the efficacy of learning and teaching, thereby facilitating more effective student learning. This definition of formative assessment again indicates that effective learning is the ultimate goal in assessment (this is significant, and contrasting to summative assessment, where assessment only takes place after learning has presumably happened).

Schools and teachers need to understand students, the way they learn, their strengths and weaknesses whilst using these pieces of information to improve curriculum content, instructional methods and learning ultimately. In a similar vein, the Assessment Reform Group posits that formative assessment, as a consistent element of classroom practice, plays a pivotal role in optimizing learning outcomes and informing instructional design. (Assessment Reform Group, 1999).

Elsewhere, Brandmo et al. (2020) also talk of the connections between classroom evaluation and student self-directed learning. The core aim for assessing learners in countries like Finland is to support and enhance the quality of learning which happens in schools (Hendrickson, 2012). In this wise, assessment in Finland focuses on optimizing the standard of educational achievement, and by extension that of teaching across all Finnish

schools. This shows how intentional the Finnish education system is about the quality of their education.

Another study views formative assessment from the viewpoint of providing remedial action to students. It helps the teacher to evaluate students' understanding of concepts taught with the aim of augmenting academic development through organised feedback. According to this study, formative assessment is seamlessly woven into the fabric of the education process in the classroom, offering ongoing feedback to educators during instruction to gauge students' learning progress. Additionally, it furnishes insights into the efficacy of teaching methods, enabling educators to identify areas requiring improvement and implement suitable remedial measures as needed (Amua-Sekyi, 2016). Based on the foregoing, assessment takes place during, and not after teaching. In effect, teachers gather their data about student learning while teaching is ongoing and leverage the data to inform and enhance subsequent teaching practices and learning.

On the other hand, learning can be viewed from two perspectives depending on how we view assessment. For instance, learning can be taken to mean listening to and assimilating what the teacher is saying. In this wise, learning is largely dependent upon the teacher and is passive. Maintaining this trajectory, Elmore calls this kind of learning institutionalised learning.

At its core, institutionalized learning unfolds through a structured transmission of approved information from a designated educator, known as a teacher, to a student. The student is tasked with absorbing and retaining this information, subsequently showcasing their grasp of the material through assessments. Typically set within physical confines, such as a classroom, where students are often grouped by age, this process adheres to predetermined guidelines regarding the content's suitability and the students' developmental stage. Assessments likewise adhere to these organizational frameworks to gauge students' comprehension and retention of the material (Elmore, 2019).

The type of learning described above resonates with the behaviourist theories of learning described by James (2006). Research indicates that behaviourist theories, which surfaced in the 1930s, persisted as the dominant theoretical paradigm in education and

psychology until the 1960s and 1970s, significantly influencing instructional design and pedagogical practices (James, 2006).

Furthermore, the atmosphere in which learning takes place is considered very crucial to learning. In other words, where, how and when learning takes place is the determining factor for learning. The behaviourist paradigm posits that learning is fundamentally a process of conditioning, where external stimuli elicit responses, and associations are formed through reinforcement, ultimately shaping an individual's behavioral repertoire (James, 2006, p. 7). This suggests that learning cannot happen without some form of external components such as the teacher, peers or other abstract factors such as the use of reward, praise or sanction. Therefore, in this paradigm of learning, the human mind is not an important force to reckon with, neither is the concept of intelligence significant (James, 2006).

The above form of learning is prevalent in many school settings in Nigeria. This is so considering that the majority of today's educators received their training through this mode of learning. This view of learning also has huge implications for assessment practices. A number of studies on the behaviourist approach to learning are well documented in the literature (Agarkar, 2019; Al-shammari et al., 2019; Bandura & Hall, 2018).

Conversely, intellectual growth or learning may be conceptualised as a process in which the student should be actively involved. It means that this process is not left at the mercy of the teacher as was the case with the former perception of learning. Rather, learning can be understood as the capacity to intentionally adapt one's perceptions, beliefs, and behaviors based on evidence, personal experiences, and thoughtful contemplation.

In this context, *intentionally adapt* implies that learning is inherently an active process, necessitating the cultivation of human agency and autonomy. Individuals interpret their surroundings by actively engaging with them; the ability to deliberately and consciously interact with one's environment serves as a gauge for the depth and nature of their learning (Elmore, 2019).

From the above perspective, learning is seen as involving the human mind and some level of intelligence. In fact, the extent to which learning takes place will be determined by

how well the mind is put to use. The learner is seen as taking charge of his own learning through the use of human agency and deliberate actions. This is why this perception of learning is probably similar to the views held by constructivism as well as the sociocultural learning theories. This type of learning entails learners' active involvement and is influenced by cognitive processes. Constructivist theories delve into the connection between the mind and the brain, with a specific focus on how individuals construct meaning and perceive the world.

This emphasis highlights the process by which mental structures, concepts, and principles are organized into schemas to facilitate understanding. Prior knowledge plays a significant role in determining a student's ability to grasp new information. Understanding, along with the rectification of misconceptions, is prioritized, with problem-solving serving as the framework for constructing knowledge (James 2006).

Teachers who view learning from this perspective are likely to make better use of AfL practices since these practices encourage self-, and peer-assessment strategies which of course put learners at the helm of their own *learning affairs*. Students relate with their peers, teachers and the outside world in order to construct learning. Parallel to this piece of understanding, the dependence upon, and use of students' previous knowledge is key in the way these teachers carry out their pedagogic practices. This means that learning in this context moves from the known to the unknown.

From a neurological standpoint, Jensen acknowledges the brain's intricate functionality, conceptualizing it as a dynamic, continually active processing center that underlies human learning and cognition (Jenson, 2005). It would therefore seem that learning is always happening, either actively or passively. Again, this view of learning has huge implications for how teachers view and use assessment. From the foregoing, learning and assessment cannot be isolated from each other – they are interdependent and in fact reinforce each other as can be seen in Figure 5.

Figure 5

Complementarity of Learning and Assessment
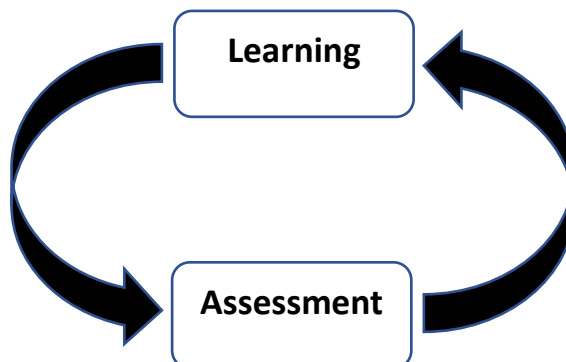
Effective assessment practices should lead to better learning as opposed to merely happening after learning has been concluded as is the case in many classrooms. This view and assertion, is pivotal to this study.

2.15 Teachers' views of assessment

The phrase *teachers' view* in this section and the rest of this study is used interchangeably with *teachers' perception* or *teachers' conception* or *teachers' belief*. The literature is fraught with information on the nexus between the beliefs or perceptions of educators, their teaching and assessment strategies (Alsubaiai, 2021; Huang & Jiang, 2021; Mardjuki, 2018; Prakoso, Ramdani et al., 2021).

Such beliefs are commonly linked to different educational contexts (Brown et al., 2019; Ha & Lee, 2019; James, 2006; Kerma & Ouahmiche, 2018; Monteiro et al., 2021). In their submission, Monteiro et al. (2021) interpret teachers' interpretations of assessment by virtue of how teachers perceive assessment in view of how they might have interacted with the phenomenon in their work with children.

To a very notable extent, teachers' views of teaching and learning are able to influence their assessment practices. In other words, the way learning is perceived, directly or indirectly affects the way it is assessed or measured (Halinen, 2018). For example, many teachers still believe that learning is determined mainly by a child's level of intelligence. So, teachers label some students as intelligent and others as 'not intelligent'. Their judgements of these children and their so called 'unintelligent counterparts' are therefore already biased. However, learning according to James (2006) …

…is no longer seen as a private activity dependent largely, if not wholly, on an individual's possession of innate and generally stable characteristics such as general intelligence. Interactions between people, and mediating tools such as language, are now seen to have a crucial role in learning. (p. 2)

Consequently, teachers must employ effective assessment practices that are underpinned by the principles of social interaction, culture, language etc. If teachers pay more attention to how different people learn, their assessment practices are likely to consider these differences in their students. If students are assessed based on how they learn, their learning outcomes are likely to become far better. It is logical for one to assume that the training teachers receive covers at least the basic skills of learning and assessment (James, 2006).

Unfortunately, this is not always the case because teacher development programs rarely put these views into consideration. In an Ethiopian study which considers educators' assessment techniques and experiential insights at an Ethiopian University, Sewagegn (2019) observes that the student teachers were assessed using mostly summative methods such as written exams and tests, assignments, quizzes etc. irrespective of differences in their personality or learning abilities.

For emphasis, teachers' views about assessment will always influence how they use assessment. Historical, cultural, social contexts, views about learning and policies are all factors that may manipulate teachers' beliefs about assessment (Azis, 2012; Brown et al., 2019). Even in grading practices, research shows that teachers' choices in grading are largely dependent upon the contexts they have developed familiarity with. Based on a particular study, Cheng et al. argue that teachers' grading practices are shaped by a complex array of factors, encompassing personal values, professional experiences, contextual considerations, and the dominant discourse of standardized testing (Cheng et al., 2018).

The reasons which are responsible for teachers' perceptions about assessment are advanced in a study by Delandshere and Jones (1999). Basically, the basis for their research was to identify the factors which define educators' beliefs and perceptions about assessment. Research reveals that teachers' perspectives on assessment are influenced by several factors, including externally defined functions and purposes of assessment, their

perception of the official curriculum within the school framework, their positioning within the academic subject, and their insights about learning and students.

Therefore, teachers' beliefs and perceptions of assessment are largely influenced by factors within their operational context. This assertion finds support in the following settings depicting teachers' beliefs and perspectives on teaching, learning, and assessment. These settings are drawn from various educational contexts and cultural backgrounds.

In a study conducted in South Korea investigating elementary teachers' perspectives on smart learning, Ha and Lee (2019) collaborated with 438 elementary teachers from 20 randomly selected schools. Their findings revealed that despite policymakers allocating significant budgets to schools for improving technology infrastructure, the integration of smart learning has not been fully realized in these educational institutions. Their study equally revealed that teachers with a student-centered learning view were more likely to key into the technological reforms made to education in South Korea.

The researchers advocate for a pedagogy-first approach, wherein teachers initially explore the essential characteristics of effective learning environments, subsequently investigating how smart technology can facilitate and augment these environments (Ha & Lee, 2019). Teachers must first have an adequate knowledge about an effective learning environment before they can effectively leverage technology. This study illustrates the effect teachers' perception of learning can have on how they respond to an educational intervention, in this case, smart learning.

In an identical study carried out in Algeria to investigate the success of the Competency Based Assessment program introduced by the government in 2003, the researcher surveyed 156 primary school teachers from 40 schools with a view to exploring the strengths of teachers' assessment strategies and how such strategies affect the standard of education in the learning space (Kerma, 2018). The investigation revealed that the teachers perceived themselves as being weak in certain assessment practices and strong in others. Their perceptions naturally affected the level of academic excellence.

For instance, the teachers showed weakness in implementing assessment practices requiring the application of higher-level reasoning skills. The perception of teachers about

these assessment practices influenced their attitude towards them. This is the basis for attempting to explore the views or perceptions of elementary school mathematics educators in Research Question 1.

Furthermore, Azis (2012) reviewed a number of studies on teachers' perceptions towards assessment, teaching and learning. The studies were conducted in different contexts and cultures and highlighted the important connections between perceptions and practice. Three of these studies are selected for review based on their level of connection to the present study.

One of the studies was conducted by Brown et al. (2011 as cited in Azis, 2012) in Queensland and Australia with a total of 1398 participant teachers from 92 state schools. The survey employed a multifaceted approach to examine teachers' attitudes, beliefs, and instructional practices within the domains of curriculum, pedagogy, and assessment (Azis, 2012), providing insights into their educational philosophies and classroom implementations.

The majority of the participating teachers were elementary school teachers located in a context where high stakes testing was not applicable. Hence this influenced their perception of assessment. The study indicates that within this realm of low-stakes testing, teachers view assessment as a catalyst for enhancing student outcomes and so tend to put greater attention on the deployment of formative assessment. This approach allows teachers to employ various assessment formats and offer feedback to students (Azis, 2012).

Another of these studies was conducted in Hong Kong (Azis, 2012). The study featured 288 primary and secondary school teachers across 14 schools. Due to Hong-Kong's tradition of high-stakes testing, teachers in this study believed that student improvement was largely dependent on the application of traditional measurement tools such as written tests and formal examinations.

The third of the three selected studies was carried out in New York (Azis, 2012). 222 teacher candidates were surveyed with a view to probing their perceptions of assessment and learning. This study uncovered notable discrepancies in learning conceptions and perspectives between elementary and secondary educators in New York,

underscoring the importance of context and school level in shaping teacher beliefs (Azis, 2012). While the secondary school teachers tended to favor a behaviourist approach to learning, the primary school teachers endorsed the constructivist approach to learning.

As suggested by James (2006), these approaches had implications on the teachers' assessment practices. Whilst the secondary teachers relied more on traditional methods of assessment, their primary school counterparts tended to depend more on less common modes of assessment such as the use of portfolios, projects, rubrics etc. The reason for this difference was because although the secondary school teachers believed in formative assessment practices, they sometimes used traditional assessments as a *punishment* tool for students (Azis, 2012).

Furthermore, in a Nigerian study conducted to examine how teachers viewed and implemented continuous assessment practices in Ekiti State (south-west Nigeria), Modupe and Sunday (2015) sampled 160 secondary school teachers from 4 different schools. The authors discovered that about 94% of the teachers believed that assessment was a mere ritual conducted at regular intervals of 3 – 4 weeks. 93% of them saw assessment as continuous testing. Moreover, 41% of the teachers viewed tests as the only instrument of assessment. In other words, the majority of these teachers viewed assessment from a summative viewpoint. These teachers are either unaware of formative forms of assessment or just do not use it.

Therefore, their view tallies with the behaviourist approach to learning (James, 2006; Van de Watering et al., 2008). This also suggests that teachers in Nigeria see assessment as written tests or exams.

It is also important to mention that Modupe and Sunday (2015) observed a sharp discordance between policy and practice. Although the policy requires students to be assessed across three learning categories - cognitive, affective, and psychomotor domains - teachers in this study primarily concentrated on evaluating cognitive skills, largely neglecting the affective and psychomotor aspects. Yet, assessment should encompass an educational framework that strives to measure progress in all three domains: cognitive, affective, and psychomotor learning (Bhat & Bhat, 2019).

In another region of Nigeria, a study sought to investigate teachers' views on assessment and their preferences for assessment tasks. This study's findings are in tune with those from Modupe and Sunday's (2015) study. Information was compiled from 28 teachers selected at random who were enrolled in a postgraduate program at a Nigerian university. The findings indicated that although the teachers used a variety of assessment practices, they showed greater preference for summative assessment approaches (Raji et al., 2020). However, the study also found out that teachers were likely to embrace formative assessment strategies provided they were given regular and sufficient training (Raji et al., 2020).

Therefore, based on the discussed studies, there is no gainsay in the fact that teachers in Nigeria are largely committed to using summative assessment practices as opposed to formative assessment practices. In fact, some teachers believe that the pressure to achieve high test scores and favorable grades could incentivize students to exert greater effort, leading to increased learning (Adaka & Ugo, 2015). This also explains why these teachers administer several tests within short periods of time.

In a Gombe study which researched the extent of innovative assessment methods in inclusive classrooms, the authors arrived at the following conclusion: Teachers in Gombe Local Government Area are presently not implementing formative assessment methods in their classrooms, which could hinder the achievement of Universal Basic Education (UBE) objectives. It's essential for teachers to endeavor to incorporate formative assessment approaches for evaluating learning outcomes instead of solely relying on traditional paper and pencil tests (Adaka & Ugo, 2015).

One of the benefits of formative assessments is their suitability in terms of catering to the diverse needs of a wider range of learners (Adaka & Ugo, 2015).

The cumulative evidence from this review underscores the complexity and heterogeneity of teacher conceptions of assessment, problematizing the notion of a globally applicable, homogeneous construct (Brown, 2019). One study attempted to determine whether various models of teachers' conceptions about assessment from eight different contexts could be generalised to an initial assessment conception model across 11 data sets

(Brown, 2019). The study categorized the contexts studied into 2 broad jurisdictions – low stakes (New Zealand, Queensland, Cyprus and Catalonia) and high stakes (Hong Kong, Egypt, India and Ecuador) exams environments. The summary of the findings shows that generalization to a single model was not feasible.

Brown's findings emphasize the need for contextualized understanding, revealing that the impact of ecological factors on teacher assessment conceptions is best captured through diverse, context-specific models rather than a single, universal framework (Brown, 2019). In other words, teachers' perspectives on assessment and the various strategies used to conduct assessment is affected by the various elements which impact the environments or contexts within which they operate. How teachers conceive assessment varies from one context to another.

Based on the literature review therefore, it would appear a number of the teachers (especially those in the Nigerian studies) have a summative perception of assessment. They view assessment as a tool for separating weak students from their stronger counterparts rather than a tool for closing the gaps between these groups of students. Also going by the amount of large-scale testing going on in Nigeria, majority of the teachers in this clime tend to adopt a summative approach to their assessment practices. These teachers see assessment as a ritual conducted at intervals instead of an ongoing activity. They also view tests as the most common tool for assessment.

2.16 Students' views of assessment

In recent years, the perception of students about assessment has gained the attention of several researchers (Lim, 2019; Mushtaq & Mash'hadi, 2021; Ogange et al. 2018 etc). It is now believed that students are crucial participants in their own assessment (Black & Wiliam, 1998; James, 2006). In the past, efforts to improve assessment practices have focused more on teachers than on students. This is despite the fact that learners have always been the puppets at the receiving end of the activities of assessment (Adie et al, 2018) and the ones for whom assessment was primarily designed.

It is a fact that if all efforts to improve assessment practices must yield desired results, students should be encouraged to play a more prominent role in assessment. Additionally,

a detailed comprehension of each student's learning and assessment perceptions facilitates personalized instruction, thereby optimizing student outcomes and promoting sustained academic growth (Bhat & Bhat, 2019). Knowing and understanding the perceptions of students about assessment is certainly key to fostering student improvement.

Black and Wiliam (1998) suggest that students are increasingly perceiving assessment not just as a labelling mechanism but also as a source of anxiety, with low-achieving students often bearing the brunt of this phenomenon, experiencing heightened demoralization. The implication of such views, is poorer, rather than better learning outcomes among students who belong to this grouping. How students view assessment is likely to impinge on their approach to it and the outcomes from it.

The research underscores the dynamic interplay between assessment perceptions and student preparation, highlighting the significance of understanding how students' views on assessment evolve throughout the assessment process (Van de Watering et al., 2008). Sadly, the literature suggests that assessment practices often fail to adequately consider the challenges students encounter during assessments (James, 2006). From the author's experience, some students think of assessment, especially summative assessment as a punishment or some necessary evil they must put up with.

Others tend to view it as the teacher's whip for getting even with students. Few students see assessment as a strategy for improving learning because several teachers do not see it as such. Teachers with this mindset see assessment as merely a way to quantify learning outcomes. Drawing from personal experience, the author notes, many students tend to view assessment as punishment. Again, this is the rationale for the first and second research questions in the current investigation – to understand teachers' perspectives on assessment and their implications for student learning and academic success.

Unfortunately, the emotions and experiences of students about assessment influences their learning and learning outcomes, and also has an interesting impact on how they take part in assessment tasks (Monteiro et al., 2021). Hence, it is crucial for educators to have informed views about assessment and learning such that their students can also benefit from such views.

Research also indicates that students tend to have evaluation preferences (Van de Watering et al., 2018). It is becoming increasingly clear that students are more inclined to achieve improved learning outcomes if their assessment preferences are utilized. The research demonstrates a significant interaction between students' assessment preferences, learning preferences, and academic outcomes, emphasizing the significance of taking student viewpoints into account during evaluation design (Buyukkarci & Sahinkarakas, 2021). There is therefore a need for students to be exposed to more assessment alternatives to boost their learning and achievement.

In an investigation into the introduction of formative assessment aimed to discover if this prompted any shifts in students' assessment preferences (Buyukkarci & Sahinkarakas, 2021). The authors discovered that students preferred the traditional methods of assessment until they were introduced to formative assessment methods. They also observed that this new preference was related to the use of such strategies as sharing learning goals, the implementation of feedback and peer/self-assessment within other formative assessment strategies (Buyukkarci & Sahinkarakas, 2021). Figure 6 below, shows the formative assessment strategies which resulted in the new student preferences.

Figure 6

Formative Assessment Strategies (Adapted from Buyukkarci & Sahinkarakas, 2021)
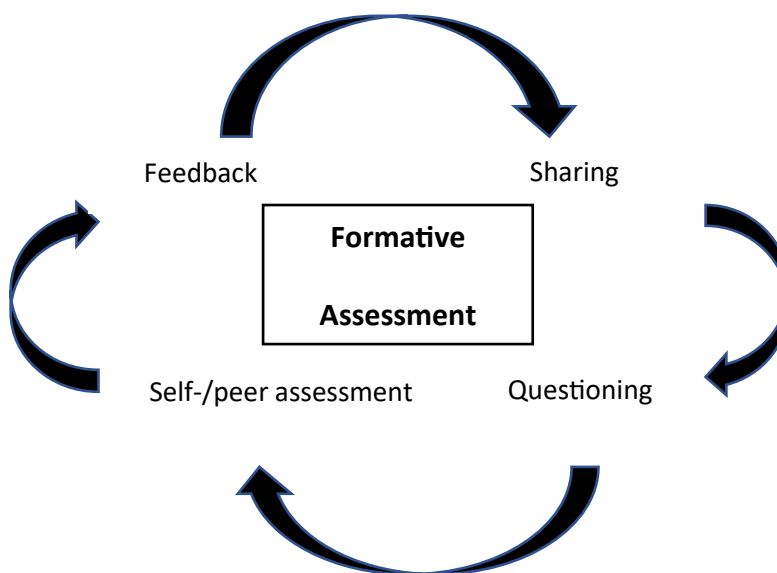
Furthermore, according to a review of the literature, Monteiro et al. (2021) observed that students tend to see assessment from at least one or more of the following viewpoints:

- Enhancement: Assessment contributes to enhancements in learning and teaching.
- External Attribution: Assessment is associated with external factors related to the student, such as future performance, career prospects, intelligence, and the reputation of the school.
- Emotional Impact: Assessment has a positive emotional influence on students.
- Perceived Irrelevance: Assessment is viewed as oppressive, inaccurate, and disregarded by students.

Some students view assessment as an activity targeted at their improvement. Others view it as being linked to one situation or the other. For example, assessment could be written because their school says so; or because they need to pass the assessment to go to college etc. In other words, assessment is purely an exercise performed by such students based on external circumstances. Still, some view the purpose of assessment as 'affective', meaning an activity which helps to shape their attitudes, interests and values. Finally, some students view assessment as being an irrelevant or unnecessary activity targeted at oppressing the student especially when the use of grades is involved. In this regard therefore, the application of grading in some types of assessment is highlighted.

Grading is a crucial component of summative or traditional assessment. Black and Wiliam (1998) view grading as the final assessment of a student's academic achievement. As mentioned before, most teachers tend to over rely on the use of summative assessment strategies which include paper and pencil tests (Modupe & Sunday, 2015; Raji et al., 2020; Sewagegn, 2019). The research by Obilor substantiates the normalization of this assessment approach, demonstrating its widespread integration into the educational fabric, with stakeholders such as educators, students and parents exhibiting a deep-seated acceptance of its legitimacy (Obilor, 2018).

However, and rather unfortunately, grading holds substantial implications within educational settings, profoundly influencing student self-image, learning motivation, curriculum prioritization, parental expectations, and social dynamics both within and

beyond the school environment (Cheng et al., 2018). In other words, the good intentions of assessment could be sacrificed at the risk of grading if adequate care is not taken by teachers and all stakeholders who use it. This is especially true when excessive focus is placed on the grading component of assessment whilst the learning aspect of the same is grossly under-emphasized (Black & William, 1998).

Furthermore, and rather sadly, it is noteworthy to mention that students who require the greatest amount of academic support tend to receive the greatest blow dealt by the unpleasant consequences of grading – the low ability learners. Added to this perception is the fact that grading tends to compare students with each other in a rather negative fashion. According to Black and Wiliam (1998), when using traditional testing methods, the dominant approach tends to emphasize normative comparisons, highlighting student competition, rather than concentrating on individual student progress. This approach often results in feedback that reinforces the perception of lower ability among weaker students, leading to demotivation and a loss of confidence in their learning capabilities (Black & Wiliam, 1998).

In line with this view, the most vulnerable students are left to fall behind without sufficient guidance or assistance – leaving them to wallow in self-pity. Thus, the teacher covers the scheme and tests the students based on what was taught. The teacher and the smart students move on, leaving some students, especially the slower ones who might not be able to keep abreast with the class pace to finish with relatively lower grades (Chappuis & Stiggins, 2002). In other words, there might be a negative effect on especially the lower achieving students when teachers view assessment only from a grading perspective.

There is therefore a critical need for teachers to design assessments that encourage self-motivation and a growth mindset in all students. This is why some countries in the developed world are reviewing their assessment practices in this regard. In Finland for instance, in order not to de-motivate students, all assessments are designed to facilitate learning rather than serve as summative evaluations. Children's work is not assigned numerical grades; instead, it is usually graded or labelled using a metric which ranges from 'very good' to 'needs practice' (Hendrickson, 2012).

There is also strong evidence that students (especially the lower achieving ones) tend to have more positive views about the use of effective feedback practices which constitutes the backbone of the principle of formative assessment, as opposed to the application of grading. For example, in Australia, students take pride in the specific and regular feedback they receive to help them achieve defined learning objectives. (Santiago et al., 2011).

Also, the application of constructive affirmative feedback in the classroom is associated with increased student learning and self-esteem (Hendrickson, 2012). Buyukkarci & Sahinkarakas' (2021) study also shows that students liked formative assessment strategies once they were exposed to it. All these studies at least agree on the impact that students' perception of assessment practices could have on their attitude towards learning.

In all, this does not mean that traditional or high stakes testing should be completely abolished. The Assessment Reform Group (1999) underscores the imperative of grading in assessment, highlighting its significance in promoting accountability, evaluating student performance, and informing instructional decisions.

Furthermore, research highlights the potential for summative assessment to be augmented through strategic alignment with formative assessment, enabling instructors to harness the benefits of a comprehensive, multifaceted evaluation framework (Bhat & Bhat, 2019). The point however, is that, relying solely on traditional assessment methods is insufficient for enhancing students' learning capabilities. Thus, incorporating diverse alternative assessment methods is essential for fostering students' creativity, proficiency, and productivity in their respective study areas (Sewagegn, 2019).

In summary, it is essential to recognize the significance of the concept of student agency. This concept arrogates power to students such that they meaningfully participate in the activities that surround their own learning. According to OECD (2019), student agency can be defined as,

> …the capacity [of students] to set a goal, reflect and act responsibly to effect change. It is about [students] acting rather than being acted upon; shaping rather than being

shaped; and making responsible decisions and choices rather than accepting those determined by others. (p. 2)

It follows then that when students are allowed to participate in talks about assessment practices, especially those used in assessing them, they are more likely to respond better to such assessments. For instance, students (as well as teachers) can be allowed to attend forums where criteria for vetting high stakes summative assessments are discussed. A strong relationship can be observed between student agency and the use of formative assessment – the students take charge of the learning process. Research Question 3: 'What is the effect of formative assessment practices on learning outcomes in mathematics?' hopes to find out whether the issue of student agency plays any vital role in student learning and academic achievement.

2.17 Educational assessment policy reforms assessment in Nigeria

References have been made to various studies on mathematics teachers' assessment practices in Nigeria in the previous sections of this chapter. This section provides an overview of the evolution of the assessment practices in Nigeria. The assessment system in Nigeria has evolved over the last few decades. A number of authors and publications capture teachers' assessment practices in Nigeria (Adediwura, 2012; Afemikhe and Omo-Egbekuse, 2011; Ajayi, 2019; Esomonu et al., 2020; Modupe & Sunday; Matilda & Helen, 2019; National Policy on Education, 2014; Osiesi, 2023).

Nigeria's National education policy captures government's intended purpose for assessment in Nigeria's education system. The National Policy on Education in Nigeria constitutes a seminal document that delineates the nation's educational philosophy, objectives, and benchmarks, thereby providing a strategic framework for the attainment of quality education (FRN, 2014). Before the 1980s, students were assessed based on just one summative assessment in the form of a final exam, given at the end of the term.

Durotolu's findings suggest that traditional assessment methods relied heavily on a single, high-stakes examination to determine learners' overall achievement, cumulatively evaluating their progress over time (Durotolu, n.d.). This system of assessment was accompanied by a number of setbacks. For instance, its outcome may not necessarily

represent the students' true abilities. Writing about this system's demerits, Ayua (2012) observes that,

> The old system of education in Nigeria was that of the British system of education, did not lay emphasis on several samples of an individual's performance. It lacks continuous assessment. Thus, a single shot sample of an individual assessment was used. The ''almighty'' final examination was the sole determinant of the learner's progress and promotion to higher educational levels. (p. 146)

This system did not capture all aspects of the learner's ability but focused only on certain aspects of learning. The traditional assessment paradigm exhibited a pronounced bias toward cognitive evaluation, thereby neglecting the affective and psychomotor dimensions of learner development, resulting in an incomplete and fragmented understanding of learner abilities (Ayua, 2012). It was in view of this demerit that the continuous assessment system was introduced in the early 1980s (Durotolu, n.d.). Accordingly, the new assessment system was meant to correct the deficiencies spotted in the old assessment system.

Based on Falayalo's understanding of the matter, continuous assessment of learner progress refers to a systematic approach where final evaluations integrate performance data from throughout the learning period, encompassing cognitive, affective, and psychomotor domains (Yashim & Jibrin, 2020).

Despite this new reform, the continuous assessment system also had its own setbacks. For the records, the intentions of continuous assessment system are set out in the National Policy on education. In alignment with the policy, continuous assessment was established as the primary evaluative mechanism to inform student progression decisions and ensure consistency across both public and private school sectors (FGN, 2014). This statement suggests that the fundamental aim of assessment is to advance students from one class to the next one. This purpose resonates well with the idea of summative assessment where the main focus is to determine if the examinees are competent to move to the next level.

In Nigeria, it comes as no surprise that continuous assessment in conjunction with national examinations are solely for the purpose of certification (FGN, 2014). Arguably, the

National Policy itself does not clearly portray assessment as *formative* – which is a learning tool vital to students' academic improvement over time. According to Blakemore, (as cited in Bell and Stevenson, 2006, p. 14), policies are 'aims or goals, or statements of what ought to happen'. In effect, Nigeria's education policy on assessment sets the tone for assessment practices in Nigerian schools. Based on the problem statement of the current research, there is a critical need to examine assessment in this clime from policy to practice in order to ascertain where it may have fallen short of expectations (Afemikhe & Omo-Egbekuse, 2012) and to fill these gaps accordingly and promptly too.

Apart from the rather shallow purpose of assessment, the literature also reveals a number of significant issues affecting assessment practices in Nigeria. These include teachers' attitude to assessment, absence of uniformity for implementing assessment, lack of adequate teacher assessment skills, absence of proper supervision of teacher assessment practices etc. (Afemikhe & Omo-Egbekuse, 2012), teachers' negative view of the relationship between assessment and its effects on teaching practices and student learning (Adediwura, 2012) etc. These issues suggest that all is not well with teacher assessments in many schools despite the fact that assessment ought to improve student learning for both school-based and certification exams (Afemikhe & Omo-Egbekuse, 2012).

Durotolu's (n.d.) investigative study undertook a comprehensive examination regarding the Continuous Assessment system in Nigerian schools, elucidating 10 pivotal challenges that impede its effective implementation and proposing viable solutions as detailed below:

1. ways to guarantee that educators at every stage of the educational journey have the necessary and comprehensive technical knowledge of the Continuous Assessment (C.A.) system;

2. strategies to diminish or eradicate teachers' overall indifferent attitude and lack of commitment towards the administration and execution of Continuous Assessment (C.A.) in our schools;

3. methods to standardize the practices of Continuous Assessment (C.A.) across schools;

4. strategies to address the high teacher-student ratio, which has led to excessive workloads for teachers in our schools;

5. measures to maintain integrity in the practice of Continuous Assessment (C.A.) and the assignment of C.A. grades by teachers and head teachers;

6. methods to safeguard Continuous Assessment (C.A.) records in our schools;

7. strategies to reduce or eliminate the pervasive issue of examination malpractice nationwide;

8. methods to address the disparities in the quality of education among various types of schools in the country (Federal Government-owned, State Government-owned, Private, Command/Naval Schools);

9. methods to enhance supervisory practices in our schools and ensure consistent and adequate oversight;

10. strategies to secure improved and adequate funding for education in the country.

Durotolu (n.d.)

From the above, it comes as no surprise that most of the problems listed are not unrelated to teachers. Therefore, it is reasonable to think that many of these challenges can be tackled by addressing teacher assessment needs in Nigeria. Nortvedt and Bucholtz's (2018) findings suggest that mathematics education would benefit significantly from the advancement of assessment practices, warranting further investigation and development (Nortvedt & Bucholtz, 2018).

Another important issue raised in Durotolu's list of challenges is not unrelated to the formulation and implementation of workable policies across the school system in Nigeria. Hence, the critical need to review the effectiveness of the primary school mathematics assessment system in Nigeria with a view to repositioning it for better outputs, especially with regard to its potential to enhance student learning outcomes.

2.18 Challenges mathematics teachers face with assessment

The challenges teachers encounter with assessment in mathematics education are enormous. Several studies attest to this claim. For instance, Ekong (2012) asserts that

mathematical assessments are theoretical in nature. This means that practical evaluations are rare or absent in teachers' mathematical assessment practices. Other issues with the assessment practices of primary school mathematics teachers include absenteeism, tardiness and truancy of pupils, lack of assessment materials, lack of motivation by pupils and teachers' poor assessment skills (Azuka, 2014). Other challenges experienced by mathematics teachers include students' phobia for the subject, inadequate teacher training (Benebo-Solomon & Abavier, 2024), large class sizes and unclear assessment policies.

In trying to address these challenges, the importance of teacher training and the provision of resources for assessment is key. Several authors therefore call for the prompt implementation of these measures. For instance, Modupe and Sunday (2015), Obilor (2018), Raji et al. (2020) and Sewagegn (2019) advocate for relevant teacher training opportunities while Benebo-Solomon and Abaver (2024) solicit for the provision of hands-on resources such as math manipulatives and games. Murphy and Ferrara (2023) also call for the integration of technology in assessment practices.

2.19 The way forward: suggestions from the literature

In view of discoveries from the literature, what then is the way forward, particularly in relation to the evaluation methods employed by public primary school mathematics teachers? Which assessment practice(s) should primary school mathematics teachers, schools and policy makers adopt? This review would be incomplete if it fails to highlight suggestions as to how such assessment practices can be improved upon in various contexts. The literature provides useful suggestions which attempt to answer these questions.

However, there is an obvious need for further studies, especially if these questions must be answered judiciously. There is no doubt about the fact that new forms of assessment are growing faster in demand due to the changing perspectives in teaching, learning and curriculum. Some authors are calling for an eclectic approach which combines learning theories and assessment practices from the behaviourist and constructivist paradigms. Is it possible that in the future, we might develop a more comprehensive meta-theory that integrates insights from what currently seem like distinct perspectives? This meta-theory has the potential to enable diverse assessment practices to fit various contexts and objectives, while preserving internal consistency and coherence (James, 2006).

James is not the only researcher calling for the exploration and/or adoption of combined assessment practices (James, 2006). More recently, Brown (2019) also recommends repurposing summative tests for formative and diagnostic purposes. Similarly, Obilor (2018) posits that a holistic assessment framework necessitates the strategic integration of assessment of learning, assessment for learning, and assessment as learning, with the effective teacher exercising professional judgment to determine the optimal balance. Sewagegn (2019) calls for the combination of summative and formative assessment practices. Sewagegn's assertion underscores the necessity of supplementing traditional assessment methods with alternative approaches, thereby cultivating a more sophisticated and impactful learning environment that nurtures creativity, proficiency, and productivity (Sewagegn, 2019).

Sewagegn's assertion underscores the inherent limitations of singular assessment methods, emphasizing the requirement for a nuanced and multifaceted assessment approach to accurately measure the complexity of student learning and provide varied opportunities for demonstration (Sewagegn, 2019). Other recent studies in favour of combining formative and summative assessment practices include Broadbent et al. (2018) and Buchholtz et al. (2018).

Research by the Assessment Reform Group emphasizes the critical need for assessment reform, arguing that timely innovation will unlock significant improvements in achievement profiles and foster a more effective learning environment (Assessment Reform Group, 1999). Beyond the changes being solicited for in assessment practices, there have also been calls for changes in policies, teachers' thinking and preparations.

For instance, Australian policymakers might consider clarifying their objectives regarding the execution of formative assessment and take steps to guarantee that teachers possess the necessary skills and knowledge to effectively utilize it (Santiago et al., 2011). It means that if the quest to apply the appropriate form(s) of assessment practices required to match the demands of both today's, and tomorrow's needs must be achieved, policy makers must shift grounds on their views about assessment.

Halinen's work underscores the imperative for teachers to undergo a paradigmatic shift in their thinking and practices, embracing innovative pedagogies that cultivate students' critical thinking, creativity, collaboration, and sustainability awareness, thereby preparing them for an increasingly complex, interconnected world (Halinen, 2018). No matter how good assessment reforms are, it is only teachers with the right mindset who can successfully implement them.

There is no gainsay in the fact that teachers whose thinking capabilities are poor are unlikely to maximise assessment strategies that require teachers to have the necessary proficiency and knowledge base, and students to think in creative ways. This is why several authors have called for more teacher training, especially in the area of alternative or innovative assessment methods (James, 2006; Modupe & Sunday, 2015; Raji et al., 2020; Santiago et al., 2011; The Assessment Reform Group, 1999).

Sewagegn notes that all teachers require assessment expertise to craft, implement, and scrutinize assessments that foster learning achievements (Sewagegn, 2019). Another group of authors believes that teachers are likely to embrace alternative and innovative assessment strategies provided they are given regular and sufficient training (Raji et al., 2020). Still, another source (Santiago et al., 2011) notes that,

> Effective [alternative] assessment requires that teachers develop sophisticated skills for uncovering students' level of understanding, for providing feedback and adjusting teaching strategies to meet identified needs, and for helping students to develop their own skills for learning to learn. (p. 68)

Similarly, an Organisation for Economic Cooperation and Development report (OECD, 2005 as cited in Santiago et al., 2011) reiterates the need for an upskilling in teacher expertise in assessment methodologies to strengthen the outcomes of alternative assessments.

> Strategies to improve the impact of [alternative] assessment might include a stronger focus on short-cycle classroom interactions, building teachers' repertoire of research-based formative assessment techniques, and strengthening the approaches to respond to identified learning needs. (p. 68)

One crucial role of assessment is the gathering of student information in order to determine how to support him/her best. To maximize student learning, teachers need to move beyond mere data collection, developing the skills to analyze, interpret, and act upon the information gathered, using it to inform and improve instructional decisions. As noted by Bhat and Bhat (2019), the significance of teachers collecting information/data on student learning extends beyond mere accumulation. How teachers respond to and act on the information they obtain is arguably very important. On the basis of all the foregoing, the figure below illustrates all the components required to improve upon current assessment practices.

Figure 7

The Way Forward for Assessment
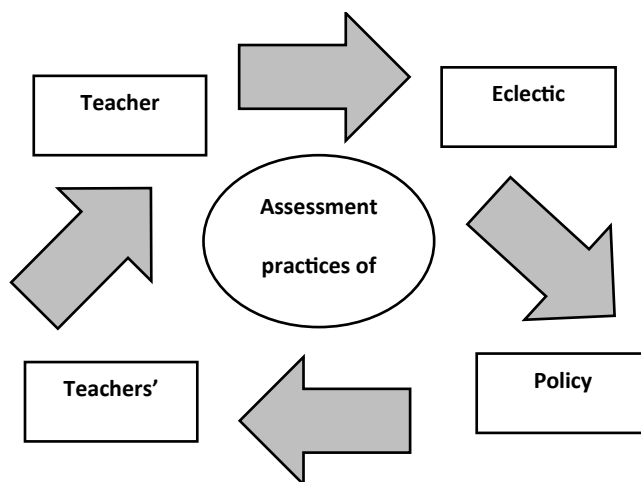
First, there is a crucial need to improve or upgrade teachers' skills and perceptions through productive training sessions by specialists in the field of assessment. Eclectic approaches which combine effective assessment practices can then be deployed based on viable adjustments in assessment policies. This process will have to be a continuous process in order to be effective and relevant. In other words, for changes to current assessment practices to be worthwhile, such changes will need to consider the use of combined approaches in assessment which are student-centered and policy aligned.

Fullan et al. (2005) list 8 forces for leaders of change in education. When it comes to implementing new innovations in education, these forces are quite significant. They involve engaging moral purposes, building capacity, comprehending the change process,

developing learning cultures, nurturing evaluation cultures, emphasizing change leadership, fostering coherence, and supporting trilevel development (Fullan et al., 2005). The implication of these forces is that training (building teachers' capacity) alone is insufficient to drive the needed change.

There are other factors necessary to bring about change that guarantees results. For instance, engaging teachers' moral purpose must precede any meaningful training. Similarly, teachers must understand or own the change process in order to overcome the barriers that lie in the way to change and so on. It is not unlikely that most of the teacher development efforts so far, especially in this part of the world, are failing (or at least not achieving their desired outcomes) because their emphasis has been restricted to only trying to build teachers' capacities without providing any or sufficient supporting mechanisms.

2.20 Summary of literature review

This chapter provides a comprehensive review of the current state of knowledge on the impact of teacher assessment practices on student learning outcomes in public primary school mathematics education. The discussion explores various theories of learning focusing on how these theories have helped to shape assessment practices as we understand them today. It stresses that behaviorist theories of learning alone cannot produce the best type of learning and learning outcomes. There is a need for more flexible approaches such as the constructivists and sociocultural theories of learning that encourage critical thinking and collaborative skills which promote better learning.

The chapter highlights mathematics as the foundation of science and technology, underscoring its importance in fostering logical reasoning, problem-solving skills, and national development. Additionally, a significant part of the chapter is devoted to the types of assessment used by teachers in mathematics education. There is a general consensus that the best assessments provide feedback to both teachers and students, identify learning gaps, and guide instructional adjustments.

The chapter also reviews empirical studies, noting persistent gaps in assessment practices among mathematics teachers, particularly in public schools. Many rely heavily on summative tests, neglecting formative techniques that support deeper learning.

Consequently, students' mathematical proficiency often remains below expectations, affecting performance, especially in higher education and STEM-related careers.

The study also reviews teachers' and students' views about assessment focusing on how these are likely to influence its quality. It provides an overview of the common assessment practices used in Nigeria and how these impact mathematics learning and learning outcomes. Challenges such as lack of resources, large class sizes, poor teacher preparation, and learners' negative attitudes are identified as barriers to effective mathematics teaching.

The review concludes by identifying the need for improved assessment strategies which use a blend of summative and formative methods, better teacher training, and a shift toward practices that integrate both summative and formative assessment strategies.

CHAPTER THREE: RESEARCH METHODS AND DATA COLLECTION

3.0 Introduction

This research assessed the proficiency of assessment techniques employed by public primary school mathematics teachers in Abuja, Nigeria.

The study explores the persistent poor learning outcomes evidenced by the poor performances posted by several students in both school-based and external exams in mathematics. The aim of the study therefore is to tackle this challenge through the use of a formative assessment strategy. Evidence from recent studies confirms that students have a tendency to either fail mathematics exams or perform poorly in them due to a myriad of reasons (Brookhart & Nitko, 2019; Maliki et al., 2017; Mazana et al., 2020). Alongside these failures are various other challenges such as examination malpractice (Maeda, 2021) and the risk of nurturing a science- and technology-stunted economy (Abuge, 2021; Mazana et al., 2020).

Furthermore, a significant challenge persists regarding students' preparedness for post-secondary education. The development of mathematical abilities is vital, as these skills are foundational for understanding and excelling in STEM disciplines (science, technology, engineering, and mathematics). Mastery of mathematics is crucial for students' future success in these fields, which are essential for producing innovative professionals equipped to drive technological progress and scientific discovery (Mazana et al., 2020).

Clearly, this mathematical challenge is a national problem. The implication of poor mathematics results is ultimately a failed state waiting to happen, since these challenges pose serious threats to the development and sovereignty of Nigeria as a nation. There is an urgent need to address these challenges in order to mitigate the steady decline already being witnessed in the country's economy.

The use of assessments to raise and better the quality of student education and their academic performance is fast becoming an accepted classroom tradition in many parts of the world today (Abejehu, 2016; Korb, 2018; Sewagegn, 2019). Almost all schools in Nigeria use assessment practices but the effectiveness and capacity of such practices to reasonably improve student learning and academic performance need to be carefully

ascertained. The employment of subpar assessments by mathematics educators creates shortcomings in their assessment strategies. Such gaps in turn breed poor learning and academic achievement as far as students are concerned.

This investigation aims to address the gaps and limitations in the assessment strategies employed by public primary school mathematics teachers in Abuja, Nigeria by evaluating the views of these teachers and exploring the workability of alternative forms of assessment. The following constitute the research problem in the present study.

First, many teachers struggle with providing constructive feedback to students, a crucial aspect of effective assessments. According to Osiesi (2023), effective feedback plays a vital role in enhancing teaching and learning quality. The Nigerian educational policy emphasizes the importance of assessment in improving learning outcomes (FGN, 2014). Ideally, assessments should drive learning in classrooms, but when they fail to do so, it poses a problem. Research has shown that effective feedback can significantly improve learning quality (Harrison et al., 2015; Osiesi, 2023).

However, the emphasis on grades often overshadows concerns for constructive feedback and improvement. Teachers tend to prioritize numerical grades over meaningful feedback that addresses misunderstood concepts. As noted by the Assessment Reform Group (1999), grades may indicate success or failure but do not provide guidance on how students can improve or progress.

To achieve better learning outcomes, Nigeria's assessment practices need to focus more on enhancing conceptual understanding rather than just celebrating grades. By shifting the emphasis from grades to the learning process, teachers and students can achieve more profound outcomes. Building a strong feedback culture in Nigerian primary schools is essential to improving teaching and learning standards (Harrison et al., 2015).

Secondly, Nigerian primary school mathematics teachers often have misconceptions about assessment, prioritizing grades over learning enhancement. This leads to flawed assessment practices, including cheating and malpractices. According to Raji, Daramola, and Oladele (2021), assessment should be an ongoing process that fosters effective teaching

and learning. However, many teachers view assessment as a means to rank students rather than improve learning outcomes.

To address this, teachers need to rethink their approach to assessment, focusing on enhancing student learning rather than just measuring it (Guskey, 2003). By shifting their perspective, teachers can use assessment to promote learning and improve instructional practices. This study aims to highlight the true purpose of impactful assessments in primary school mathematics and promote a more effective approach to assessment.

Thirdly, the National Policy on Education in Nigeria outlines a comprehensive assessment framework that includes both summative and formative assessments. However, the implementation of this policy has been a challenge, with many teachers relying heavily on paper-and-pencil tests that prioritize grades over meaningful feedback. Despite the policy's aim to accurately measure student abilities and enhance competitiveness, the reality is that assessments often focus on numerical grades rather than learning improvement. This disconnect between policy intentions and classroom practices undermines the effectiveness and integrity of assessments.

The continuous assessment system in Nigeria, which involves written tests and end-of-term exams, has been reduced to a grading system that neglects the formative aspects of assessment. Teachers often view continuous assessment as ongoing testing, rather than a tool for learning improvement. To improve assessment practices, it is essential that all stakeholders, including policymakers, curriculum developers, and teachers, have a shared understanding of the purpose and implementation of assessments.

Ultimately, the success of assessment policies depends on their effective implementation in the classroom. By prioritizing meaningful feedback and learning improvement, assessments can play a crucial role in enhancing student learning outcomes and promoting competitiveness. However, without a clear understanding of the purpose and workability of assessments, the policy's intentions are unlikely to be fully realized.

Finally, many teachers are unfamiliar with alternative assessment methods that could potentially enhance students' learning and academic performance (Korb, 2018). This

knowledge gap underscores the need for the present study, which aims to investigate the effectiveness of a formative assessment approach in public primary schools in Abuja.

This mixed methods research, designed as a single-phase study incorporating both quantitative and qualitative elements, aims to understand the assessment approaches used by primary school mathematics teachers in Abuja, the capital of Nigeria, with a view to determining the effectiveness or otherwise of such practices. Specifically, the objective of this study was to examine the effectiveness of assessment practices in selected public primary schools in Abuja using mathematics as the basis for the research.

The reason for using mathematics as the basis for this study is that mathematics is a core subject offered by all learners in both primary and secondary schools in Nigeria. Furthermore, mathematics is gateway to other fields such as science, technology, and engineering (Manzana et al., 2020). Because schools and teachers play a vital role in using assessment to support children's educational development, an evaluation of the extent to which their assessment practices are successful is likely to help identify and fill any potential loop holes in their assessment competencies and expertise.

In view of the fact that the nature of a research problem is a core requirement for deciding the research method (Zaborek, 2009), this research applies a blend of narrative and statistical methods. It applies a qualitative method for collecting the views of mathematics teachers on assessment, and a quantitative research method for determining the demographic data of the participants and more views about assessment. It also uses content analysis to determine the effectiveness or otherwise of a formative assessment method.

In relation to the method adopted for the current investigation, the author employs a triangulation mixed methods design, integrating both narrative and numerical approaches. The main basis of this research was to optimize the learning outcomes in mathematics education in Nigerian primary schools and to establish a solid foundation for other fields such as science, technology, and engineering in Nigeria.

In summary, this chapter focuses on the research methodology and design employed in the study by attempting to describe and also substantiate these. Thus, the research

questions, purpose, methods and theoretical frameworks used are mentioned briefly. It reviews the participants and sample selected for the research.

In terms of the study's target population, a general description of the participants included in the study is provided. For instance, years of teaching experience, gender ratio, experience etc. are discussed. It also describes the tools employed in data collection and the rationale for using them. Study procedure and ethical assurances are further elaborated on in this chapter. Finally, this chapter offers a description of the data collection techniques deployed in the present study. It discusses the subjects of the study and provides brief details about the data analysis. Chapter Three closes with a brief recap of the chapter's content.

3.1 Research approach and design

Several factors influence the design of a research project and this study is not in any way an exception to this rule. The most successful research projects are therefore the ones that pay sufficient attention to these factors. Researchers will need to plan their design such that these factors do not work against the overall success of the research.

According to Neuman (2014), crafting an ideal research project is a stimulating academic endeavor, yet practical constraints inevitably influence its design when it comes to actual implementation. Key limitations encompass factors such as time constraints, budgetary considerations, resource accessibility, regulatory approvals, ethical considerations, and requisite expertise (Neuman, 2014).

Building on the previous discussion, the current study design was influenced by factors such as the overall aims and approach of the study, time constraints, costs, approval from the University Research and Ethical Committee (UREC), and resource availability. The following are the steps taken in designing this research.

3.1.1 Research paradigm

The character of the study and its guiding questions significantly influenced the selection of the research paradigm, approach, methodology, and sampling strategies (Figure 8). After all, research questions provide the basis for determining most of the components in research (Robson, 2011). This is because research questions, when effectively designed, can contribute to resolving the research problem. They provide valuable insights that help

the researcher determine the most effective study design and population for the research. They also provide direction as to the specific data to collect and analyze.

Figure 8

The Role of Research Questions in a Research Design
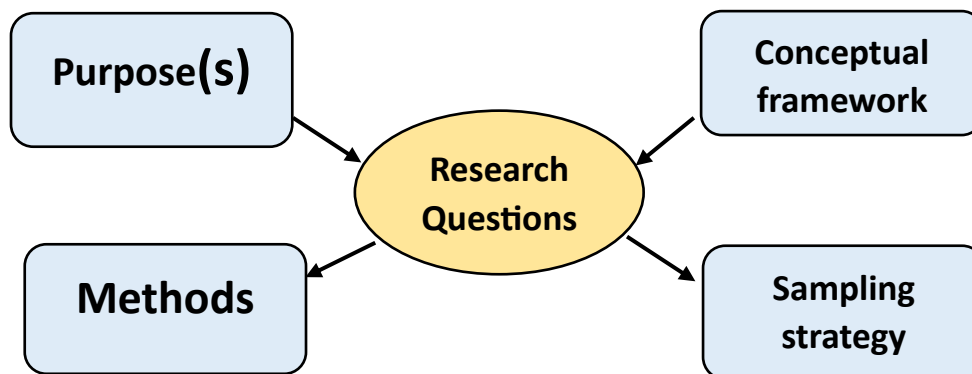
For the purpose of emphasis, the research questions formulated for this study include the following:

Q1. What are the views of primary school mathematics teachers about assessment practices?

Q2. How effective are the existing assessment strategies teachers use, in improving students' learning and academic achievement in mathematics?

Q3. What is the effect of formative assessment practices on learning outcomes in mathematics?

Based on the research questions therefore, a research paradigm and method were considered. The research paradigm and method needed to effectively address the research questions while also offering the best kind of evidence needed for the research study.

Research paradigms refer to the shared understanding and methodological approach adopted by a community of researchers within a specific field (Robson, 2011). It is a researcher's worldview or set of beliefs within which a research study is situated. The paradigm is how a researcher sees and understands the world. The significance of paradigms in scholarly inquiry lies in their provision of foundational beliefs and dictums that shape the epistemological and methodological orientations of researchers within a specific discipline (Kivunja & Kuyini 2017).

In other words, the research paradigm tells how meaning would likely be constructed in a study considering the data collected and the researcher's background experience. Although multiple paradigms inform and influence the practice of narrative and numerical research in education and social sciences (Hartas, 2010), this investigation takes a hands-on approach, concentrating on methods rather than abstract concepts (Robson, 2011).

Nonetheless, in this study, the pragmatist epistemological assumption aligns with a practical and action-oriented approach to evaluating the effectiveness of the assessment practices of public primary school mathematics teachers. This perspective focuses on the concrete consequences of assessment practices (such as student learning outcomes) as opposed to solely on theoretical or abstract considerations.

Furthermore, in terms of philosophical assumptions this study may be viewed within the ontological and epistemological perspectives. The study views teacher assessment practices and student learning outcomes as real or existing entities which are related to each other such that effective assessment practices should result in both better learning and learning outcomes. It uses an enquiry approach to study this relationship. Theoretically, the study is guided by the constructivist theory and sociocultural theories of learning (SCT). The basis of choosing these theories is that some studies have linked them to certain alternative assessment practices which the researcher wanted to follow up on and verify in the study reported here.

It is also worth noting that it is essential to acknowledge that advocates of the pragmatic paradigm in research tend to endorse practical methodologies and pluralistic approaches that enable a combination of methods. This combination sheds light on participants' actual behaviors, the underlying beliefs driving those behaviors, and the potential consequences stemming from different behaviors. Furthermore, (Onwuegbuzie and Leech, 2005 as cited in Robson, 2011) consider the following as the benefits of a pragmatic approach:

> Flexibility in investigative techniques, ability to address a wide range of research questions, promotion of collaboration among researchers including those with different philosophical thinking, the tendency to see research as a holistic pursuit, the tendency to favor the use of qualitative methods to inform the quantitative parts of a study and vice versa. (p. 171)

Thus, this research explores the views of teachers about assessment practices by using qualitative techniques to validate the quantitative aspects of this study. Thus, Research Question 1 (RQ1) was used to generate quantitative data on teachers' assessment practices, and the beliefs behind these practices, while Research Questions 2 and 3 were used in synthesizing qualitative data on the success (or otherwise) of the practices highlighted from RQ1. The choice of collecting quantitative data through RQ1 is based on the possibility of the questionnaire to reach all members of the sampled population.

The researcher is not unaware of the controversies surrounding pragmatism as a research paradigm, and the *paradigm tussle* between the positivist and interpretivist research paradigms. In fact, Maarouf (2019) notes that,

> During the '80s each group of [quantitative and qualitative] researchers claimed that their approach is superior and some of them were *purists* assuring that the quantitative and qualitative approaches cannot be combined together because of the quantitative-qualitative paradigmatic differences, what is known as the incompatibility thesis. (p. 1)

However, in recent times, researchers such as Maarouf, 2019, began to explore the idea of mixing both research methods so much so that 2013 witnessed a significant output of mixed-methods research, with nearly 1800 studies published, compared to just around 20 articles per year in the 1990s (Maarouf, 2019).

Another criticism of the pragmatic paradigm stems from the stance that this paradigm does not address the rifts between both quantitative and qualitative methods. It combines the two without fully considering their interrelationship, predicated on the notion that methodology operates independently of epistemology, disregarding the potential influence of underlying beliefs and knowledge structures on research approaches (Maarouf, 2019).

Hampson and McKinley (2023) also identify six criticisms against pragmatism as a research paradigm. These authors note the following, 1. It is considered a paradigm of convenience, 2. It adopts a consequentialist perspective on what constitutes good research, 3. It views truth through a consequentialist lens, 4. It posits that responses to knowledge-based questions lie somewhere midway, 5. It prioritizes the research question over

ontological or epistemological concerns and 6. It sees itself as essential for conducting mixed research (Hampson & McKinley, 2023).

However, pragmatism is simply an approach that allows the researcher to use what works best to achieve practical results, or to use what has had the most success in practical terms. In trying to overcome the philosophical debates and criticisms which shroud the mixed methods approach, this current investigation employs a combined methods approach, integrating quantitative and qualitative methods within a single paradigm (Barnes, 2019; Maarouf, 2019). Moreover, several researchers continue to stress that pragmatism does have a metaphysical rationale for the combined methods research approach (Denscombe, 2007; Maarouf, 2019; Mitchelle, 2018).

3.1.2 Research method

Given the previous points, it is a well-established fact that this study employs a mixed methods design. Mixed methods research asserts that combining statistical and thematic approaches provides a thicker and in-depth understanding of the research problem as opposed to engaging a single methodology alone (Maarouf, 2019). In other words, the total aim of using a combined research approach, is to lend credence to a study's outcomes and also support the published literature. In short, a combined research design is considered in this research for the following reasons:

- Complementarity – This involves leveraging the potentials of one study technique to complement and beef up another (Maarouf, 2019)

- Processes and outcomes – The ability of the mixed research design to focus on both the processes and the outcomes of the research also render it suitable for the present study (Robson, 2011, 75).

- Triangulation – According to Maarouf (2019), triangulation aims to enhance and fortify research outcomes by employing a blended method for collecting and analyzing data to investigate the same phenomenon. This comprehensive approach facilitates a richer and more multifaceted comprehension of the phenomenon being investigated. In addition, triangulation can be used to validate the results obtained

from one method by comparing them with those derived from an alternative approach (Glogowska, 2011; Maarouf, 2019).

Notwithstanding, one of the major drawbacks of employing a mixed methods research design is that it requires more effort, time and money. Additionally, it requires combining at least a minimum of two research phases (Maarouf, 2019) which are namely a quantitative phase and a qualitative phase. It also means the researcher needs to learn to utilize a mixed-methods approach such as incorporating both statistical and thematic analysis techniques (Maarouf, 2019).

In terms of methodology, the issue of generalization is also an important factor. Not all mixed-methods (hybrid) research can be generalised. Whether mixed methods can be generalised or not is a function of some factors. The manner in which the sample is selected for instance matters to whether it can be generalised or not. For instance, probability samples are known to offer better chances for generalization compared to non-probability samples. This is because probability samples are often randomly selected while non-probability samples are selected purposively or conveniently. The basis for using non-probability sampling is usually not for the purpose of statistical generalization from sample to population (Robson, 2011). In hybrid research therefore, if the quantitative part of the study uses probability or random sampling and sufficient sample size, the results may be applied or generalised to the sampled population. In contrast, the qualitative part of the study which uses purposive or convenience sampling for instance, may not be generalizable to the broader population.

Notwithstanding, it is noteworthy to observe that the interest of the current investigation lies mainly in understanding the research problem by studying one aspect of an educational problem (which is teachers' assessment practices and how this relates to student learning outcomes) elaborately (Bell, 2010). Therefore, it uses a purposive sampling strategy to obtain primary data to validate the objectives of the investigation. The use of non-probability samples in small scale surveys like that of the present study is not only recognized, but also uncontested in the literature.

Non-probability sampling designs are appropriate when: 1. The research aim is exploratory or descriptive, rather than inferential, 2. The focus lies in gaining in-depth insights from a specific group, rather than making population-level inferences, and 3. Generalisability to a larger population is not a primary concern (Robson, 2011). To this end, the subjects or respondents in the present research were chosen in view of their suitability for the research based on predetermined criteria e.g. it was necessary for them to be mathematics teachers, have accumulated a minimum teaching experience of three years etc.

In trying to arrive at a design decision, it is expedient to mention that the initial plan was to employ a case study design for this research project. Case studies are commonly used in qualitative research designs that entail an in-depth, empirical investigation of a particular, present day occurrence within its naturalistic setting, leveraging multiple data sources and evidence-based approaches to facilitate a comprehensive understanding (Robson, 2011). The rationales for considering a case study design are as follows:

- The conclusions from a case study have external validity, allowing for application or generalization to comparable settings. Yin (2014) describes Diane Vaughan's research. This study represents a quintessential example of single-case research design, resulting in findings that extend beyond the specific case to inform broader contexts. Robson's work sems to underscore the view that theory development facilitates the understanding of analogous cases and situations (Robson, 2011) as that of external generalisability.

- Case studies provide individual researchers with a flexible and focused research methodology, enabling detailed exploration of a particular facet of a broader issue (Bell 2010).

- According to Schoch, A case study facilitates the extrapolation of insights and principles gleaned from the examined phenomenon, enabling the transferability of findings to analogous contexts, thereby promoting the applicability of lessons learned to other cases or situations (Schoch, 2020).

- Lastly, it's acknowledged that case studies have the capacity to integrate both narrative and numerical approaches for the collection of data within a single research

study (Gerring, 2006; Yin, 2009). This reason resonates with the philosophy of this study.

Moreover, some authors conceptualize case study design as a distinctly qualitative research approach, leveraging its inherent flexibility to explore complex phenomena in-depth (Robson, 2011). In other words, a quantitative approach should not be associated with a case study strategy since it is a qualitative strategy.

It is equally important to mention that an action research strategy was also considered for the design of this study. Action research constitutes a form of applied inquiry conducted by practitioners within their own professional contexts, driven by an identified need for organizational improvement or change, which may be facilitated through internal initiatives or collaborative partnerships with external stakeholders (Bell, 2010). This strategy was considered because the researcher thought he could carry out this study in the institution where he worked. Moreover, most conditions favoring the use of this strategy seemed to have been satisfied. For instance, Bell's (2010) work raises a number of important questions which must be answered as a means of validating the application of action research. Some of her questions include: How can researchers refine their approach to achieve greater effectiveness? What strategies can the researcher utilize to develop a deeper insight into this practice, fostering fairness and inclusivity? What strategies can the researcher employ to utilize their expertise and impact the situation effectively? In addition, can the researcher collect meticulous data that generates evidence to validate demands for action (Bell, 2010)?

Regrettably, the propensity for complications arises when firmly held beliefs and practices of certain participants are challenged, especially when research evidence suggests the necessity for radical changes to achieve progress (Bell, 2010). This circumstance necessitated the abandonment of the action research strategy. Moreover, the researcher was unsure of remaining in this institution long enough to complete the study, not to mention continuing with it after concluding his thesis. This is due to the fact that action research investigations are ongoing, as the researcher and participants engage in a continuous cycle of reflection, evaluation, and improvement, recognizing that practice is dynamic and requires regular refinement (Bell, 2010).

The specific hybrid design deployed in the present investigation is a triangulation design (Figure 2). A triangulation design constitutes a mono-phase approach where researchers conduct the statistical and thematic aspects of an investigation in similar

Figure 9

A Triangulation Design
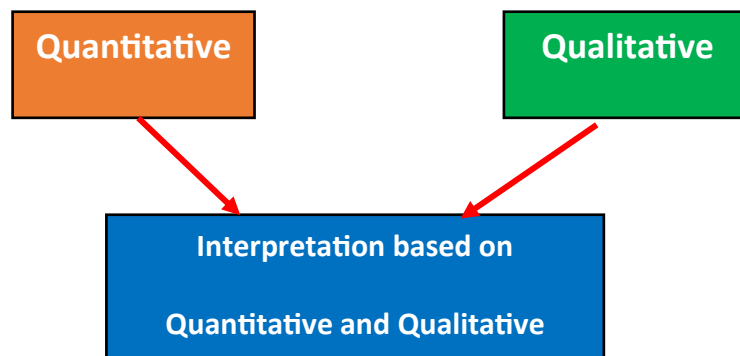
Mixed-methods research designs involve combining quantitative and qualitative approaches; when exploring these designs, Maarouf (2019) categorizes three types of designs. These designs comprise the explanatory sequential model, the exploratory sequential model, and the convergent parallel model. Of these 3 designs, the convergent parallel design appears to align best with the data collection procedure employed in this study. The convergent design is also known as parallel or triangulation design.

Overall, this study can be characterized as a mixed methods explanatory study with descriptive elements. While Research Question 1 generates descriptive information, Research Questions 2 and 3 provide explanatory information. It aims to explain the relationships between assessment practices, student learning outcomes, and the effectiveness of formative assessment strategies, while also providing a detailed description of teachers' views and current practices.

Maarouf (2019) discusses the explanatory sequential design as a form of concurrent mixed-methods research design that integrates the synchronous collection of numerical and narrative data. In other words, quantitative data is first collected and analyzed to identify trends, patterns or correlations. This followed by collecting and analyzing qualitative data to gain a deeper understanding of the quantitative findings, often to explain or elaborate the results. By merging these datasets, researchers achieve a meticulous and comprehensive

exploration of the research conundrum, resulting in a grounded comprehension of the event being investigated.

The purpose and procedures in the research at hand underscore the basis for selecting the triangulation or concurrent triangulation design. The design necessitates the researcher to gather data separately using both numerical and narrative methods to gain deeper insights into the research problem. This approach also involves integrating the separate findings during the interpretation stage (Creswell et al., 2011).

Furthermore, the data collected through all three research tools employed in this study was triangulated to ensure validity and reliability. By combining these three tools, the researcher was able to gather a rich and varied dataset, paving way for an in-depth analysis and investigation of the research problem and associated questions.

In addition to the primary reasons outlined above, another rationale for employing a hybrid approach is that neither a narrative nor a statistical method alone would sufficiently evaluate the assessment strategies applied by mathematics teachers in primary schools. The complexity of the research problem necessitated an integration of both narrative and numerical data to obtain balanced and accurate responses to the various lines of research inquiry.

Quantitative data is a valuable tool for objectively measuring phenomena and can effectively be used to examine the positions of primary school mathematics teachers about assessment practices, aligning well with the initial phase of the research (Bell et al., 2022). Conversely, qualitative research offers depth, complexity, and context sensitivity, making it a more potent instrument for comprehending the efficacy of teachers' assessment methods. This highlights the imperative for an integrated methodology.

3.1.3 Research variables

The operationalization of the variables in this study involved several key features. The independent variable, assessment practices, was studied through the collection of data on teachers' views and perceptions about assessment. A questionnaire and semi-structured interviews were used to gather data on teachers' perspectives on assessment practices, allowing for an in-depth understanding of their thoughts and experiences (Bell, 2010). Thus,

the effectiveness of assessment practices was explored through teachers' views and perceptions.

The operationalization of the formative assessment feedback strategy not only allowed the author to examine its effect on student learning outcomes but also revealed the relationship between this form of assessment and student learning outcomes (Hopfenbeck, 2018; Sewagegn, 2019). Through this investigation, the author was able to observe the impact of the formative feedback strategy on the dependent variable, student learning outcomes, and gain insight into how this assessment approach influences student learning. By analyzing the relationship between the formative assessment feedback strategy and student learning outcomes, how this approach contributes to improved learning outcomes was better understood.

3.1.4 Research procedures

The following procedures characterized the research:

A. Following the approval by the UNICAF Research Ethics Committee (UREC) in December 2022 to proceed with data collection, a gatekeeper letter was submitted to the authorities of 13 proposed primary schools in January 2023. The researcher received an affirmative response from 11 of these schools to proceed with the data collection exercise within the same week. Furthermore, these 11 schools opened their doors to the researcher and permitted him access to middle and senior managers of the institutions. The schools are all day schools located in Abuja, Nigeria's Federal Capital Territory. The schools are all primary schools and use the National curriculum prepared by the National Education Research and Development Council (NERDC) to teach a number of subjects inclusive of mathematics, English, Information and Computer Technology (ICT) etc. The schools provide education to children aged 6 – 11 which represent ages of primary 1 – 6 children. A total of 115 mathematics teachers took part in the present study.

B. Next, a sensitization meeting was held with heads of department and/or subject coordinators (middle managers) over a 1-week period as it was not easy to meet with all the teachers at the schools due to the nature and demands of their work. These meetings also took place in January 2023 during school hours when most of the teachers

were busy with their lessons and other duties. The study's core and research problem were examined at these meetings.

The middle managers also were provided with an opportunity to ask questions and seek further information about the study. This was important since the middle managers were expected to in turn explain the rationale for conducting the research to the teachers in their schools/departments. In addition, they were expected to distribute the questionnaire to the right personnel. This aspect of purposeful sampling necessitates access to a key informant who serves as the source for subsequent samples (Shaheen & Pradhan, 2019).

C. Since Research Question 1 was meant to investigate demographic details, teachers' approaches to assessment and the reasoning that informs them, the importance of completing the questionnaire correctly was emphasized. The significance of Research Questions 2 and 3 was also discussed.

D. The questionnaires (Appendix 1) were mailed to the middle managers in the same week for onward distribution to teachers in their various schools/departments. Based on the meetings with the middle managers, the questionnaire instrument was distributed to the 115 mathematics teachers at the 11 schools. This episode lasted for another 2 weeks. The questionnaires were completed and returned online using Google Form. Furthermore, the survey was designed to collect numerical data and assess respondents' views about assessments. Clear and concise questions were featured using multiple-choice questions (MCQs) and the Likert scale. To ensure reliability and validity, attention was paid to the stage of wording questions and piloting the instrument (Bell, 2010) as well as expert opinion. The questionnaire comprised 25 questions and answered RQ 1.

E. Semi-structured interviews (see Appendix 2) were carried out over a period of approximately 2 to 3 weeks, according to how available the participants were. The interview questions were designed to gather in-depth qualitative insights. A pilot test was conducted with the aim of ensuring validity (Abd Gani et al., 2020) and reliability (Bell, 2010, p. 119) of the procedure/tool. Eleven teachers were initially chosen for interviews from the eleven schools using a purposive sampling method. This equated to

selecting one teacher per school. However, only nine teachers were eventually interviewed in all representing about 82% of the eleven teachers. The middle managers were tasked with selecting the interviewees based on the following inclusion criteria:

- First degree in mathematics
- Possession of teaching qualification(s)
- Possession of a Teachers Registration Council of Nigeria (TRCN) certificate
- Evidence of teaching and preparing students for certificate examinations
- Years of teaching experience

The interviews were conducted on telephone to gain valuable time as well as to maintain anonymity of the participants. Responses to the interview questions helped to address the Research Questions. The interview questions were therefore grouped into 2 stages so as to adequately capture the essence of the research questions. There were 15 questions in all in the interview instrument. In total, each of the interviews lasted from about 25 – 30 minutes.

F. A formative assessment strategy involving the use of feedback in a classroom setting was also introduced. Documentary analysis was used to collect data here. This was set up to compliment data from the questionnaire and interview stages. The aim of this aspect of the study was to check if a feedback strategy could improve learning and to what extent, particularly among low ability learners in the schools under investigation. It also provided triangulation for the study's results.

First of all, teachers of the selected classes were oriented on how to effectively deploy this formative assessment strategy by the researcher. The check was carried out in the classrooms of some selected teachers from the interview stage. This stage lasted for about 2 weeks. It is important to note that the test was used to obtain further direct evidence of the students' classroom practice (Granberg et al., 2021). The analysis used a *sentence level* recording unit and hence the number of times such recording units occurred in each pupil's math exercise books was counted. This also ensured reliability and validity of the process.

G. The gathered data were studied and interpreted through descriptive statistics, thematic analysis and content analysis. Data analysis took place from May 2023. The data collected through all three tools was triangulated to ensure validity and reliability. By combining these three tools, the researcher was able to gather a robust and varied dataset, paving way for a detailed examination of the investigation's inquiries and problem.

3.2 Population and sample of the research study

The investigation concentrated on primary school mathematics teachers responsible for instructing students in Grades 1-6 in Abuja. There are about 14,471 primary school teachers in Abuja (Statista, 2021). This encompassed both male and female qualified adult educators actively involved in teaching mathematics at the elementary class level throughout the duration of the study. The sample frame or population refers to a sizable, homogeneous group of individuals or cases that a researcher identifies and samples from, in order to provide insights of general relevance based on the findings from such a sample back to this specific population (Neuman, 2014).

The study comprised 115 primary school mathematics teachers, consisting of 67 female and 48 male teachers. These educators were purposively selected from 11 distinct public schools in Abuja, adhering to specific criteria. There are about 613 public primary schools in Abuja (Daily Trust, 2021). Given the current investigation directs attention to the assessment practices of mathematics educators in elementary schools, it was imperative to solely sample teachers of mathematics at this level, thus targeting this specific population. Furthermore, this approach was deemed most suitable for addressing the pertinent research inquiries.

Participants' teaching experience spanned from 1 to 7+ years (refer to Figure 3). They possessed diverse teaching qualifications, including NCE (National Certificate in Education), B.Ed. (Bachelor of Education), PGDE (Post Graduate Diploma in Education), M.Ed. (Master of Education), Ph.D. (Doctor of Philosophy), among others, in mathematics, science, and engineering-related fields.

Figure 10

Years of Teaching Experience
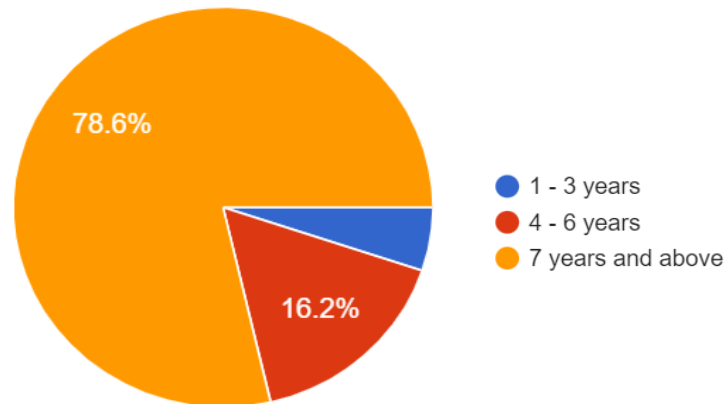
A total of 115 participants responded to the questionnaire. This comprised 67 female and 48 male teachers. In terms of percentage, nearly 56% of the participants were women while

Figure 11

Ratio of Male to Female Participants by Percentage
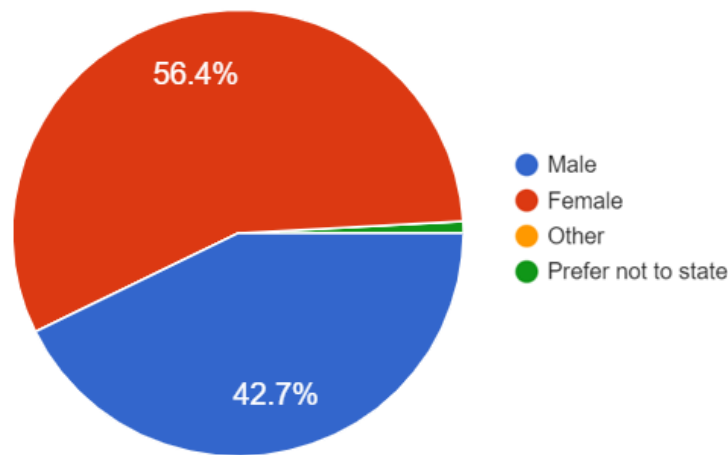
The rationale for featuring 11 primary schools was to try to make the sample as representative as possible with regards to the population of the study (Bell, 2010).

For the interviews, 9 teachers were sampled using purposive sampling, which satisfied the specific demands (Robson, 2011; Shaheen & Pradhan, 2019) of the research. In other words, the sampling focused on teachers who, had accumulated no less than 3 years of pedagogical familiarity teaching mathematics, with a recognized teaching qualification to support their claim, as illustrated in Figure 12, are registered with the Teachers Registration Council of Nigeria (TRCN) (Figure 13) and who prepare pupils for a certificate

exam. Purposive sampling involves selecting a non-random sample using various strategies to identify and include all potential cases from a unique and hard-to-access population, where the goal is to capture the entire population rather than a representative subset (Neuman, 2014).

In comparison to the questionnaire, the interview had a substantially reduced sample size. A good reason for this is because purposive samples though comparatively smaller in size are capable of yielding more in-depth details. While purposive samples are relatively smaller in size, they are able to generate deeper insight and understanding into a research problem compared to random samples (Shaheen & Pradhan, 2019).

Figure 12

Teachers with a Teaching Qualification
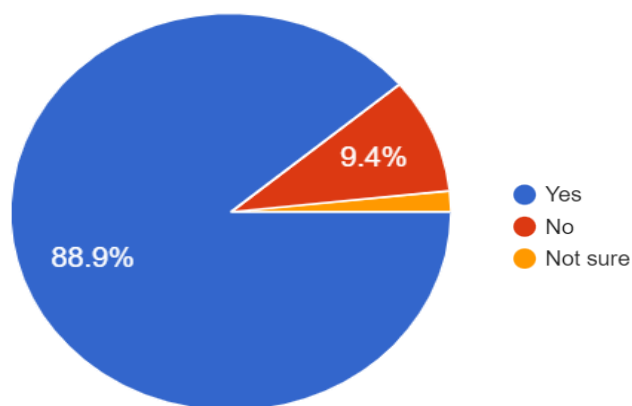
Figure 13

Teachers Registered with the TRCN
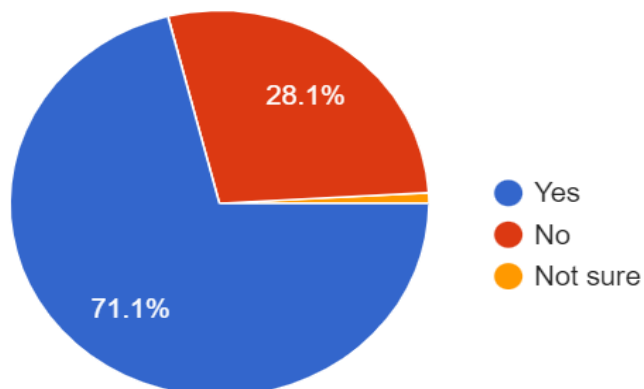
Specifically, the purpose of employing purposive sampling for the interview phase was to identify and recruit participants who could offer detailed, first-hand perspectives on the specific context or phenomenon being investigated, without necessarily aiming to represent the broader population (Schoch, 2020). In other words, to streamline interview participants based on the following criteria: a minimum of 3 years teaching experience, age, a teaching qualification, registration with the Teachers Registration Council of Nigeria (TRCN) and experience preparing pupils for a certificate exam.

One of the aims of conducting the interviews was to confirm the questionnaire data thereby adding flesh to it (Bell, 2010) which also justifies the pragmatic nature of the present research.

The concept of employing sampling criteria aimed to guarantee that these teachers possessed the necessary relevant experience and knowledge required to provide comprehensive inputs to the study's lines of inquiry explored in the course of the current investigation. Stated in another way, the criteria were adopted so that participants could share their thoughts and opinions confidently on their assessment practices based on their experience. Shaheen and Pradhan (2019) note that at the outset of purposive sampling, the researcher opts for participants possessing broad and general familiarity with the study's topic or phenomena.

Furthermore, participants' chronological ages ranged from 24 years to 54 years which broadened the chances of selecting more age groups. Questionnaire respondents taught children in at least one or more of stages 1 – 6 classes. It is worth highlighting that approximately three-quarters of the participants said they had attended at least one official training in assessment within the last 12 months (Figure 14).

Figure 14

T*eachers Who Have Officially Attended a Training on Assessment in the Last 12 Months*
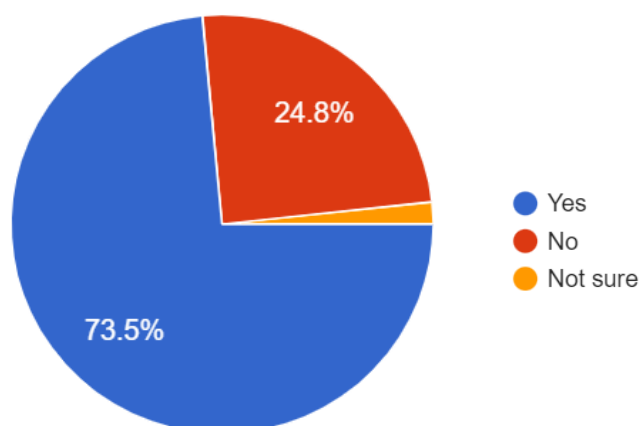
Almost half of the respondents have a first degree as their highest qualification while slightly more than a quarter have a second degree as their highest qualification. About 14% of the participants only have the National Certificate of Education (NCE), which is the requisite qualification for teaching at the primary school level in Nigeria. Nearly 3% of the sample possess a doctoral degree as their highest qualification. Some 4% of the sample have a post graduate diploma in education (PGDE) which is a teaching qualification for graduates without one (Figure 15).

Figure 15

Highest Teaching Qualifications of Teachers
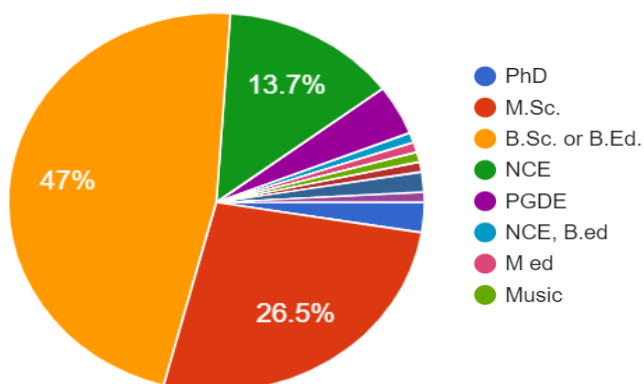
In terms of sample size for the interviews, the researcher is quite aware that for numerous qualitative research endeavors, the sample size emerges as a critical factor when evaluating the quality and reliability of the findings (Mocanasu, 2020). In other words, sample size is a big deal in qualitative research. Despite this fact, there are no specific rules

as to what the sample size should be in qualitative research (Mocanasu, 2020; Shaheen & Pradhan, 2019). A number of authors use the principle of saturation to determine the size of the sample in some qualitative studies (Mocanasu, 2020; Neuman, 2014; Shaheen & Pradhan, 2019).

In qualitative research, data saturation is attained when further sampling and data collection cease to yield novel theoretical insights or categories that contribute meaningfully to the comprehension and explanation of the phenomenon under investigation (Mocanasu, 2020). At saturation, it becomes clear that the interview responses no longer contain any new ideas. Therefore, the goal of sampling is not necessarily to achieve large sample sizes but to obtain information-rich samples.

In qualitative research, the sample size is determined by various factors, including population characteristics, the intended data analysis approach, and the level of precision required for the study's objectives. Notably, a large sample size does not necessarily ensure a representative sample, as other factors also influence sample quality and accuracy (Neuman, 2014).

Samples for documentary evidence comprised 132 mathematics exercise books from 3 of the 11 schools featured in the research. These books were selected through purposive sampling by the teachers chosen to take part in the intervention phase of the investigation. The exercise books belonged to Year 5 lower ability pupils identified and selected by the mathematics teachers from these schools. The criterion for selection includes choosing pupils with consistently less than average scores from written tests administered over the last 6 months to date. This helped to select only children (and exercise books) considered to be lower ability learners.

Using exercise books of low ability pupils to measure the impact of a feedback strategy was deliberate. This offered the opportunity to confirm or dispel evidence from the literature that formative assessment strategies such as timely constructive feedback, student self-assessment, and peer assessment helped low ability students to improve the most (Black & Wiliam, 1998; Goodburn et al, 2010).

Validity and reliability were taken seriously to maintain the credibility and trustworthiness of the study's conclusions. For instance, to reduce threats to internal validity, the following considerations were made during the intervention stage – mitigating selection bias and demand characteristics.

Selection bias: To ensure that there was little or no selection bias, a deliberate attempt was made to select the participants recruited for the intervention from those who participated in the questionnaire and interview aspects of the research. This helped to put all three participants on the same page, despite being from different schools or presenting three different groups of pupils.

Selection bias can arise from an experiment featuring 2 or more groups of respondents, especially in a design which lacks random assignment (Neuman, 2014). Selection bias constitutes a formidable threat to internal validity in experimental designs, arising when participant groups exhibit non-equivalence at baseline with respect to the dependent variable, thereby compromising the comparability of treatment and control conditions (Neuman, 2014). Therefore, participation in the questionnaire and interview aspects gave all the participants an equal footing.

In addition to threats from selection bias, possible threats from maturation effects were mitigated by carrying out all the data collection around the same time. The concept of maturation effect in research pertains to inherent time-dependent alterations in a participant, such as growth, aging, fatigue, boredom, or shifts in attention. These changes can introduce threats to internal validity, which is a critical consideration in the design and implementation of longitudinal studies.

Demand characteristics: These occur when research participants become aware of the study's hypothesis or purpose and intentionally change their behavior to align with what they believe the researcher is looking for, thereby influencing the results and potentially supporting the hypothesis (Neuman, 2014). To mitigate this effect, the aim of the feedback strategy was not shared with the pupils who participated in the intervention. In fact, they didn't know they were being studied as the researcher operated only in the background and had no direct contact with the pupils.

Similarly, the teachers were not told about the possible outcome of using a feedback strategy. They were only told that the research sought to check if this strategy had any effect on learning outcome. The pre-test and posttest scores also ruled out any likely interferences from this effect.

During the feedback strategy, attention was also paid to external validity. Consequently, the strategy took place in the pupils' classrooms as a field experiment. This increased external validity, particularly in terms of *naturalistic generalization* because the pupils were not aware they were being studied. Field experiments typically employ a non-reactive research design, wherein participants remain unaware of their involvement in the study, thereby facilitating authentic behavioral responses and minimizing reactivity effects. (Neuman, 2014).

3.2.1 Participant recruitment

In recruiting participants for the present study, ethical considerations were made (Neuman, 2014; Robson, 2011). The researcher understands how intrusive studies of this nature can be; therefore, participants were recruited and well informed of the research problem and purpose. Furthermore, meticulous participant selection is crucial for ensuring a faithful portrayal of the target population (Manohar et al., 2019). Thus, preceding the start of the research project, the researcher undertook a thorough process to anticipate recruitment outcomes. This involved crafting a research protocol (endorsed research proposal), drafting participant consent forms, and undergoing scrutiny and endorsement by the University Research Ethics Committee (UREC).

In line with Manohar et al.'s (2019) frame of thinking, research participants should have access to the following information:

- To receive comprehensive information regarding the potential advantages and risks linked to the proposed research, including how it might benefit them if they are unwell.
- To ensure the safeguarding of their interests, encompassing a clear elucidation of the research's requirements, the responsible party for their health concerns, implemented safety measures to prevent harm, verification of the research's review and approval

by relevant committees, clarification on financial obligations or compensation for participation, assurance of their entitlement to exit the study without repercussion, and disclosure of whether study results will be shared with them upon its conclusion.

- To possess some comprehension of the study's structure and leadership, comprising identification of the protocol designer and the protocol's adequacy, verification of the investigator's competence, clarification on the research's significance, disclosure of other involved parties, and confirmation of community advocate involvement in research design and review.

- To be notified of any conflicts of interest or controversies associated with the study, previous similar studies, financial beneficiaries, and any self-interest exhibited by the investigator.

Furthermore, the respondents were handpicked using a non-random, purposive selection procedure. A non-random selection procedure is a method of selecting respondents or participants where the researcher deliberately chooses individuals based on specific characteristics, expertise, or criteria, rather than by chance. The aim is to use a sample that is capable of providing the required responses to the research questions thus allowing the research to yield in-depth insights and perspectives of the phenomenon under investigation – the assessment practices of public-school mathematics teachers.

3.3 Instrumentation (Research tools)

The study's data were sourced from three primary methods: questionnaires, semi-structured interviews, and documentary evidence. The sampling protocol differed across the various data collection methods. While obtaining a true random sample may be challenging for an individual researcher conducting a small-scale project (Bell, 2010), this research ensured the sample was representative and generalizable to the broader population. with careful attention. Additionally, owing to the sample's relatively small scale, maintaining absolute anonymity for the participants was imperative.

A census type of sampling was targeted in collecting data through the questionnaire. Hence questionnaires were completed by 115 mathematics teachers in all.

As mentioned in Section 3.2, sampling for the interviews was targeted at teachers who possessed at least 3 years teaching experience, a teaching qualification, professional registration with the TRCN (Teachers Registration Council of Nigeria) and who prepare students for at least one certificate exam. The inclusion criteria for the interview sample are listed in Section 3.1.3. Teachers without these qualities were excluded from the interview statge. It was believed that purposive sampling would isolate participants who could provide the required and appropriate insights into the study, the general population characteristics not withstanding (Schoch, 2020). This measure upheld the trustworthiness of the data by circumventing incomplete evidence (Robson, 2011).

The following tools were used for collecting data during the study:

- Questionnaire
- Semi-structured interviews
- Documentary evidence

Although observation was also considered as an option for collecting data, its prolonged (Robson, 2011) nature given the limited data collection period led to jettisoning the idea. Rather than conducting an excessively prolonged investigation, documentary evidence was utilized as a more efficient approach. Furthermore, obtaining informed consent from parents to observe their children in classroom settings proved to be particularly challenging. Many parents expressed distrust regarding the videotaping of their children due to safety concerns. The primary motivation for considering observation was its direct and supporting role in social investigation (Robson, 2011).

Although using documentary evidence appeared to be a simpler alternative, given its inherent availability and low cost (Cohen et al., 2000), several challenges arose. For instance, the documents under consideration were not originally intended for the current research, potentially leading to issues of representativeness and objectivity (Cohen et al., 2000). Nonetheless, data derived from this source ultimately proved highly valuable to the study, particularly in assessing whether a feedback assessment strategy significantly impacted learning outcomes and achievement. Specifically, documents reviewed include pupils' exercise books.

3.3.1 Questionnaire

A total of one hundred and fifteen (115) respondents filled and submitted the instrument. As a self-administered survey instrument, its sophistication was deliberately minimized (Robson, 2011). The check for reliability is often associated with the aspect of composing questions and piloting of the instrument (Bell, 2010). This explains the reason for piloting the instrument, which involved testing the time participants took to complete it, ensuring clarity of all questions and instructions, and enabling the researcher to eliminate items that did not produce usable data (Bell, 2010).

Question types featured in the questionnaire include mainly category (Bell, 2010) and Likert scale. Also, the questions are closed in nature, not open. The questionnaire consisted of 25 items, divided into two sections. The first section captured demographic information about the respondents, while the second section assessed their attitudes and opinions using a three-point scale with response options 'Agree', 'Disagree', and 'Not sure'. This structured instrument was designed to gather quantifiable data on respondents' perspectives, allowing for analysis and comparison of their views.

In trying to strengthen the validity of the questionnaire, the face, content and construct validity of the instrument were considered. For instance, the instrument was reviewed by the author's supervisor and colleagues to decide if it measures what it claims to measure. Furthermore, to secure content validity, the literature was widely reviewed to ensure relevant aspects to the study were captured in the instrument. Additionally, the author's supervisor and the Unicaf Research Ethics Committee (UREC) advised on the instrument's contents. Finally, the questionnaire items were underscored by the theoretical framework and principles which underpin the study. They were also pilot tested to refine items which do not reflect the concepts of the present study.

The questionnaire data offered insights from a sizable cohort of public primary school teachers in Abuja. It offered an initial overview of the teachers' thoughts on the assessment process. Overall, the administration of the questionnaire was straightforward. However, it is not without limitations. For example, according to Wilson and Fox (2008), the utility of the questionnaire depends on the quality of its questions.

The questionnaire in this study was administered online. Thus, participants completed and submitted it online without interfacing with the researcher. Data obtained from this tool underwent analysis through descriptive statistical methods. Descriptive statistics are analytical methods, including numerical and graphical approaches, used to describe and present the main attributes of a sample (Fisher & Marshall, 2009).

3.3.2 Interview

The interview served as a means to collect evidence addressing all the Research Questions, while also delving deeper into insights previously obtained from the questionnaire data. This research design decision (carrying out interviews) was motivated by a desire to gather more direct and empirical evidence regarding the teacher's classroom practices, thereby providing a nuanced understanding of the phenomenon under investigation. (Granberg et al., 2021).

It is widely held that interviews provide the opportunity to adapt one's line of inquiry, pursue intriguing responses, and delve into underlying motives in a manner that questionnaires cannot match (Robson, 2011). Moreover, interviews can offer rich material and often add depth to survey data (Bell, 2010). A preliminary survey was conducted with four test respondents to ascertain if the tool could elicit responses aligned with the themes of the Research Questions.

The pilot test was additionally carried out to guarantee validity (Abd Gani et al., 2020) and reliability of the procedure/tool. This also aided in assessing the viability of the survey tool (Robson, 2011). The interview instrument comprised two broad stages with 6 and 9 items respectively, making a total of 15 questions. The 15 questions addressed mainly Research 2 and 3 but also briefly responded to Research Question 1.

A flexible or moderately-structured approach was employed for conducting interviews. This method aimed to maintain interviewer control over the process while granting respondents the freedom to elaborate beyond the questions asked when necessary (Bell, 2010). One of the primary reasons for opting for a semi-structured approach was its popularity among educational researchers, as it enables respondents to express themselves

extensively while providing enough structure to avoid aimless digression (Wragg 1994). Consequently, the respondents were able to express themselves freely.

Semi-structured interviews help prevent inadvertently allowing personal perspectives to influence the outcome. Therefore, the data is safeguarded against errors or biases. Standardized key questions were used to collect data from all participants, allowing for meaningful comparison and triangulation. Only teachers who had a teaching qualification and were involved in preparing students for certificate exams were interviewed. Conditional upon the quantity and quality of data provided by participants in response to the research inquiry, each interview lasted from about 25 – 30 minutes.

To ensure reliability of the semi-structured interviews, the researcher piloted the interview guide with two teachers outside the study sample, leading to minor revisions for clarity. All interviews were conducted using the same guide and procedures, with each session audio-recorded and transcribed verbatim. Coding consistency was ensured through careful comparison of themes.

Audio recordings were captured using a mobile phone, as all interviews were conducted via telephone. Phone interviews were used to gather data, allowing for in-depth discussions with participants. The phone's record feature made this possible, allowing the conversations to be automatically stored to the device after each conversation. The phone battery was sufficiently charged to forestall losing invaluable data which is a possibility if the phone went off. The audio recordings were later moved into an external device for safety, storage and processing purposes. Nine participants were interviewed in all. These teachers teach primary 5 or 6 classes in their respective schools. Therefore, the age group taught by these teachers range from 9 – 11 years.

Since researchers are fallible, the issue of researcher bias was not ignored. This was mitigated through the use of member checking and triangulation of data (Schoch, 2020). Hence this study's methodological framework was grounded in Chi's (1997) notion of methodological complementarity, wherein quantitative and qualitative approaches are combined to mutually address their respective shortcomings. Moreover, triangulation is

recognized for its efficacy in mitigating threats to validity, thus this approach ultimately augmented the trustworthiness and credibility of the findings (Robson, 2011).

3.3.3 Documentary evidence

Reports have indicated the utilization of documentary analysis to verify the reliability of evidence obtained through other methods, such as interviews or questionnaires (Bell, 2010). The rationale underlying this methodological decision was driven by a desire to procure more immediate and empirical evidence of students' classroom behaviors and practices, thereby providing a nuanced understanding of their pedagogical engagement. (Granberg et al., 2021).

Documentary analysis was employed to investigate the relationship between teachers' assessment approaches and student learning outcomes, providing empirical evidence of their interconnectedness. The aim of using this evidence was to check to what extent a constructive feedback strategy, which is a formative assessment approach, resulted in significant improvements in student learning outcomes (if in fact it did).

Research has demonstrated that constructive and affirmative feedback positively impacts students' learning outcomes and self-esteem (Hendrickson, 2012). Evidence from students' mathematics exercise books was analysed using content analysis. According to Bell (2010), content analysis constitutes a systematic research methodology employed to examine the frequency, context, and manifestation of linguistic elements, such as words, terms, or concepts, within a textual document. This approach allowed for a systematic investigation of the prevalence of feedback-related language in the children's books under study. The intention was to then check if such feedback led to any notable improvements for students.

Three schools were selected from the list of sampled schools in this research for the documentary evidence. There was no particular rationale for the selection. However, these 3 schools showed the greatest enthusiasm towards advancing the study in this direction. One mathematics teacher was then selected per school for this stage of the research. These teachers were given a brief orientation about a constructive feedback strategy and what it entailed. They were also told what role to play in this stage of the study.

In order to render the data collection process more manageable, a 2-week period was used to carry out the feedback strategy. The level of use of constructive feedback comments in the exercise books was checked before and after the 2 weeks. The quantity of documentary evidence one can study depends on the amount of time available for data gathering and statistical analysis (Bell, 2010). The objective of this strategy was twofold: to gather data for documentary analysis and to investigate the outcomes of utilizing a formative assessment strategy centered on feedback.

A total of 132 mathematics exercise books were sampled from the 3 schools examined in the context of this study. These are denoted as School A, School B and School C. The exercise books belonged to Year 5 students identified and selected by the mathematics teachers from these 3 schools. The criterion for the selection of the 132 students includes choosing pupils with consistently average or less than average scores from written tests administered over the last 6 months to date. For the purpose of this study, such scores range *generally* from 0 – 5 out of 10. This helped to select only children considered to be average to low ability learners.

During the 2-week period, the teachers focused on providing useful feedback to the learners in question in a written form. According to The Assessment Reform Group (1999), effective feedback to students is identified as one of the five crucial factors which underpin the formative assessment strategy. These factors include: the provision of powerful feedback to learners, the need for pupils to be actively invested in and responsible for their own learning outcomes., using assessment to inform teaching, recognizing assessment's impact on motivation and self-esteem, and developing pupils' ability to self-assess and improve (Assessment Reform Group, 1999).

Upon completion of the 2-week period, the exercise books were retrieved and analysed using content analysis to check the claim that supportive positive feedback can increase student learning outcomes (Black & Wiliam, 1998 in Hendrickson, 2012). The present study recognizes that exercise books could sometimes be viewed as inadvertent sources. Inadvertent sources are used by researchers for reasons other than that for which they were originally intended (Bell, 2010). These include class registers, exercise books,

duty report books, minutes of statutory meetings at various levels, exam question papers, school timetables etc.

Therefore, Bell (2010) calls for great caution when using inadvertent sources since these sources may in fact be intended to mislead whoever they were meant to deceive. The contents in the exercise books featured in this study were in fact collected for this research. Therefore, they were not meant to misguide or mislead it. Nonetheless, the author in this study took great care in working with these sources. For instance, by triangulating the data from the documentary analysis with those from other research approaches, by clearly defining the research questions which provided guidance for the current research etc.

3.4 Ethical Assurances

The procedures adopted in this study are listed in Section 3.2. However, the following considerations were made in terms of securing ethical assurances for this study.

- UREC approval: Data collection only commenced upon receiving the UNICAF Research Ethics Committee's approval on December 21st 2022. The gatekeeper and informed consent letters approved by the UREC clearly pointed out issues related to confidentiality and anonymity (Appendix 3).

- Voluntary participation: Respondents were given the leeway to accept or decline participation in the study or aspects of it without coercion or reprimand. This condition was made clear during the introductory meeting with the middle managers, and also at the beginning of each interview.

- All participants provided written informed consent before commencing the study. 97% of the survey respondents gave their informed consent while all 9 of the interviewed candidates also gave their informed consent. They participated voluntarily. Participants also knew the study's purpose and potential contributions.

- Anonymity – Participants' identities are unknown and remain undisclosed to the researcher. Interviews took place via phone calls such that respondents and the researcher had no physical contact. This is also the case with the questionnaires which were filled and submitted online. The interviews and questionnaires did not require sensitive personal data such as participant names and identities or their email

addresses. With respect to documentary evidence, the names of the learners who owned the exercise books used for the intervention were not copied or written down anywhere. This was deliberately done to maintain anonymity.

- Participants were not in danger of potential harm since the data collection processes was unharmful.

- The research is free of plagiarism and/or any misconducts, thus eliminating the tendencies of the results to be misleading.

Lastly, the researcher was mindful of the importance of avoiding bias, which entails refraining from preconceiving or unduly influencing the research procedure or outcomes (Schoch, 2020). Recognizing the necessity of remaining vigilant about personal feelings, thoughts, and preconceptions, and staying open-minded toward data and evidence that may challenge one's own expectations or hypotheses, was also acknowledged (Schoch, 2020). Unchecked researcher bias can compromise the internal validity of research studies.

3.5 Data collection and analysis

Data analysis is essential because raw data, in its unprocessed form, often lacks the capacity to provide meaningful insights or convey significant information, requiring interpretation and examination to uncover its underlying value and significance (Robson, 2011). To ensure simplicity in analysis procedures and the suitability of the data collected for the study, the researcher began contemplating the data analysis approach right from the design phase (Robson, 2011). Various researchers have defined data analysis differently. For example, LeCompte and Schensul (1999) characterize it as converting data into a meaningful narrative and analyzing it for key findings.

In essence, data is condensed into manageable segments or categories to facilitate comprehension. The method of analysis employed in the present research was informed by the study's objectives, questions, data characteristics, the underlying theory, and the suitability of the analysis method. Two main data types were identified and collected during the study: numerical and narrative datasets. The questionnaire produced numerical data, while the interviews and documentary evidence yielded mainly narrative type data. Numerical data underwent analysis through statistical methods.

3.5.1 Quantitative data

Numerical data was collected through the administration of questionnaires. The data were analysed using descriptive statistics method. The purpose of descriptive statistics is to present quantitative data in easily understandable forms such as graphs, charts and tables (Neuman, 2014). They also provide a clear and concise overview of the quantitative data including measures of central tendency (mean, median and mode) and variability (range, variance and standard deviation) (Robson, 2011).

In the present study, data were summarized as tables, bar charts, graphs and pie charts making it easier to identify patterns and trends in the data. The quantitative data provided an overview regarding the participants' views about assessments. Majority of the charts and graphs used are univariate in nature, because they describe one variable (Neuman, 2014) e.g. participants' qualifications and views regarding assessments.

3.5.2 Qualitative data

For the narrative data, Miles and Huberman's (1994) qualitative analysis framework was employed as a guiding tool. A triangulation approach was employed, wherein interview responses were compared and contrasted to corroborate and validate participants' viewpoints. A thematic coding analysis was also conducted to further examine the data and elucidate key findings.

As per Robson (2011), this approach is described as 'highly adaptable' and applicable to almost all forms of qualitative data, including interview data. In this instance, codes and themes surfaced through an interactive engagement with the data (Robson, 2011). This method of operation aligns with what Bassey refers to as *extended interaction* with the data (Bassey, 1999). Since the questionnaire was designed using Google forms, data collected were automatically converted into charts and graphs through Google analytics.

The generated themes served as a foundation for evaluating teachers' perspectives on assessment. They also prepared the ground for ascertaining how effective such perceptions were in terms of student learning and achievement. Through a process of iterative analysis, the initial codes were winnowed down and reorganized into a more concise and

conceptually coherent set of themes during the second-level coding phase (Miles & Huberman in Robson, 2011).

Responses to analogous questions were consolidated and organized into distinct categories, enabling a more systematic and efficient coding process across each dataset. This approach was helpful in consolidating the theme ideas already predetermined from the literature earlier on in the study. Finally, interpretations were made and conclusions drawn.

Data from documentary analysis were analysed using content analysis. A *sentence level* recording unit and hence the number of times such recording units occurred in each pupil's math exercise books was counted.

In more concise terms, the study compiled the following sets of data:

- Questionnaire data comprising alphanumerical information on
    - Demographics
    - Views about assessment

A descriptive statistical approach was used to examine the data, facilitating the identification of patterns and trends.

- Thematic coding analysis was applied to the semi-structured interview data to elucidate meaningful themes and concepts. Thematic analysis is a qualitative research method that enables researchers to systematically organize and analyze complex datasets, uncovering salient themes that distill the core meaning of the narratives within (Dawadi, 2021).

  The codes and themes used in insights and implications derived from the study's findings were predetermined, as opposed to emerging on their own. The ideas for the themes came from the author's prolonged engagement with the literature. The risks of using predetermined codes are not unknown, especially in terms of the bias they may bring to the findings. However, it is also possible to view predetermined codes and themes as guides to not veer off in the wrong direction in the course of data analysis. For instance, previous immersion in the literature can enrich your analysis by sensitizing you to aspects of the data that could easily go unnoticed (Robson, 2011).

The interview was utilized to collect evidence for addressing Research Questions 2 while delving deeper into insights gleaned from the questionnaire data. Interviews can yield rich material and often provide depth to survey findings (Bell, 2010). A preliminary survey was conducted with four test respondents to determine if the instrument could elicit responses associated with the themes of Research Questions 1 and 2.

Furthermore, this process allowed for the evaluation of the instrument's feasibility and applicability (Robson, 2011). Participants engaged in semi-structured interviews, providing rich and detailed responses. This method aimed to maintain interviewer control over the process while allowing respondents the flexibility to expand upon the questions as necessary (Bell, 2010). The author opted for a semi-structured approach due to its widespread acceptance among educational researchers, as it strikes a balance between affording respondents the latitude to articulate their thoughts in depth and maintaining a structured framework to prevent meandering responses (Wragg 1994). Thus, the respondents were not inhibited by the interview. Based on Walsh's (2001) line of thinking, this also prevents the possibility of inadvertently introducing one's own preconceptions into the process. In essence the validity of the data is protected.

To optimize efficiency and manage the temporal demands of qualitative data collection, the author adopted a facilitative role, exercising control over the interview proceedings to ensure focused and productive interactions, given the time-intensive nature of interviewing. The same key questions were asked all participants to enable their responses to be adequately compared and to allow for triangulation. Here the participants were limited to only certain primary school mathematics teachers since Research Question 2 was linked to the assessment practices of primary school mathematics teachers. Participating teachers had substantial mathematics teaching experience, with a minimum of 3 years teaching the subject. Nine participants were interviewed.

- Documentary data was collected and analysed using content analysis. In Bell's (2010) view, content analysis is a systematic methodology for examining the

occurrence and contextualization of specific terms or concepts within a document to discern their semantic significance. After deciding on a sampling strategy, coding or recording units were generated based on Research Question 3. The sampling strategy selected was content analysis which used a *sentence level* recording unit and hence the number of times such recording units occurred in each pupil's math exercise books was counted.

Since mathematics lessons take place at the 3 schools at least 3 – 5 times each week, it was possible to glean sufficient data over the 2-week period reviewed. In other words, the researcher was able to analyze up to 6 – 10 math lessons per class in the 2-week period under review using the pupils' exercise books.

For feedback to be effective, it should state what the student has done well, as well as the areas considered important for improvement. Thus, the researcher focused on searching for statements like '*Good work, Richie. You have applied the Pythagoras theorem correctly. However, you must also walk through the logical progression of steps that resulted in the answer.*' during the analysis. This is why formative assessment is first and foremost about improvement.

It is nonetheless noteworthy to state that in studying pupils' exercise books, the researcher paid attention to both *witting* and *unwitting* evidence. Witting evidence in this case refers to information which the teachers intended to communicate (to the pupils) while unwitting evidence refers to everything else that can be learned from the sources examined (Bell, 2010).

For emphasis, questionnaire data and interview data addressed Research Questions 1 – 3 while the documentary evidence data checked claims about formative assessment strategies.

Given the fact that the qualitative data generated in this study is relatively small, all qualitative data analysis were performed manually (Bhandari, 2023). However, google analytics and Microsoft Excel were used in obtaining statistical representations of quantitative data.

To conclude, this study is based on several assumptions, acknowledges certain limitations, and is delimited by specific boundaries, which are outlined below.

The study operates under the assumptions that effective assessment practices are crucial for enhancing learning outcomes and student success, and that the participants possess the requisite knowledge to provide accurate responses to the research questions. Despite efforts to maintain objectivity, a potential limitation of this study is the researcher's bias owing to his background as a mathematics teacher, which could impact the validity and reliability of the findings. However, measures were taken to mitigate these threats, including acknowledging the bias, employing data triangulation, and engaging in peer debriefing through regular Research Degree Committee meetings. The scope of this study was deliberately delimited to focus on mathematics teachers as participants in both interviews and questionnaires, ensuring a concentrated exploration of assessment practices within this specific context

3.6 Summary

A comprehensive evaluation of the assessment practices of primary school mathematics teachers in Abuja was conducted to determine their effectiveness. The purpose was to explore whether formative assessment practices are able to influence learning outcomes. Utilizing assessments to enhance and advance student learning and academic performance is increasingly recognized as a standard practice in classrooms worldwide. This research endeavor is focused on examining the potential shortcomings in teachers' understanding and implementation of assessment strategies in Nigerian schools.

The research paradigm, approach, methodology, and sampling strategies were deliberately chosen to align with the research questions and objectives, ensuring a robust and effective research design. This study is situated within a pragmatic paradigm, which emphasizes methodological considerations and practical applications over abstract metaphysical or philosophical debates (Robson, 2011). The research design of this study integrated both qualitative and quantitative methodologies, enabling a comprehensive and detailed examination of the research questions.

Although a case study approach as well as an action research design were considered at some point, these ideas were dropped due to the fact that the study comprises quantitative aspects, and also because the researcher was unsure of remaining in his institution long enough to complete the study, not to mention continuing with it even after concluding his

thesis. Following the UREC approval, data collection was painstakingly done in 5 steps which include:

- Submission of gatekeeper letter to the authorities of the 13 schools penciled for the study.

- Sensitization meeting with the middle managers of the consenting schools

- Administration of the questionnaire – a total of 115 mathematics teachers completed and submitted their questionnaire online

- Conducting semi-structured interviews – A total of nine individuals participated in semi-structured interviews. Purposive sampling was utilized to recruit teachers with precise qualifications: minimum 3 years of teaching experience, teaching certifications, TRCN registration, and responsibility for preparing students for the Year 6 certificate exam.

- Collection of documentary evidence data

Questionnaires, semi structured interviews and documentary evidence were deployed to retrieve data for the study. A census type of sampling was targeted in collecting data through the questionnaire. Although observation was also considered as an option for collecting data, its extensive time requirement (Robson, 2011) nature given the limited data collection period of just six weeks led to jettisoning the idea.

Pilot studies were carried out for both questionnaire and interview data so as to maximise the consistency and accuracy of the tools. Various moral considerations including confidentiality, anonymity and securing informed consent were made. Data analysis techniques were also mentioned and discussed at length. This study is based on assumptions about effective assessment practices, acknowledges potential limitations due to researcher bias, and is delimited to exploring the perspectives of mathematics teachers.

CHAPTER FOUR: FINDINGS

4.0 Introduction

The choice of assessments employed by teachers significantly impacts the caliber of learning and academic accomplishments within both individual classrooms and educational institutions as a whole. Therefore, how teachers assess is germane to student success. There is a need to explore ways through which schools can leverage assessment practices that promote student attainments and hence the basis for this study. To succeed in this mission, the following objectives guided the current investigation,

- Explore the views of primary school mathematics teachers about assessment practices.
- Examine how effective the existing assessment strategies teachers use are in improving students' learning and academic achievement in mathematics.
- Evaluate the effect of formative assessment practices on learning outcomes in mathematics.

The significance of this study can be viewed from the following perspectives:

1. Bridging gaps in assessment practices: The study aims to identify and address shortcomings in assessment practices among primary school mathematics educators.

2. Reframing assessment purposes: The study seeks to promote a broader understanding of assessment purposes, beyond just measuring learning progress, to include improvement of learning.

3. Addressing misconceptions: The study aims to correct the erroneous belief that assessments are meant solely for evaluating students for public exams and scoring high grades.

4. Promoting effective assessment tools: The study highlights other effective assessment tools, such as formative assessment strategies, peer-assessment, self-assessment, and feedback, that can promote learning and academic achievement.

5. Improving teacher training: The study advocates for comprehensive training for mathematics education professionals in assessment practices to enhance student learning outcomes.

6. Informing policymaking: The study aims to inform and influence policymaking processes, particularly in reevaluating and strengthening policies related to mathematics assessment.

7. Empowering students: The study seeks to empower students with vital skills and knowledge, particularly in mathematical and critical thinking, by providing teachers with the skills and expertise to apply effective assessment strategies.

8. Contributing to curriculum development: The study provides actionable intelligence for curriculum developers in mathematics, highlighting the importance of placing greater emphasis on assessment aspects of the curriculum.

9. Providing a resource for researchers: The study offers a rich resource for researchers, particularly those seeking to study teachers' assessment practices in Nigeria.

Apart from the forgoing, the study adds to the doctoral student's proficiency in research methods and assessment techniques. This is quite significant since the researcher is a practicing educator. Given the aforementioned significance, findings from this study will likely boost students' success rates across many public primary schools in Abuja and Nigeria as a whole.

The overall question which served as a feeder to more specific questions was *Can assessment practices improve the quality of teaching and learning in Nigerian schools?*

Research Question 1 – What are the views of primary school mathematics teachers about assessment practices?

This question aims to find out about the views or the attitudes and beliefs of primary school mathematics teachers towards assessment. A questionnaire was used in gathering data geared towards tackling the research questions and solving the research problem. Moreover, the data collected for this research question underwent descriptive statistical analysis to summarize key trends and patterns.

Research Question 2 - How effective are the existing assessment strategies teachers use, in improving students' learning and academic achievement in mathematics?

The intention behind this question was to inquire into the effectiveness or otherwise of existing assessment strategies in terms of how they help to improve student learning outcomes in mathematics. In this case, data was collected by making do with partially structured interviews. Furthermore, the evidence gathered via from the interviews was analysed using thematic coding analysis.

Research Question 3 - What is the effect of formative assessment practices on the learning outcomes of students in mathematics?

This question examined the effectiveness or otherwise of an innovative assessment strategy in enhancing mathematics education and student performance. Information was gathered via flexible, open-ended interviews and documentary evidence. The data obtained from this investigation were analysed using theme analysis and document analysis respectively.

The primary aim of this research endeavor is to investigate and elucidate the assessment methodologies employed by public primary school mathematics instructors in Abuja, Nigeria's capital, in order to ascertain their effectiveness. Specifically focusing on mathematics, this investigation determined the success of these practices within selected public primary schools in Abuja.

Mathematics was chosen as the focal point due to its universal presence as a fundamental subject throughout primary and secondary schooling across Nigeria. Moreover, given its role as a foundational discipline, proficiency in mathematics is crucial for advancement in fields like science, technology, and engineering (Manzana et al., 2020).

Since schools and teachers rely heavily on assessment to inform their instructional decisions and support student learning, an evaluation of the extent to which their assessment practices are successful is likely to help identify and fill any potential lacunas within their assessment experience and skills. As the research design is inherently linked to the research problem, this study employs a convergent mixed-methods design to provide a comprehensive understanding of the phenomenon under investigation.

Thus, it combines narrative and numerical data collection and analytic approaches to address the research questions. It applies a qualitative method for collecting the views of mathematics teachers about assessment, and a quantitative research method for determining the demographic data of the participants and more views about assessment. It also uses content analysis to determine the effectiveness or otherwise of a formative assessment method.

Regarding the organization of this chapter, the study initially outlines its core objectives. Subsequently, it provides an overview of its significance, emphasizing the importance of enhancing teachers' assessment practices and its broader contributions to nation-building and research development. A brief examination of how the research questions intersect with the principal aims of the study follows. Finally, the primary objective of this investigation is also summarized.

The basis for choosing and using the selected research method is mentioned. Next, a critical evaluation of the data's trustworthiness is presented in the following section. Trustworthiness can be seen as a way to establish credibility, where the author transparently documents and makes visible the methods, procedures, and decisions involved in their study, allowing for auditability and scrutiny, and thereby persuading readers of the study's rigor and validity (Gunawan, 2015). The credibility, dependability and transferability of the research process and final findings are also discussed.

In terms of credibility, this section examines the establishment of credibility through a process of triangulation i.e. using several sources of information or methods retrieved or gathered from the field to repeatedly establish recognizable patterns, dependability as trust in trustworthiness (Stahl & King, 2020) transferability concerning the data sourced and utilized throughout the study – Effective transfer relies on rich, contextualized descriptions that empower researchers to adapt and implement knowledge in their own settings (Stahl & King, 2020) and confirmability (Gunawan, 2015).

The steps taken to overcome any threats to the validity pertaining to the data integrity and the trustworthiness of the research tools deployed in the study are also discussed. Subsequently, the results and conclusions derived from the study are presented based on the

research questions. The findings presented in this section are derived from a comprehensive analysis of the questionnaire data, semi-formal interviews, and documentary evidence. Subsequently, a detailed analysis and synthesis of the collected data are undertaken, with the main themes and conclusions of the chapter provided at the end, setting the stage for Chapter Five.

4.1 Trustworthiness of data

There is a rising acknowledgment of the importance for qualitative researchers to actively enhance reliability and validity in their research endeavors. To attain this standard, qualitative researchers implement measures to bolster the trustworthiness of their studies. Given that this research partly employs qualitative methods including interviews (utilizing thematic coding) and documentary analysis (employing content analysis), the subsequent section outlines the measures taken to establish the research's credibility and trustworthiness.

Trustworthiness in in-depth, non-numerical research encompasses the methodological rigor, researcher credibility, finding validity, and applicability of the research methodology (Rose & Johnson, 2020). In essence, trustworthiness serves as a gauge of the depth and rigor inherent in in-depth, non-numerical research endeavors. The level of trustworthiness in subjective, interpretive research methodology is what defines the reliability and validity or otherwise of such a study. Rose and Johnson (2020) describe trustworthiness as the overarching perception linked with a research endeavour. This is why the present study prioritizes 'trustworthiness' and does not take it with levity.

Since specific research methodologies that researchers employ foster trustworthiness in both their research processes and their subsequent reports (Stahl & King, 2020), the present study focuses on certain procedures that engender trustworthiness. For instance, the study uses a triangulation design where findings are interpreted through a combination of numerical and narrative data. In this particular design, the researcher adopted a dual-methodology strategy, incorporating both numerical and narrative data collection methods separately, aiming to attain a more thorough and insightful grasp of the research issue.

This design is obtained by integrating the different results during the interpretation stage of the investigation (Creswell et al., 2011). To increase the richness and rigor of the study, the researcher used primary and secondary data sources in the current research. The study utilized a questionnaire and semi-structured interviews as the primary means of data collection.

The questionnaire sampled demographic details and also the views of public primary school mathematics teachers about assessment. This means in addition to providing rich data on teachers' views on assessment and assessment practices, it also provided rich data which led to demographic and statistical information.

On the other hand, the data from interviews yielded more descriptive information on assessment and assessment practices. Sampling for the interviews was targeted at teachers possessing at least three years of experience in a teaching capacity, a teaching qualification, registration with the Teachers Registration Council of Nigeria (TRCN) and who prepare students for at least one certificate exam.

Based on these requirements, purposive sampling was used to isolate such respondents. The researcher hoped that the isolated participants would provide the required and appropriate insights into the study unrestricted by general population trends (Schoch, 2020). This equally safeguarded the trustworthiness of the data by avoiding half-done evidence (Robson, 2011).

Deliberate sampling was employed in order to choose the ideal interview subjects that could provide the rich information needed for generating rich data, and ultimately, findings. The questionnaire was completed by 115 respondents while nine participants participated in the semi-structured interviews. While qualitative data was presented as descriptive text, visual aids such as tables and charts were used to display the quantitative data in a clear and concise manner.

Furthermore, Gunawan (2015) attempts to describe trustworthiness by breaking it down into 4 components as follows: credibility, akin to the positivist notion of internal validity; dependability, akin to reliability; transferability, akin to external validity; and confirmability, primarily concerning presentation (Gunawan, 2015). These four areas

therefore become very sacrosanct to qualitative studies. For emphasis, they include credibility, dependability, transferability and confirmability.

Rose and Johnson (2020) also view these areas from a slightly varied viewpoint. Alternative qualitative researchers have delved into aspects such as credibility (ensuring the analyses are credible), transferability (ensuring the analyses can be applied to other contexts), dependability (ensuring the analyses are consistent and replicable), and confirmability (ensuring the analyses are backed by the data), showcasing the subtle distinctions that arise when framing similar concepts differently.

In the light of the above, the following specific steps or considerations were made in order to secure the trustworthiness of the present research process:

4.1.1 Credibility

The concept of credibility in qualitative research is similar to internal validity in quantitative research, as both relate to the accuracy and authenticity of the findings in representing the studied phenomenon, and is a key indicator of a study's reliability and trustworthiness (Gunawan, 2015). To promote credibility in this study, especially in the qualitative phase, triangulation was utilized as a technique to corroborate findings through the convergence of multiple perspectives, data collection methods, or analytical techniques, thereby strengthening the validity and reliability of the results (Stahl & King, 2020).

In the present study for instance, data triangulation involving questionnaire data, interview data and data from documentary evidence was used to establish the findings from the research process. Methodological triangulation, incorporating both quantitative and qualitative data, was employed to achieve a more profound understanding of the research problem. Finally, the use data from 11 different primary schools provided environmental triangulation for the study.

Member checking, another method of advancing credibility in qualitative research was employed through the feedback supplied by certain individuals who took part in the interviews conducted for this research. Member checking entails sharing (incognito) collected data—often in the form of a draft report—with research respondents in anticipation of their feedback about the procedure (Rose & Johnson, 2020). Specifically,

the interviewed participants provided feedback about the evidence gathered via the questionnaires, partly structured interviews and documentary evidence.

The importance of member checking as a crucial strategy for mitigating researcher bias has been underscored in research (Robson, 2011), a perspective that this study wholeheartedly endorses and has endeavored to implement. Member checking is arguably the most essential technique for establishing credibility in research, as it involves verifying the accuracy and validity of findings with the participants themselves, thereby ensuring that the results truly reflect their experiences and perspectives (Gunawan, 2015).

Ultimately, the primary goal of member checking is to establish trust between the researchers and the participants, ensuring that the findings accurately reflect the participants' experiences and perspectives, and fostering a sense of confidence in the research process and its outcomes (Stahl & King, 2020).

Peer checking was also used to strengthen trustworthiness. Thus, feedback from the researcher's supervisor and the School of Doctoral Studies helped refine the research process and guarantee its accuracy, especially during the data collection and analysis stages. Peer checking involves soliciting a panel of experts or an experienced colleague to independently re-examine a portion of the data, providing an additional layer of verification to ensure the accuracy and validity of the researcher's analysis and interpretations (Gunawan, 2015). The doctoral student's participation in the Doctoral Research Group (DRG) presentations played a major role in this regard. Feedback from the Online Unicaf University Graduate Conference (UGraC) and viva voce sessions also contributed to peer checking.

4.1.2 Dependability

The main focus of dependability is ensuring that analyses are consistent and replicable (Rose & Johnson, 2020). In the present study, triangulation and peer debriefing served to enhance the reliability and validity of the research findings, boosting confidence in the accuracy and dependability of the study's outcomes.

Triangulation was achieved by using multiple methods to collect data. These include questionnaire, semi-structured interview and documentary evidence. Peer debriefing took

place during Doctoral Research Group (DRG) sessions organised by UNICAF University's School of Doctoral Studies. The feedback from fellow doctoral students during the researcher's presentations and feedback sessions, especially with respect to the data collection aspect, were not only constructive but also helped the researcher to view those aspects of the present study from other perspectives.

For instance, the decision to carry out a pilot phase before commencing with the questionnaire and the interview stage came in handy and eventually enhanced the dependability of the research results. Such feedback also confirmed some of the earlier decisions already taken by the researcher, for instance, the adoption of a hybrid research methodology for the purpose of triangulation. Outside the confines of Unicaf, the researcher also had the opportunity to receive feedback from other peer level doctoral candidates and such feedback provided rich communications which further enhanced trust and credibility.

Some of these doctoral candidates were not as adept with the research topic, nevertheless they were quite familiar with the nitty gritty of research methodology in general. As posited by Rose and Johnson (2020), qualitative research can benefit from collaboration with a methodological expert who possesses robust analytical skills, yet maintains a level of detachment from the specific research topic or methodology, thereby complementing the principal investigator's in-depth knowledge (Rose & Johnson, 2020).

Peer debriefing is a vital trust-building practice that enables individuals to share their thoughts, feelings, and experiences in a safe and supportive environment. Enlisting another researcher to review and respond to views, including the researcher's interpretations, serves as a form of validation, reinforcing the researcher's understanding.

At its core, this process implies, the researcher might have interpreted this subjectively, but someone else perceived it similarly, suggesting significance (Stahl & King, 2020). Peer debriefing is about communications between the researcher and his peers. Such communications are intended to enhance trust in the research. They also help in solidifying the doctoral student's confidence.

In the present study, some of the other doctoral candidates were able to engage in querying the rationale for choosing certain methodological practices, analytical frameworks, and overall lucidness of the study procedure, contributing to the credibility of the study (Rose & Johnson, 2020). For example, the decision to include documentary analysis in the research design was as a result of peer debriefing.

4.1.3 Transferability

Transferability is a form of external validity (Gunawan, 2015) or generalisability. According to Neuman (2014), external validity is indeed a key concept in experimental research, focusing on the generalisability of investigation results beyond the specific conditions of the study. It pertains to the extent to which results obtained from a particular sample or setting can be extrapolated to broader populations or different contexts. This involves assessing whether the findings are applicable to other individuals, settings, and situations beyond those directly studied.

In qualitative studies, external validity is achieved through a process called transferability. The central question external validity seeks to answer is *how widely can the study's conclusions be applied to other relevant situations or environments?* Qualitative researchers posit that the patterns and descriptions emergent from one contextual setting may possess transferability to other settings, thereby facilitating the identification of analogous phenomena and informing broader theoretical understanding (Stahl & King, 2020), especially when such patterns and descriptions are rich.

Therefore, the doctoral student addressed this issue by providing a thorough explanation of the research methodology, with particular emphasis on the data collection and analysis techniques employed. Gunawan (2015) also corroborates this idea by noting that transferability is equivalent to external validity in a quantitative study and can be obtained through the utilization of thick descriptions in qualitative studies.

Transferability hinges on the richness of thick descriptions, which offer detailed portrayals of circumstances for potential application to others' situations, often guided by input from local stakeholders. Such transfer relies on researchers' comprehensive

descriptions, including contextual details of the research site, organizations, and key participants.

Explanations of any excluded parties that might impact data collection are also essential. Detailed accounts of data collection methods, timelines, and the entirety of the field study duration are vital. Together, these components influence the practical relevance and applicability of the study's outcomes to various locations or contexts (Stahl & King, 2020).

Therefore, the present study tries to describe each phase or segment in meticulous detail in the research process. Such descriptions include (but are not limited to), identifying the research problem and questions, extensively reviewing the literature and existing knowledge, carefully choosing the study design and methods, field aspects which cover the submission of gatekeeper letters to the authorities of the schools targeted, rigorous data collection processes which include interviews and questionnaire administration and documentary evidence.

Background context for the issue under review in the present study is also provided in the literature review. In fact, transcriptions portray salient features such as hesitations, repetitions and emotions exhibited by respondents during their interviews. Rose and Johnson suggest that the development of rich, contextualized narratives and analyses that capture the complexities of social, political, or economic phenomena enhances a qualitative researcher's depth of embeddedness and reflexive awareness within the field of study, thereby fostering a more nuanced understanding of the research context (Rose & Johnson, 2020). Indeed, the present study increased the researcher's awareness of assessments and assessment practices.

4.1.4 Confirmability

Confirmability in research pertains to the degree to which the outcomes of a study remain objective, impartial, and uninfluenced by the researcher's biases or personal perspectives. It stands as a criterion for evaluating the reliability and credibility of qualitative research. The criterion of trustworthiness scrutinizes the level to which the outcomes of research accurately reflect the views and experiences of the participants,

unfiltered by the researcher's own biases. This indicates that the study should inspire enough confidence that the findings derive from the narratives and words of the participants rather than potential biases of the researcher.

Therefore, the present study makes a concerted effort to ensure that data interpretation was participant friendly, thus making the findings participant-based. Put another way, the findings from this study are neither based on the thinking of the researcher or his biases. The more *participant-based* the findings in a study are, the more objective or real such a study is likely to be. Perhaps, this explains why Stahl and King (2020) emphasize confirmability as a means to enhance objectivity in qualitative research (Stahl & King, 2020). Furthermore, the researcher bolstered the confirmability of the current study by employing reflexivity (reflecting on personal biases, perspectives, and assumptions throughout the study's design and implementation phases), triangulation, and peer debriefing.

4.2 Validity and reliability of data

Accurate data collection is the cornerstone of successful research, forming the foundation for reliable and trustworthy findings, and by extension the data collection tools deployed during the research (Rose & Johnson, 2020).

4.2.1 Validity

This research utilized a mixed-methods approach, consisting of questionnaires, partially structured interviews, and an examination of relevant documents.

In order to ensure that the right tools were selected for the present study, the following factors were considered: the research aims, nature of the research questions, and types of data needed. Throughout the study, the author paid sufficient attention to being thorough, careful and honest, especially in terms of data collection and the tools deployed in collecting the data. This explains why a full record of each activity in the study was kept.

Specifically, the following steps were taken to ensure the validity of this research – pilot testing, expert validation and triangulation.

a) The research instruments, especially the questionnaire and interview items, were tested with a small group of participants to ensure they are clear and effective (Abd

et al, 2020; Bell, 2010). The authenticity and accuracy of the documentary evidence were verified by a) obtaining permission from the relevant authorities e.g. school authorities and teachers, to conduct the analysis b) checking the exercise books for any signs of tampering c) triangulating data from exercise books with questionnaire and interview data and d) anonymizing student data to protect their identities and maintain their confidentiality.

b) The questionnaires and interview instruments were reviewed and validated by the Unicaf Research Ethics Committee (UREC) before adoption and use.

c) Multiple data sources were used to validate the findings from the study including questionnaires, semi-structured interviews, and documentary evidence in order to raise confidence in the results (Neuman, 2014; Robson, 2011).

4.2.2. Reliability

In addition to the precautionary measures already mentioned above and in Chapter Three, the following measures were taken in order to mitigate possible biases and ensure the reliability of the questionnaire and interview data collected:

a) The research instruments (questionnaires, interview protocols) were tested with a small group of participants to ensure they are clear and effective (Bell, 2010).

b) For the semi-structured interviews, standardized procedures were employed for data collection and analysis to minimize variability.

c) Audio recording the interviews – the telephone interviews were audio recorded in order to ensure completeness of the interview data and monitor the consistency of the interview instrument (Rose & Johnson, 2020). Based on another author's view, the recordings were aimed at also making it easier for the researcher's supervisor to supervise his performance where this became necessary (Robson, 2011). Conversations were stored automatically to the phone device.

d) Unbiased interpretation – to overcome any potential challenges to data interpretation, the following precautions were taken:

  i. The entire process of interpretation was subjected to continuous checking with the researcher's supervisor to ensure consistency. Furthermore, steps taken to interpret data were continually charted and justified throughout the

process of interpretation. Moreover, the interpretation was descriptive in order to gain a deep understanding of the phenomenon under review (Neuman, 2014; Robson, 2011). In the absence of a descriptive interpretation, readers of qualitative research may rely on their own lay understandings and tacit assumptions, potentially leading to misinterpretation or oversimplification of the findings, as they unwittingly impose their everyday, taken-for-granted conceptual frameworks (Neuman, 2014) thereby threatening the validity of the study's findings.

ii.   Since qualitative data has a tendency to quickly become overwhelming, even in relatively small-scale projects (Robson, 2011), the study confined itself to collecting an amount of data which could be analysed within the allocated timeframe for the research. Thus, data analysis was relatively easy to complete within this timeframe. This consideration cannot be overemphasised given that the qualitative data in the present study were manually collected and analysed.

iii.   The study focused on collecting and using meaningful and real-time data in order to produce relevant and useful results (Clements, 2021). In fact, even the data for documentary evidence was generated within the research period.

iv.   To forestall any ambiguity in interpretation and to effectively communicate the quantitative results, this study employs a range of visual tools, including charts, tables, and graphs, to present the data in a clear and concise format. Giving the reader an abbreviated data snapshot (Neuman, 2014) forestalled any possible ambiguities.

v.   All data was stored in forms that could be easily accessed because successful data interpretation begins with the accessibility of such data (Neuman, 2014).

vi.   Finally, the researcher is fully aware that lack of adequate skills to interpret data can affect the quality of any research findings. For instance, Robson (2011) suggests the importance of researchers developing a working understanding of essential concepts and terminology relevant to analytical tasks and interpretation. Therefore, the researcher relied on

experience from previous research efforts, the literature and support from the researcher's supervisor.

e) Alternative interpretation (Multiple data sources) – The concept of assessment is broad and largely subjective. As such, it is laced with varying shades of opinions and beliefs. Therefore, it became necessary to review data from the present study with data from other sources. Research advocates for rigorous research analysis, involving: exploring alternative data interpretations, comparing results with past studies and identifying wider implications (Neuman, 2014; Robson, 2011). This approach ensures credibility, informs decision-making, and encourages ongoing scholarly discussion (Neuman, 2014). Therefore, this study considered and reviewed various other but reliable data on assessment practices which do not necessarily promote the concept of formative assessment.

f) Prolonged involvement – in terms of reliability, usually conceptualized as *dependability* in qualitative inquiry, consistency is achieved through strategies like maintaining an audit trail, documenting procedures clearly, reflexivity, and triangulation (Nowell et al., 2017; Johnson et al., 2020). These practices—not brief contact with participants—strengthen reliability.

Additionally, although the data collection period for the interview phase of the study lasted for roughly two weeks, each interview session was painstakingly carried out to ensure sufficient engagement with the participants. This helped to preclude any possible researcher and/or participant bias due to little or non-prolonged involvement with participants. The importance of the researcher's prolonged engagement with research participants, to the findings, in specific research studies has also been mentioned (Dado et al., 2023).

g) Triangulation – various forms of triangulation were deployed in this study to enhance the rigor of the study. For instance, data triangulation was achieved through using three different methods of data collection – questionnaire, interviews and documentary evidence. Furthermore, methodological triangulation featured the use of a research design which deployed both quantitative and qualitative approaches. Lastly, environmental triangulation which is, adopting a cross-contextual research

strategy, exploring the phenomenon across diverse situations or environments (Stahl & King, 2020), was achieved by applying data collected from 11 school contexts.

It's important to note that triangulation, a multifaceted research approach, can mitigate various threats to validity, enhancing the overall rigor and reliability of findings by confirming consistency across multiple data sources, methods, or investigators, reducing biases and errors associated with single-method or single-source research and increasing confidence in research conclusions through cross-validation (Robson, 2011) despite possible disagreements between the different approaches employed. The importance of triangulation in promoting credibility in a flexible study such as the one under review cannot be overemphasised (Stahl & King, 2020).

h) Negative case analysis – This study acknowledges that there are contrary views about formative assessment practices. According to a UNESCO International Institute for Educational Planning, IIEP (2020) brief, critics of formative assessments argue that this form of assessment can inadvertently disadvantage students from marginalized backgrounds. Specifically, concerns center around patronage risks, where teachers' personal relationships with students may influence assessment outcomes, and biases linked to gender, ethnicity, or socioeconomic status. These biases can result in inaccurate or unfair evaluations, lowered self-esteem and motivation, and exacerbated achievement gaps (IIEP-UNESCO, 2020). Concerns about the problematic nature of implementing formative assessment in the classroom have also been raised (Abu Musa & Islam, 2020).

4.3 Results

This study facilitated an investigation into the perceptions, attitudes, and thought processes of public primary school mathematics teachers in Abuja, providing valuable insights into their professional perspective on assessment. Since teachers use assessment in their work with children, the researcher's thinking was that an evaluation of the extent to which their assessment practices are successful is likely to help identify and fill potential gaps in teachers' assessment knowledge and skills.

Because the nature of a research problem largely determines the research method (Zaborek, 2009), the study employs a convergent parallel design, combining qualitative and quantitative data collection and analysis methods to achieve a more complete understanding of the research topic. The sampled population for questionnaire data comprised 121 primary school mathematics teachers from 11 different primary schools in Abuja. However, only 115 participants responded to the questionnaire. This comprised 67 female and 48 male teachers. In terms of percentage, nearly 56% of the participants were women while about 43% were men. Nevertheless, the choice of sample size in this study was guided by the fact that the appropriate sample size for quantitative studies varies depending on the attributes and size of the study's sample frame (Mike, 2017). The purpose of extending sampling to 11 primary schools was to produce a mostly representative sample in terms of the population of the study (Bell, 2010).

The questionnaire featured questions that promoted impartial data collection. These questions were vetted and approved by the University Research Ethical Committee (UREC). The questionnaire sought to explore the thoughts, opinions, and experiences of primary school mathematics teachers related to assessment, with the goal of gaining a deeper understanding of their perspectives. Thus, the questionnaire addressed issues pertaining to demographic information as well as the perceptions of the sampled teachers about assessment in addition to how they used assessment. For instance, participants were asked

The questionnaire had 25 items which cut across Research Questions 1 - 3. It provided a solid foundation for the interview which was used to gather further evidence to build on the insights already gained from the questionnaire evidence. It is a known fact that the interview can provide rich material and can often put flesh on the bones of questionnaire responses (Bell, 2010).

Finally, data was also collected using documentary evidence. Documentary analysis has been used to check the reliability of evidence gathered through other research methods (Bell, 2010). Three of the 11 sampled schools took part in the documentary evidence stage. There were no particular criteria for selecting these 3 schools apart from the fact that they showed the greatest enthusiasm towards taking part in this stage of the research. The

researcher viewed this enthusiasm as willingness to participate the study. They willingly offered to be part of the formative assessment check and didn't need to be persuaded or coerced into playing this role (Neuman, 2014).

A total of 132 mathematics exercise books were sampled from the three schools. These exercise books belonged to Year 5 students, most of whom were average or lower ability pupils. They were identified and selected by the mathematics teachers from the three featured schools for the intervention. Thus, pupils who consistently had average or less than average scores in class work and written tests administered within the last 6 months to the test period fell in this category.

In order to address the study's aims and objectives, a general research question was posed, which served as the foundation for the more specific research questions that underpin this investigation: *Can assessment practices improve the quality of teaching and learning in Nigerian schools?* Based on the above question, the following research questions were developed to further explore the topic and provide more focused insights.

a. What are the views of primary school mathematics teachers about assessment practices?
b. How effective are the existing assessment strategies teachers use, in improving students' learning and academic achievement in mathematics?
c. What is the effect of formative assessment practices on learning outcomes?

In order to guarantee ethical assurances, the following considerations were made during data collection and analysis. Data collection only commenced after receiving the UNICAF Research Ethics Committee's (UREC) approval on December 27th 2022. The gatekeeper and informed consent letters approved by the UREC clearly pointed out issues related to confidentiality and anonymity (Appendix 3).

Other considerations made include insisting on voluntary participation, securing informed consent, ensuring anonymity, the freedom to decline participation or withdraw from the study at any stage, taking precautionary measures to avoid plagiarism or harm to the participants. No participant was coerced to take part in the study (Neuman, 2014).

To further generate workable and trustworthy data, the study collected important demographic information from the research participants. According to Connelly (2013), researchers collect demographic data to provide context about the survey respondents, enabling readers to understand the sample's characteristics and composition.

Demographic information collected from participants in order of appearance on the questionnaire include (a) gender (b) teaching experience (c) age (d) years served in present workplace (e) age group taught (f) teaching qualification and (g) educational qualification held as at the time of this study. Each of these demographics is discussed below as follows:

Gender – male and female teachers responded to a purpose-built questionnaire which was used to collect information on mathematics teachers' views and use of assessment practices across selected public primary schools in Abuja. A total of 115 male and female teachers completed and returned their questionnaires. 56% of the respondents are females while 43% are males. It is heartwarming to note that about 79% of the respondents have over 7 years of teaching experience meaning that most of the respondents are well experienced in their profession.

Figure 16

Distribution of Respondents by Gender
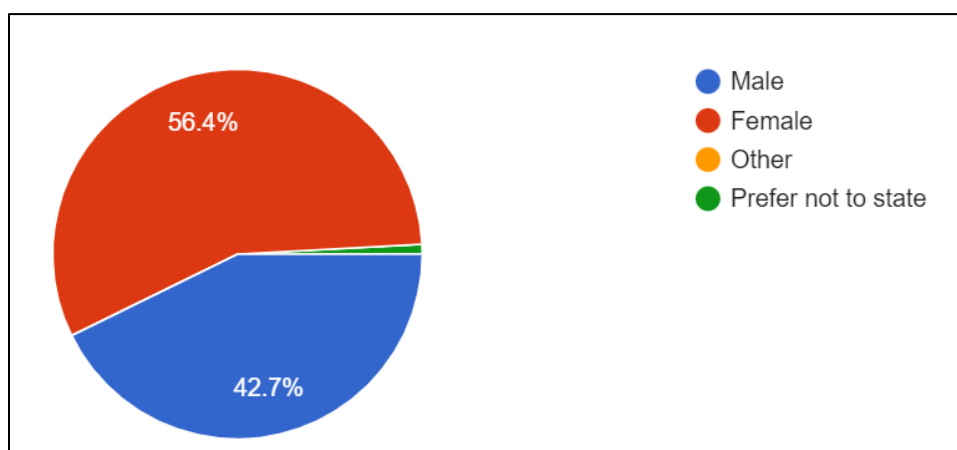
The gender distribution of the research participants can be seen from the above chart. 56% are female while 43% are male. 1% preferred not to state their gender. This reiterates the importance this study accorded to the issue of informed consent.

Figure 17

Distribution of Participants by Age
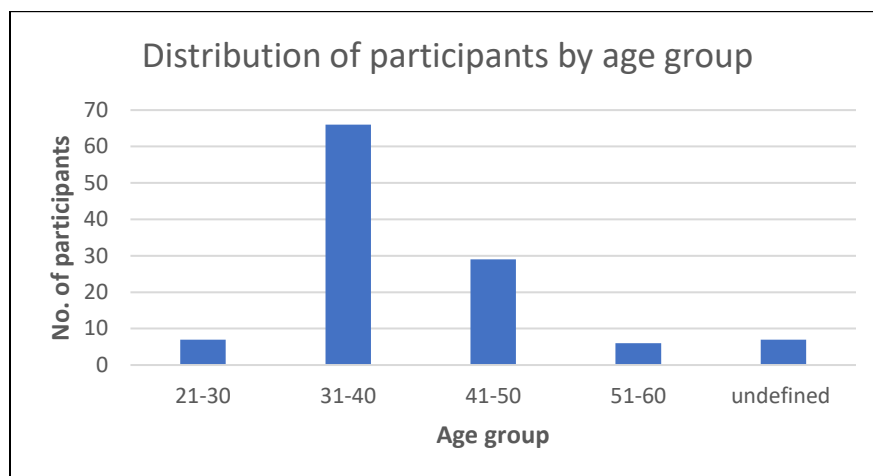
Based on the collated age groups, 57% of the sampled teachers were 31 – 40 years (66). 25% were 41 – 50 years old (29). Teachers aged 21 – 30 years made up 6%, while those aged 51 – 60 years old made up 5% of the survey participants. Unfortunately, the remaining responses (7%) were not properly defined. This shows that majority of the participants in this study are likely to be experienced teachers compared to the 6% who are relatively young and inexperienced.

Figure 18

Distribution by Years of Teaching Experience
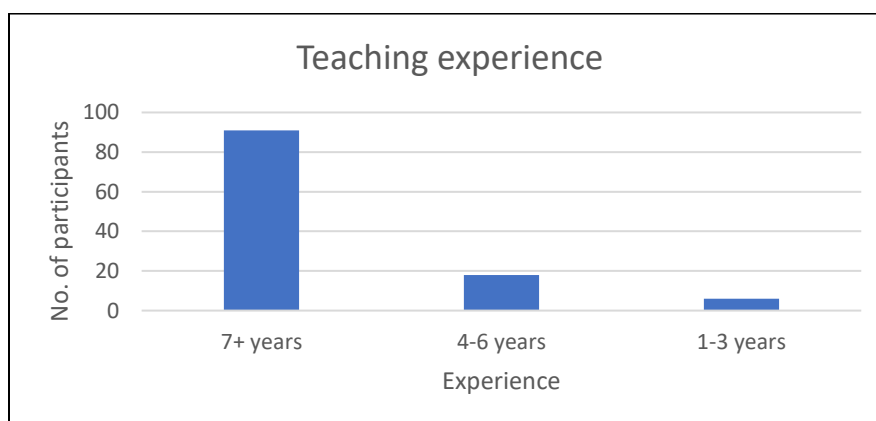
The survey found that 79% of participants have extensive teaching experience, exceeding 7 years, whereas 16% have moderate experience (4-6 years), and 5% have limited

experience (1-3 years). Ordinarily, teaching experience is considered crucial to the development of assessment skills, as it provides opportunities for educators to refine their ability to design, implement, and interpret assessments effectively (Hattie & Timperley, 2007). Through experience, teachers can develop a nuanced understanding of student learning, identify areas of improvement, and adjust their assessment strategies accordingly.

Figure 19

Years Spent at Present School
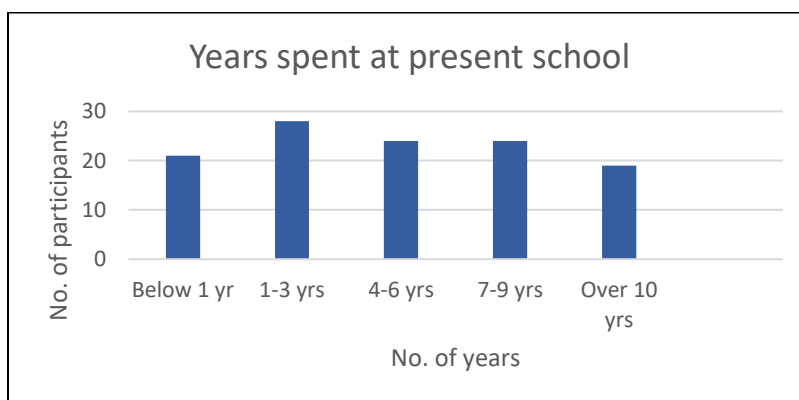
Participants have been serving at their present schools for the following durations: for periods ranging from less than 1 year to over 10 years. Specifically, 24% of them have spent 1 – 3 years at their present workplace, 21% have spent 4 – 6 years, another 21% have also spent 7 – 9 years. Finally, 17% have spent 10 years or more at their present workplace.

Figure 20

Distribution by Teaching Qualification
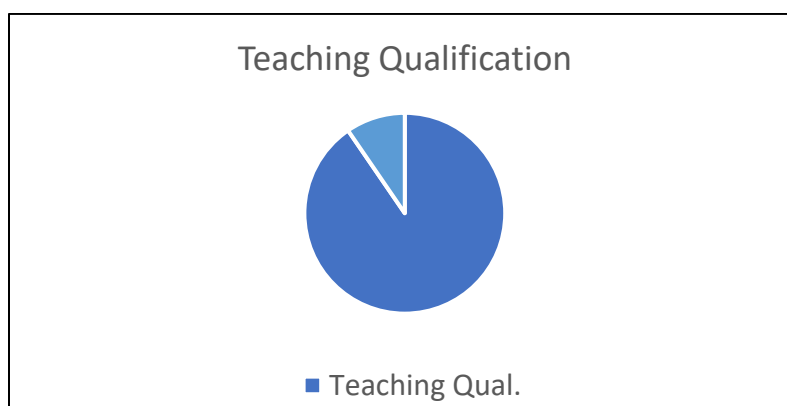
90% of the sampled teachers possess a teaching qualification while the remaining 10% do not have any teaching qualification as at the time of data collection.

Figure 21

Teachers with TRCN Certification

Teachers Registration Council of Nigeria

No response, 3, 3%
Not sure, 1, 1%
No TRCN, 32, 27%
TRCN, 81, 69%

■ TRCN ■ No TRCN ■ No response ■ Not sure
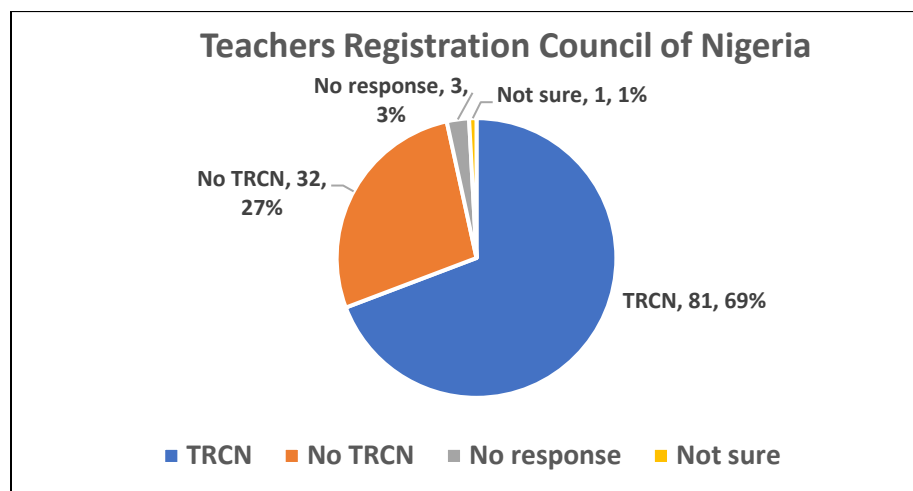
Of the 115 surveyed teachers, 69% are TRCN certified while 27% lack a TRCN certification. The remaining teachers comprise 1% who are not sure if they are TRCN certified or not, and another 3% who did not respond to this particular question.

Figure 22

Distribution of Participants by Highest Qualification

Highest qualification

(B.Sc or B.Ed, M.Sc or M.Ed, NCE, PGDE, PhD)
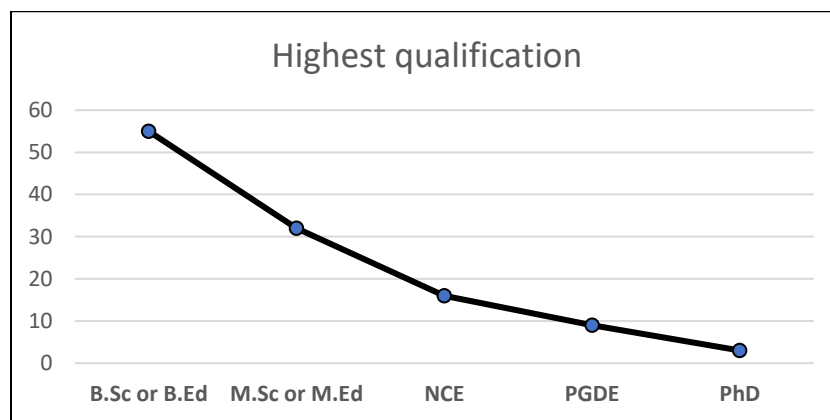
48% of the participants in the survey have a degree as their highest qualification. These teachers either have a bachelor of science or education. This is followed by teachers with a master of science or education as their highest qualification (28%). Following closely

behind are teachers holding a National Certificate of Education (NCE), comprising 14% of the participants. This is followed by 8% of teachers with a postgraduate diploma in education. The smallest group consists of PhD holders, making up 3% of the research participants.

The results of the study are now discussed below in terms of the specific research questions.

4.3.1 Research Question 1: What are the views of primary school mathematics teachers about assessment practices?

The Questionnaire provided initial feedback for the Research problem. About 44% of the primary school mathematics teachers view assessment not only as an event, but also as a tool to measure how much learning is taking place in their classrooms. They view assessment as an activity that happens once in a while, for instance once in a fortnight, once in a month etc. This category further believes that assessment comprises the use of tests and exams for gauging or measuring learning.

On the contrary, 42% see assessment as a process to improve learning. This category think assessment is continuous testing, not a 'hit-and-run' affair and that this activity is targeted towards the improvement of the learning.

Some 11% of the teachers view assessment as an event for testing and ranking students in the classroom or other educational setting. These teachers use tests to tell where a child is at academically. The remaining 3% either see assessment as all of the aforementioned descriptions or as an event for passing judgement on an evaluation process.

Figure 23

The Meaning of Assessment
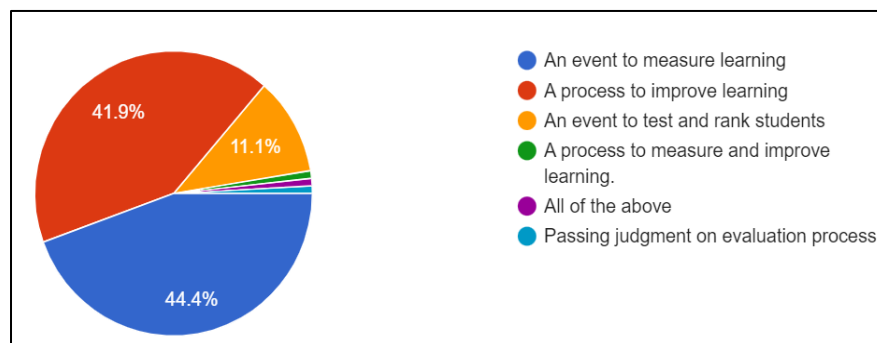
Furthermore, 45% of the public primary school mathematics teachers believe a written test or examination is the most effective method of assessment while 46% believe written tests or exams are not the best form of assessment. It should be stated that the main emphasis about tests is on the cognitive domain of learning and at the lower levels of Bloom's taxonomy such as memorization and comprehension. Some 9% of the teachers are not sure if written tests or exams are the best form of assessment.

Figure 24

The Best Form of Assessment is a Written Test
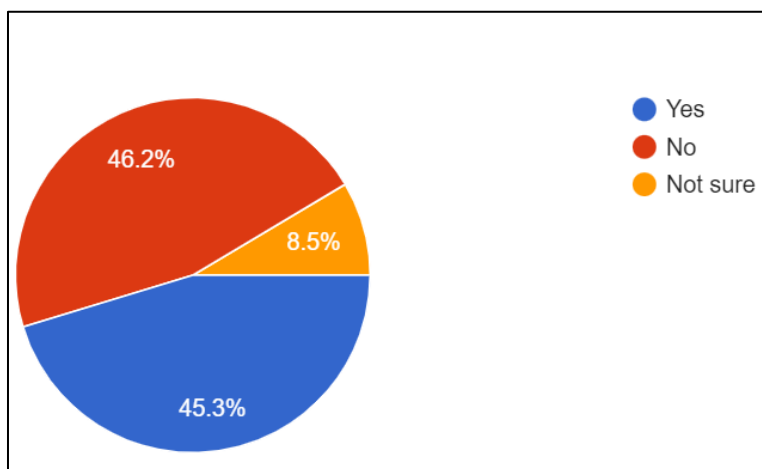
When asked whether assessment ought to be teacher driven, 56% of the primary school mathematics teachers responded affirmatively whereas 40% of them think otherwise – that assessment should not be teacher driven. This finding tallies with the view of many teachers in Nigeria that the entire process of institution-based assessment should be undertaken by the teacher right from the beginning to the end (Aduloju et al., 2016). In this instance, the student is only required to study ahead of such assessments and sit or take tests or exams.

Figure 25

Assessment Should Be Teacher-driven
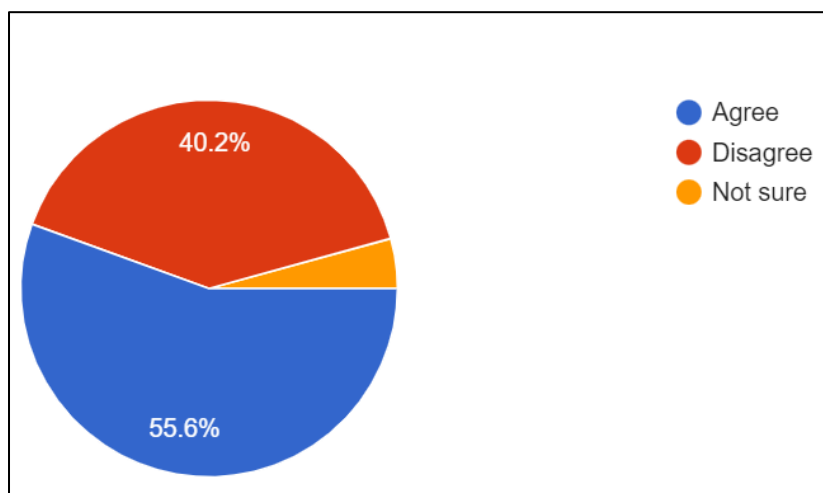
In addition, the study present wanted to know if tests and exams were the main forms of assessment the teachers use. While 53% of them responded in the negative, 46% attested to using tests and exams as their main forms of assessment. Tests and exams are the main avenues for assessing students in many schools in Nigeria (Obilor, 2018; Sewagegn, 2019). This author suggests that, summative assessment, such as written tests and exams, have become a widely accepted standard within the education system, embraced by students, parents, teachers, educators, and other stakeholders (Obilor, 2018). Less than 1% were in doubt as to whether tests and exams were their main forms of assessment.

Figure 26

Tests and Exams Are the Main Forms of Assessment I Use
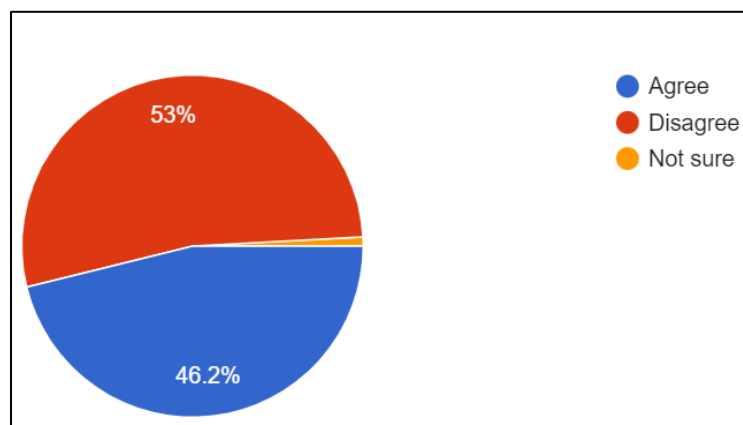
When asked whether assessment outcomes should always go with a written or verbal feedback, 95% of the teachers agreed to always adding a written or verbal feedback to assessment outcomes. On the contrary, 5% of the teachers think otherwise – that a written or verbal feedback need not always accompany assessment outcomes. It's crucial to recognize that a key characteristic of summative assessment is its focus on judgment rather than providing corrective feedback to learners (Ndubueze et al., 2015).

Figure 27

Assessment Outcomes Should Always Go with a Written or Verbal Feedback
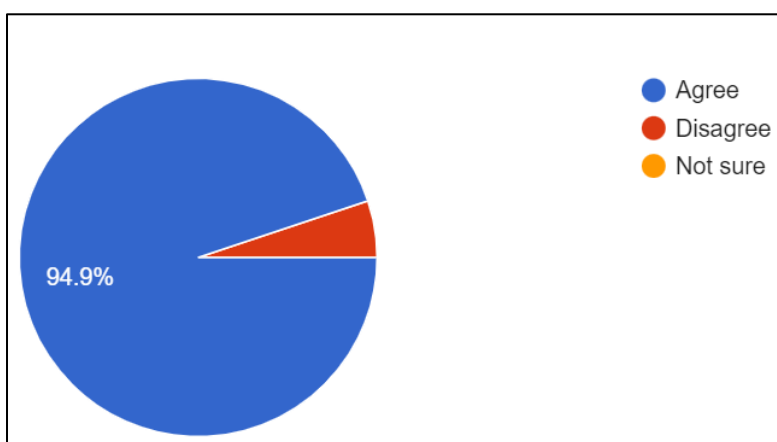
The teachers were also asked if they usually provide written feedback in each assessment they give. 80% claim they do while 15% denied providing written feedback in every assessment they gave. 5% were unsure about this. Research indicates that feedback serves as a crucial mechanism for enhancing educational outcomes, as it enables the provision of constructive information to both pupils and educators (Hendrickson, 2012). This feedback facilitates targeted improvements in student performance, better teaching methodologies, richer content and informed decision-making across various educational domains (Esere & Idowu, 2013).

Feedback constitutes one of the 5 purposes of mathematics assessment practices (Kulm 1994 as cited in Hendrickson, 2012). The other 4 purposes include "improving instruction and learning, evaluating student progress …communicating expectations, and improving attitudes toward mathematics" (Hendrickson, 2012, p. 36).

Figure 28

I Usually Provide a Written Feedback for Every Assessment I Give
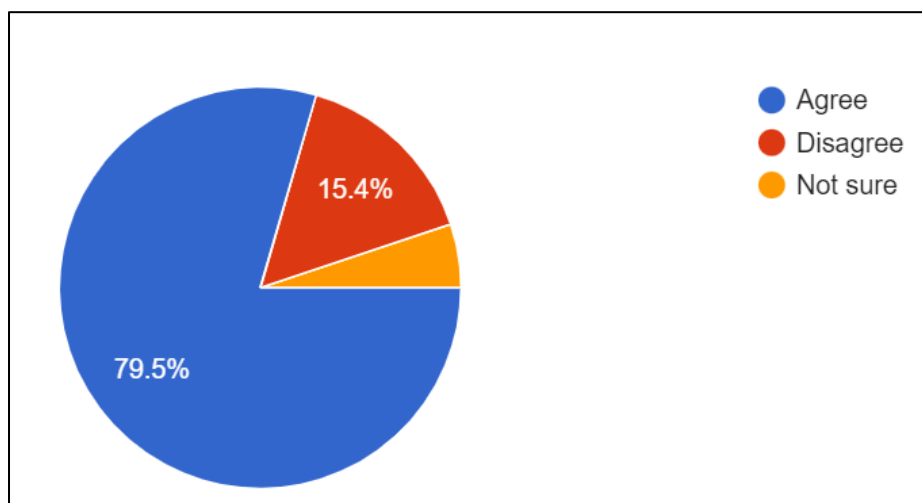
      In addition, the teachers were asked whether they make consistent use of self-assessment and peer-assessment in their classroom practices. 78% claim they do but 15% said they don't always use these forms of assessment in their classroom teaching. Another 7% of participants reported being unsure about consistently using self-assessment and peer-assessment in their classrooms. The incorporation of self-assessment and peer-assessment practices in instructional practices is known to promote collaborative, communication and self-reflection skills (Light & Pierson, 2013).

Figure 29

I Always Allow My Students to Self- and Peer Assess
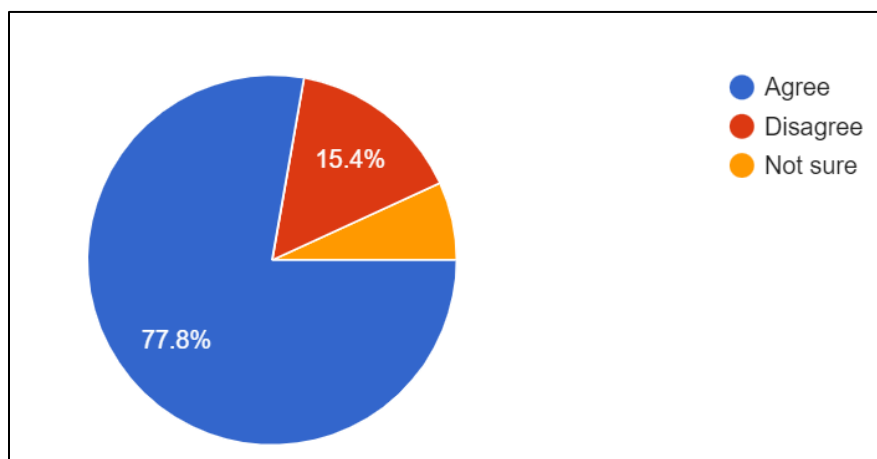
To check whether the teachers enjoyed using frequent testing as a means of assessment, the study also enquired if students should only write final exams only on an annual basis, at the conclusion of each academic year as opposed to three times in a year. 70% of the research participants disagreed with this line of thinking while 27% of them agreed with it. In addition, 3% said they were not sure if students should write exams just once in a year.

Figure 30

Students Should Write a Final Exam Only at The End of Each School Year
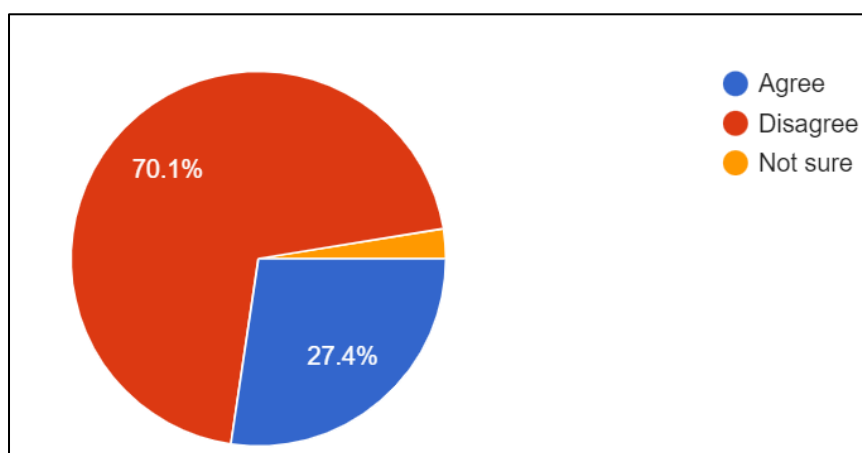
On the contrary, when asked if students should write final exams at the end of each term, 81% of the participants embraced this idea whereas 17% rejected it. Less than 2% were not sure if exams should be conducted termly. Again, the basis for this question was to check if the teachers enjoyed the use of frequent testing.

Figure 31

Students Should Write a Final Exam Only at the End of Each Term
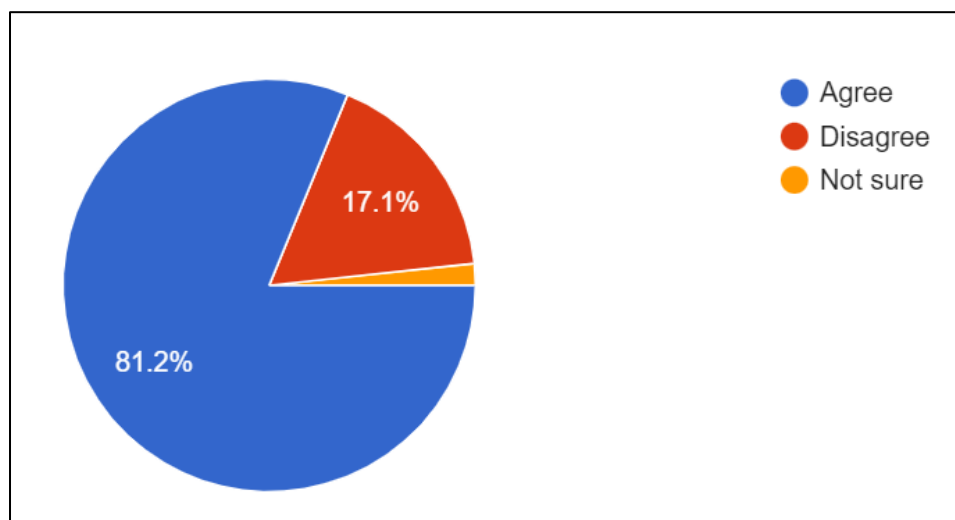
The next question sought to find out if teachers felt there were any connections between assessment and learning. 55% of the respondents in this research believe that assessment must not always be related to learning. However, 37% of them disagree with the notion. 4% of the participants are not sure if assessment should not always be related to learning. Macbeath (2008) observes that in some climes, assessment often aligns with what we've been taught rather than what has truly captivated us or what we've discovered about our own learning process. Put differently, assessment is viewed as what has been covered or taught by the teacher and not necessarily what has been learned by the learner. The majority of these teachers would rather link assessment to teaching as opposed to doing so with learning.

Figure 32

Assessment Should Not Always Be Related to Learning
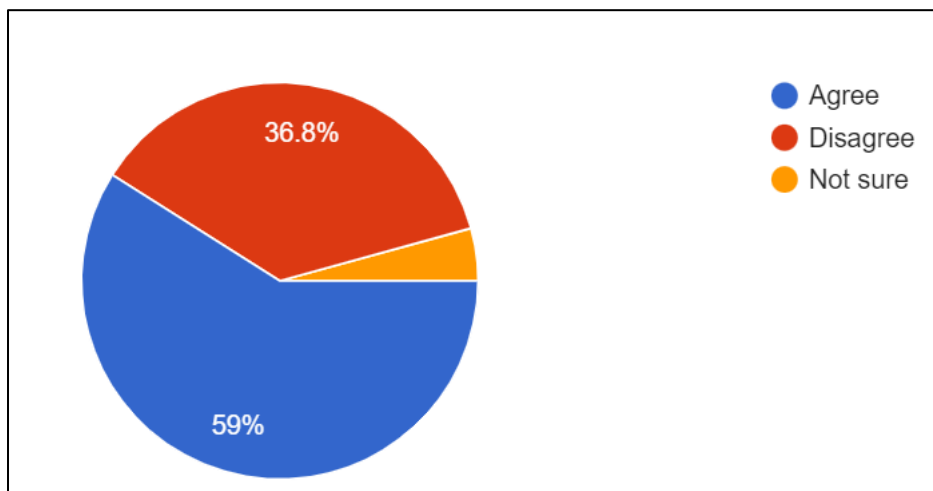
Participants were subsequently asked to report on the predominant assessment method used to evaluate them during their own time in school. The main essence of this question was to check whether how the teachers were assessed back in school had any effect on how they practice assessment today. For instance, in an Ethiopian University study, Sewagegn (2019) observes that student teachers were assessed using mainly summative methods such as written exams and tests, assignments, quizzes etc. Would this exposure influence how these teachers assess their students in the future?

82% of the teachers in the present study confirmed they were mainly assessed through graded written exams. On the other hand, 16% of them disagreed with this notion.

Figure 33

Main Method of Assessment Used Back at School
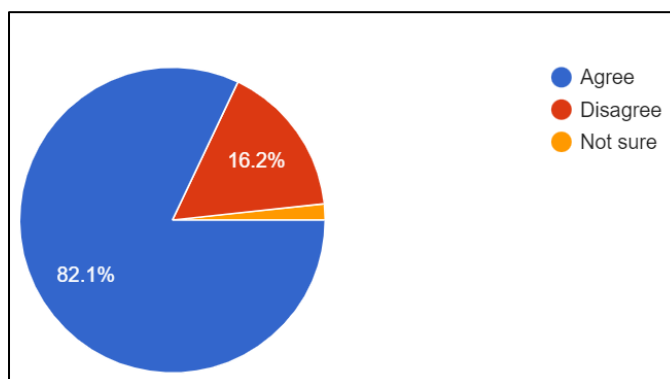
The beliefs of teachers are likely to impact their methods of teaching and assessment (Azis, 2012; Brown et al., 2019). An overwhelming 92% of participants acknowledged that teachers' beliefs about teaching and learning can influence their assessment perspectives, whereas 7% did not share this view. Furthermore, only 1% of participants were unsure whether teachers' beliefs about teaching and learning shape their assessment views.

Figure 34

Teachers' Beliefs About Teaching and Learning on Assessment Views
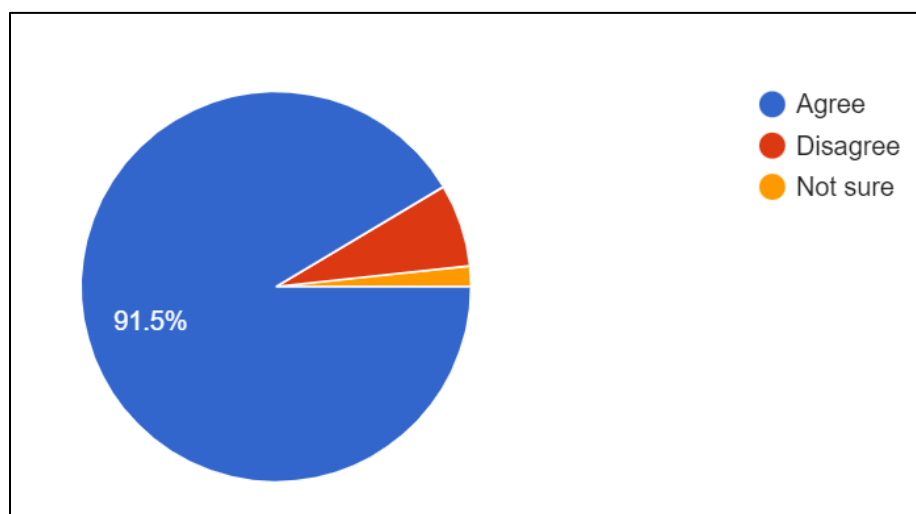
Furthermore, the participants were also asked if Nigeria's policy on assessment (1st & 2nd continuous assessment tests followed by terminal exams) should be retained. The National Policy on Education in Nigeria dictates a specific weighting for continuous assessment and school examinations, with a ratio of 40:60 respectively, for determining

student promotion to the next class, a requirement for all schools in Nigeria, including both public and private institutions.

This assessment framework aims to evaluate student performance comprehensively, ensuring that advancement is based on a balanced consideration of continuous assessment and examination results (FRN, 2014). In Nigeria, continuous assessment caries 40 marks while the end of term exam carries 60 marks. While 74% of them agreed this policy should be retained, 17% of the teachers think otherwise. 9% of the participants are not sure if the policy should be retained or not.

Figure 35

Retention of Nigeria's Policy on Assessment
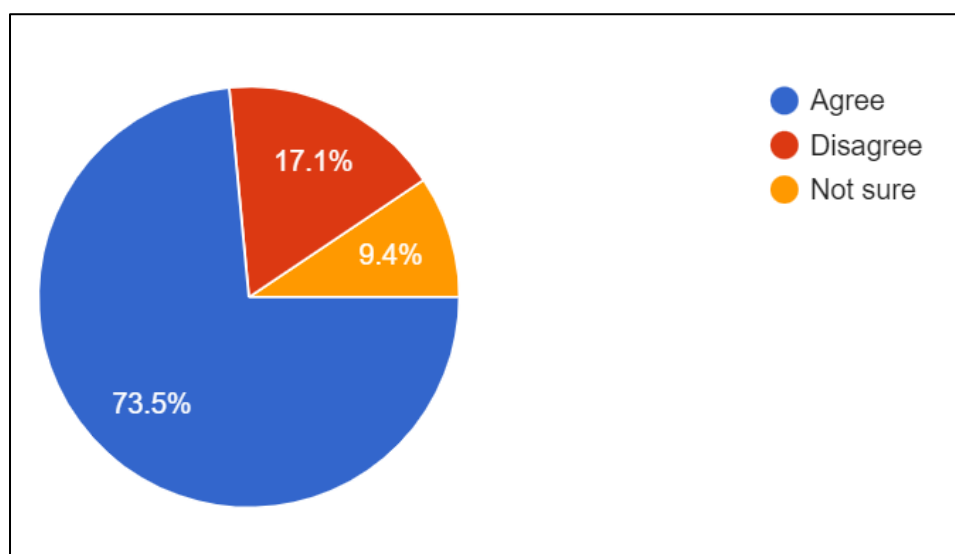
The next question sought to find out if the use of grades was important to the teachers. Is assessment meaningless without grades? The Assessment Reform Group (1999, p. 7) notes that the challenge with grades or marks is that they may inform pupils about their success or failure but often lack guidance on how to advance toward further learning. In responding to this question, 68% of the questionnaire respondents think assessment is meaningless without assigning grades or marks to students' work while 29% think otherwise. 3% are not sure.

Figure 36

Assessment Without Grades or Marks is Meaningless
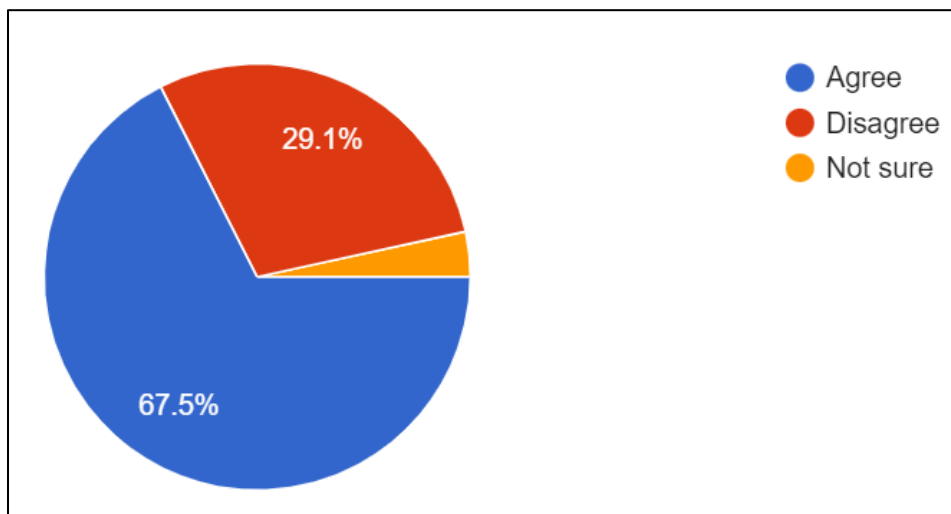
Lastly, the study wanted to check the surveyed teachers' view about the following claim - The fundamental responsibility of a teacher is to impart knowledge to learners whereas the students should listen and learn from the teacher. This view is in consonance with the behaviourist theories of learning. The behaviouristic approach to teaching views teaching as a way to impart knowledge, hence the teacher is a knowledge distributor whilst the student is a knowledge receiver. Elmore (2019) calls this kind of learning institutionalised learning and defines it as follows,

> In its simplest form, institutionalised learning takes place when officially sanctioned information or content passes through a person, called a teacher, to a student, who is expected to assimilate and remember that content and later to demonstrate that the content has been learned by submitting to some kind of assessment. This process typically occurs in a physical structure—a classroom in a school—with other students typically grouped by similar ages. Judgments about what constitutes appropriate content are organized by content areas and age. Assessments of whether students have understood the content are similarly organized. (p. 332)

About 60% of the surveyed primary school mathematics teachers think this claim is true while about 34% think otherwise. 6% are in doubt as to whether the claim is right or wrong.

Figure 37

Knowledge Impartation and Student Learning
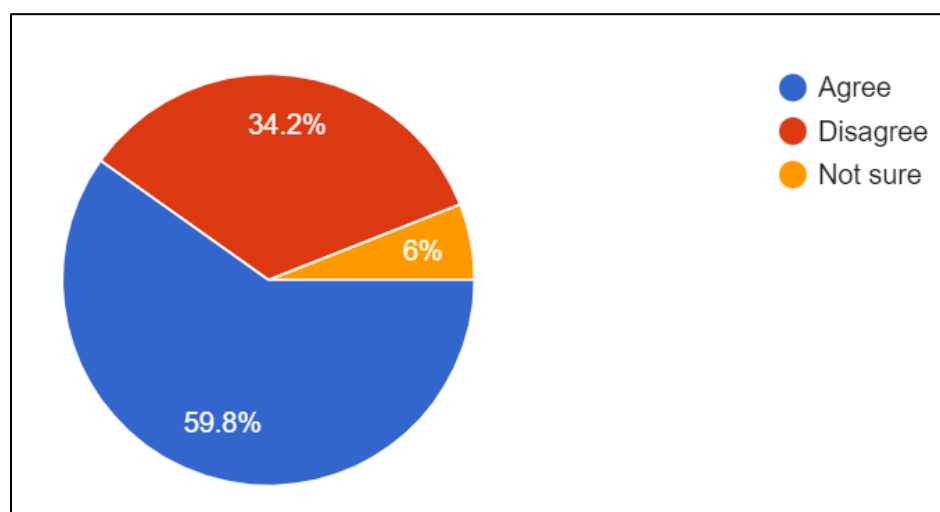
The responses to Research Question 1 are further summarized in Table 6 shown below.

Table 4

Responses to Research Question 1

Figure No.	Research Question 1 items	Agree (%)	Disagree (%)	Undecided /Other (%)
23	Assessment is a process to improve learning	42	56	2
24	The best form of assessment is a written test	45	46	9
25	Assessment should be teacher driven	56	40	4
26	*Tests and exams are the main forms of assessment I use*	46	53	1
27	Assessment outcomes should always go with a written or verbal feedback.	95	5	-
28	I usually provide written feedback for every assessment I give	80	15	5
29	I always allow my students to self- and peer-assess	78	15	7
30	A summative exam should be written at the end of each year only	27	70	3
31	A summative exam should be written at the end of each term	81	17	2
32	Assessment must not always be related to learning	59	37	4
33	I was assessed mainly through summative means back in school	82	16	2
34	The beliefs of teachers about teaching and learning are likely to influence how they assess students	92	6	2
35	The country's policy on assessment which includes writing at least 3 summative assessments per term should be sustained	74	17	9
36	Assessment without grades or marks is meaningless	68	29	3
37	Students should only sit and listen in class	60	34	6

Table 6 above shows that most of the teachers who participated in the questionnaire survey tend to align more with a summative assessment ideology. To illustrate, a near-unanimous consensus emerged among the teachers surveyed, with almost all confirming that their beliefs about teaching and learning impact their use of assessments.

4.3.2 Research Question 2: How effective are the existing assessment strategies teachers use, in improving students' learning and academic achievement in mathematics?

The main purpose of this research inquiry was to assess the adequacy and effectiveness of the current assessment practices used by the public primary school mathematics teachers in this study. To track any possible improvement these practices might generate, the study focused on checking how well the application of certain traditional assessment methods helped to improve learning for especially the lower ability learners.

When asked whether the public primary school mathematics teachers had lower ability students in their class, the responses obtained include, 'Yes, I do', 'Well yes, I do…yes I do', 'Sure, sure, sure' etc. The teachers also stated why they thought these learners were lower ability students. For instance, PMT 2 explains that…

> For every class, there is a class average. There is a class expectation and class standard so, erm… overtime these slow learners are being assessed first, based on the class standard, class expectations, minimum class expectations when they come into the class and for them to have been graded as lower learning abilities, erm… they fall way below, many times they fall way below the… class standards and then erm… sometimes we also look at their… their level of assimilation, er… through continuous assessment … over a period of time, say three to four weeks or even half term, before they are completely labeled as the lower learners, lower learning abilities but that in itself is not a static, it's not a static err… means as we find that many of them… could have been making progress although marginally, yes.
>
> PMT 2

Similarly, PMT 7 identifies lower ability learners as follows:

Ok erm, inability to grab a particular question at the right time, just like, for example now, you might give a particular question and maybe you have 15 [students] in your class and about 10 of them are already ahead, the other 5 are still dragging you back and they are wasting time. So, for their own care, it's going to take more time.

PMT 7

PMT 8 also identifies lower ability learners thus, *What makes them low ability learners is their inability to assimilate and their inability to fully understand the concept that has been taught and the pace at which they understand this concept.* Suffice it to say, this teacher recognises this category of learners by their inability to assimilate or comprehend the concepts taught by the teacher at school.

Another interviewee, puts it as follows:

They have difficulty in continuing. Like, it takes a longer time for them to comprehend. Some of them have, like learning disability. Like, or what will I call it now? It just comes with low self-esteem, and then em literally inability to comprehend quickly like their peers. Yes, I think so. I think so because it affects their work. Like they don't have confidence in their work at all… So, it really affects their work, they don't have confidence in their work.

PMT 9

In other words, lower ability students exhibit a lack of confidence and struggle to comprehend as quickly as their classmates. According to PMT 1, these students can be identified by their below average performance in the classroom.

Furthermore, the teachers agree that identifying these children was relatively a simple task. For instance, PMT 3 notes that, he identified his lower ability learners through classwork, quizzes or assignments.

The only way you can really tell if you're making progress is by ongoing assessments, maybe through classwork or assignments or short quizzes. So, within the first week, I was able to identify at least 60% of those struggling with some basic concepts.

PMT 3

PMT 2 notes that he discovers many of the lower ability students *as early as week two or week three* into the term. In the words of PMT 5, *What we do is when we start school, we do … a diagnostic test, and … that test actually informs us where all the children are, like if there's a learning gap, we know that, okay, this is it from the test.* In other words, this teacher relies on a baseline or diagnostic test to identify the lower ability students in the class. PMT 9 corroborates the claims by PMT 3 and PMT 2 by saying, she identifies the lower ability learners within the first two weeks after they get into her class! In her words, *… From the moment they got into my class…let's say first two weeks!*

In terms of the existing intervention strategies or accommodations primary school mathematics teachers make to support students with lower math abilities in the classroom, they responded as follows:

> We do what we call a separate support structure to have support classes for them [apart] from others and in this support class we, as much as possible use their learning style to reach out to their needs, to go as low as … the basics they needed before they get where they should be. Also, we also try as much as possible to, we assess, we do differentiation majorly they are differentiated using their learning style amongst others.
>
> PMT 1

In other words, this teacher focuses on using the lower ability students' styles of learning as her intervention strategy for covering gaps in learning. Similarly, PMT 2, another mathematics teacher, relies on the students' learning styles – especially those that are visual learners. He then uses visual aids as his intervention strategy to support the lower ability students. This is in addition to one-on-one tutorials and *peer learning.*

> Okay … many of the people you call … lower … ability learners have erm… different learning … styles, so for such people we introduce videos, we introduce erm… the… we introduce… visual aids, we've also introduced one-on-one tutorials, and we also introduce peer-to-peer learning.
>
> PMT 2

On his part, PMT 3 observes that the intervention strategy he uses involves conferencing with previous teachers to isolate the specific areas where the student needs improvement.

> When I noticed gaps, the first thing I did was to have a personal interaction, like an interview with some of them. Yes, and … with the nature … of my department, … we have a kind of relationship where when a child is struggling in your class, you can boldly and confidently walk to the previous class, and ask the teacher, how was the performance of this child like? And the teacher will be open enough to let you know that each child struggles in this area, or that area so that you will know how to administer help. So that was the first thing I did.
>
> PMT 3

PMT 4 uses an approach which involves segmenting the lesson into various components comprising visual and note taking activities. In addition to these strategies, he also relies on the use of repetition to support lower ability learners in his class. According to PMT 4, *I break [the] lesson into different parts like written, video, and …also, I find different ways of making sure they understand, [including] repeating those things.*

Next, the teachers were asked if their deployed intervention worked and to what extent it did on a scale of 1 - 10. It's interesting to note that all the participants claimed their strategies worked in one way or another. PMT 1 responded as follows:

> Yes, currently this system … helps with all our assessments and continuous assessments for the term, and based on the supervisors that came to assess them for their test, the report I got was way better than [the] last time. The grades coming in are all interesting, so actually, alongside the activities that have been going on in the term, I would say that they improved learning 5 to 8 on a scale of 1 – 10.
>
> PMT 1

PMT 2 rated his strategies an 'effective 7' noting that these strategies have been very effective. In his words, *Okay these strategies overtime have proven to be very effective, on a scale of 1-10, sometimes it's as effective as a seven, … yes… as effective as a seven.*

For PMT 9, the students recorded improvements in their Term 2 results compared to their Term 1 performance. She remarks as follows: *From my analysis of their results, I noticed that between Term 1 and Term two, they've actually improved. So, I'll say on a scale of 1 to 10, I'll say 7. It's still a work in progress.*

Also, PMT 8 thinks his strategy helped the lower ability students significantly. *Well, the strategy has really helped significantly, and then on a scale of 1 - 10, I will give 7.* The chart below illustrates the progress or effectiveness of the various interventions deployed by the participants. Notice that most of the strategies rarely exceed a 7 rating.

Figure 38

Ratings For Existing Strategies
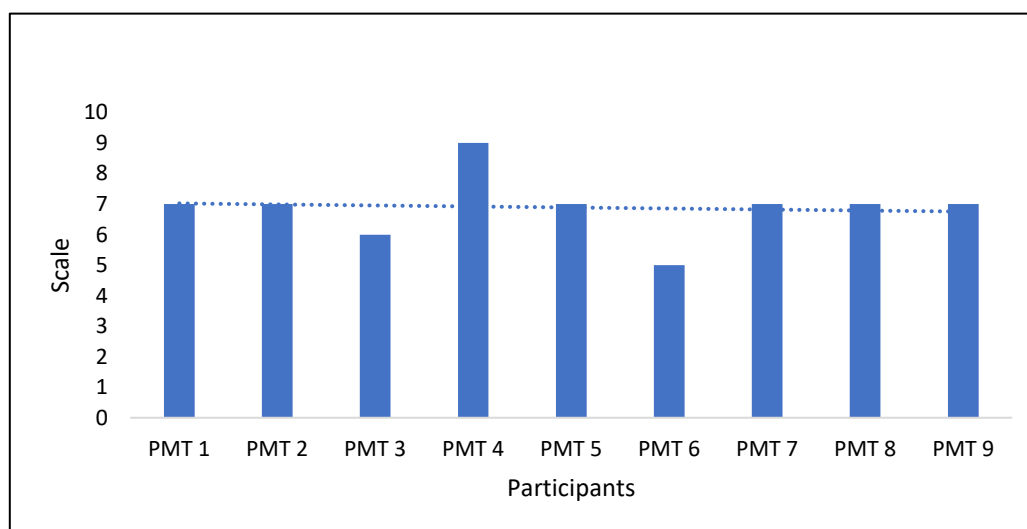
In terms of other assessment strategies used as an intervention to support the lower ability students in class, the teachers interviewed all suggested their main assessment strategies were continuous assessment tests, quizzes and exams which are all summative in nature. Although these teachers claim to use certain approaches to assist their students in the classroom, the culmination of such strategies were one summative test or another.

The strategies reported include peer tutoring, reverse teaching, group work, one on one, project-based method etc. None of the strategies mentioned include peer assessment, self-assessment or the use of teacher-student feedback. According to PMT 1, the lower ability students are paired with higher ability students who peer-teach them in areas where they have challenges.

Interestingly, PMT 3 also uses this strategy to support his lower ability learners. This teacher explained, *I try to engage the stronger ones to help those other struggling ones.* Some of the participants also use group teaching and learning strategies to support lower ability learners. PMT 3 calls this method '*group assessment'.* According to him, each of the groups in his class always comprises higher, middle and lower ability students. The higher ability students provide the necessary assistance needed to support the weaker learners. This is how he explains it,

> Sometimes, I share the class into three groups and without the children knowing, I put in each group, the strong ones, the ones at the middle, and the struggling ones, all on the same table. After teaching the concept, I then administer their classwork to them.

> PMT 3

Also, PMT 4 uses a group strategy to challenge his lower ability learners. According to him, he makes these students to work in groups where they are challenged with what their friends score. Apart from these two teachers, PMT 8 also uses what he termed 'group aspect' in which he places the students in groups of mixed abilities and allows them to discuss given questions with a view to answering such questions jointly. He says, *I put them in groups and then they discuss the particular question and tend to answer it together.*

Other strategies used by the teachers include speaking words of encouragement or motivation to try to douse the fear of mathematics among the lower ability learners. This practice is common to PMT 4 and PMT 7. For instance, in the words of PMT 4, *...what I mainly use is what I call motivation. So, I make them realize that no matter what they score they could always improve on it.* Similarly, PMT 7 puts it this way, *I decide to give more words of encouragement to let them know that there's nothing too strange about mathematics, it's just like other normal subjects.*

4.3.3 Research Question 3: What is the effect of formative assessment practices on learning outcomes?

This section aimed to check the relationship between formative assessment methods and student performance or educational attainment outcomes recorded by students. It also aimed to validate or dispel the data obtained from the questionnaires and interviews. In other

words, the aim of this stage was to validate or dispute evidence gathered through the via the earlier research questions. Therefore, the interview questions here probed deeper to know if the formative assessment strategies teachers say they use are actually being implemented in practice.

But first, it was necessary to verify the teachers' understanding of the term 'formative assessment'. Therefore, Participants were requested to describe the fundamental purpose of formative assessment. Their descriptions are compared with those from established studies such as Schildkamp et al (2020), Clark (2011), Ozan and Kincal (2018) etc., to check for similarities or otherwise.

Having drawn from other literary studies, Ozan & Kincal's (2018) work for instance note that there are 4 critical components of formative assessment. They include the explanation and discussion of lesson objectives and success criteria, an enrichment of the quality of questioning/class discussions, the enhancement of the application of formative feedback in the classroom, and finally, the use of self and peer assessment strategies during lessons (Ozan & Kincal, 2018). Thus, the researcher sought to use these components to gauge the participants' responses.

Ultimately, the goal of formative assessment is to use diverse classroom strategies, involving both teachers and students, to collect feedback and improve teaching and learning, with the ultimate goal of achieving superior learning outcomes and academic excellence. Therefore, from this definition, the main keyword is *feedback*.

Furthermore, The Assessment Reform Group (1999) list 7 critical features of assessment that enhance learning. These components are actually the hallmarks of formative assessment. They are listed as follows:

- It is integrated into a holistic view of teaching and learning, constituting an indispensable component;
- It entails communicating learning objectives with students;
- It strives to assist students in understanding and acknowledging the standards they strive to achieve;
- It engages students in self-assessment;

- It furnishes feedback that guides students in identifying their future plans and pathways for continued growth and improvement;
- It is built on the assumption that every student has the ability to increase their academic achievement;
- It necessitates a reciprocal approach, where teachers and students collaboratively examine assessment data to identify areas for improvement.

The following are the responses provided by some of the interview respondents:

As per PMT 1, formative assessment serves as a mechanism to track student learning, identify areas of improvement, and adjust instruction accordingly. In his words, *I think [formative assessment] also checks if growth and learning take place but more frequently.* This view of formative assessment has improvement as its goal but does not mention anything about the activities of teachers and students or feedback. Neither does it show that this assessment is embedded within teaching and learning. This view is also silent on the use of self-assessment. Very importantly, it is silent on the practice of reviewing assessment data by both teacher and student.

On his part, PMT 2 believes formative assessment is assessment used in diagnosing learning challenges with the goal of being able to provide appropriate learning support to the child. This approach to assessment is common in some schools in Nigeria. Teachers run this test at the beginning of each term in order to be able to zero down on the *troubled spots*. This teacher views formative assessment as something performed by the teacher on the student.

> Formative assessment is that assessment given to a child or rather you could say formative assessment is that assessment done or carried out on a learner with the aim of ascertaining the learning challenge, with the hope of providing support and *clogging* if I may use that word, clogging such loopholes the learner has.
>
> PMT 2

As per PMT 3, the role of formative assessment is to uncover students' knowledge gaps and weaknesses, informing targeted instruction. It also maps out ways to remediate

such findings. Again, this view is similar to that of PMT 2. It also places the responsibility of assessment on the teacher.

> The main purpose of formative assessment is to help discover the weakness or the struggles of learners, number one, and number two, it also helps the teacher go back to the drawing board, and then think of strategies which you can use to curb this this problem that you've discovered.

PMT 3

According to PMT 4, the main intention of formative *assessment is to check understanding, then it would now guide you into knowing how to help the child to improve from that stage to the next one*. This view is also similar to those of PMT 2 and PMT 3. It also does not state anything about feedback or the use of activities by both teachers and students.

According to PMT 5, *formative assessment is to check understanding while you are teaching*. In other words, formative assessment is a means of ascertaining if students are comprehending a lesson or not. This description of formative assessment is quite different from Black and Wiliam's view of formative assessment in that it places the responsibility of assessment on the teacher who is *checking understanding*.

According to PMT 6, formative assessment is a way of monitoring student's progress during a lesson. Clearly, this view of formative assessment is centred on tracking or monitoring student progress. In specific terms, PMT 6 notes that, formative assessment is teaching, assessing and monitoring the progress [of learners] such that this is bringing out what one desires in the learner. It's just to know how the learner is going. Again, this description of assessment places the onus of the assessment process on the teacher alone.

PMT 7 believes …*the real essence of formative assessment is to check if [scheduled] objectives have actually been attained by the conclusion of the lesson.* This teacher views assessment as summative.

PMT 8 also sees assessment from a summative viewpoint in that this teacher describes it as a means of gauging or measuring the learning which has taken place.

Well to me the main purpose of [formative] assessment is to assess the ability of the learners to know whether they are really comprehending the concept that is being taught in class or not, because when you assess them, you get to know whether they have fully understood that concept based on the questions they have answered.

PMT 8

In summative assessment, students are tested or examined at the conclusion of a unit of work or lesson or programme of study. The aim of such tests and exams is to check how well the student has understood the concept(s) taught. According to Amua-Sekyi, traditional or summative assessment occurs at the conclusion of a course or program to evaluate students' achievement levels or the performance of a program (Amua-Sekyi, 2016). Typically manifested through external examinations or tests, it is known as assessment of learning. Students often devote a significant portion of their school time to honing the specific knowledge and skills required for assessment, which subsequently shapes their acquired abilities.

The next and last participant, PMT 9 links assessment to improvement which is actually a significant aim of ongoing assessment. According to this teacher, the reason for assessing students is to bring about improvement in learning: *I'll say, [formative] assessment is done to help the learner improve in every area of learning, yes that's how I'll summarize it* (PMT 9). Research by Lau and Sou (2018) highlights formative assessment as an indispensable tool for improving student learning.

In formative assessment, assessment is seamlessly woven into the curriculum and deeply entrenched within the learning-teaching-assessment continuum. Its primary purpose is to enable schools to grasp students' learning trajectories and requirements, along with identifying their academic strengths and challenges. This information aids in curriculum planning, instructional design, and the refinement of school-based assessment practices, all geared towards maximizing the efficacy of teaching and learning processes to facilitate more effective student learning (Lau & Sou, 2018).

When asked to rate their own proficiency in the use of formative assessment, PMT 1 refrained from doing so stating she would prefer to be rated by others rather than rating

herself. PMT 2 believes he has achieved proficiency in implementing formative assessment strategies over the years but does not attribute this mastery to any tangible reason. In the words of PMT 3, *It has been one of the major tools I use.* PMT 5 gave himself a proficiency rating of 6 out of 10. PMT 7 rated himself 8 out of 10. PMT 8 avoids answering the question on formative assessment. Instead, he says *My proficiency in the use of assessment to a very large extent, I would rate myself 90%.* PMT 9 rates her formative assessment proficiency at 80%, indicating a high level of competence.

Next, the respondents were asked which formative assessment strategies they have recently used. Notable formative assessment approaches, such as constructive feedback, peer review, and self-evaluation, have been found to significantly improve student learning and achievement (Hendrickson, 2012; Santiago et al., 2011). One key strategy in formative assessment is to explicitly share and discuss learning goals with students, ensuring everyone is working towards the same objectives.

The efficacy of peer assessment was validated in a study conducted to explore how fostering reflection, resourcefulness, and resilience skills through a peer assessment activity enhances the quality of produced work. The findings of Goodburn, Higgins, and Wall indicate a notable improvement in outcomes following the peer assessment intervention, suggesting that this pedagogical approach can effectively facilitate enhanced performance. (Goodburn et al., 2010).

The responses provided by these teachers are reviewed in the light of the aforementioned strategies. According to PMT 1, she encourages peer- and self-assessment in her classes by asking the pupils to check or assess each other's, or their own work against provided standards. This teacher notes,

> Recently, I think I've used peer assessment, I've used *research* assessment, I've used umm, on the spot, will I call it on the spot assessment? Okay, for the peer assessment I tell students to teach themselves to help those that are lower and struggling. I also tell them in class to check their work, to check how well they are doing, giving them some criteria in particular, sometimes these criteria are just dictated to them, maybe counting on their fingers. So, as they go through what they've learnt they do some checks and balances within themselves after a lesson

and so sometimes it could be like A goes through B's work, B goes through A's work, we discuss what they are looking at and sometimes they come out to discuss it. In self-assessment, that has to do with them checking their own work but I stand as the *guardian* in that case. They go through their work while I give them what to look out for, we look at it together but they are the ones assessing themselves and you see sometimes they come up with talks like *oh, I've discovered what I did wrong here,* and …there is joy when doing assessments.

PMT 1

PMT 2 refers to written tests or *open book tests* as a formative strategy he has used in his work. According to this teacher, *I've used written tests, I have [also] used open book tests* (PMT 2). Written tests are largely summative in nature (Amua-Sekyi, 2016). An open book test is a situation where students are allowed to make references to texts or other sources while taking take a test.

PMT 3 describes the assessment strategies he has used as mainly observational in nature. According to this teacher,

The last one like I said, first of all is class observation – observing the learners' actions or activity towards the tasks given to them. Yes, using the workbook and worksheet in an ongoing class, and also listening to how well they attempt a question, get an answer to their level of understanding, whether it is vague or shallow or if they've really gotten the set objective.

PMT 3

Observation is a useful tool when carrying out a performance assessment. Performance assessments in mathematics require students to complete tasks, projects, or investigations, which are then evaluated through observation, interview, and product analysis to determine their mathematical proficiency (Rolfe, 2000). In other words, observation is an assessment tool geared towards gathering evidence and using such evidence to improve learning. This assessment allows the teacher to study a student's reasoning. Rolfe (2000) suggests that teachers who are exposed to more of [their] students' actual thinking than would happen in a conventional test gain better insight into such students' misconceptions or errors, and use this information to help

the students and modify the instruction. Thus, a performance test is similar to formative assessment in that it involves gathering evidence in order to improve teaching and learning.

PMT 5 simply responds by saying, *Through questioning*. Depending on how it is used, questioning can be used formatively or summatively. For instance, (Santiago et al., 2011) list questioning as a formative assessment strategy.

PMT 6 claims she uses feedback to know how well the students understand a topic. This type of feedback looks like the one from the students to the teacher. The role of feedback in formative assessment cannot be overemphasized (Black & Wiliam, 1998). However, such feedback flows from the teacher to the student grounded in the learning goals and what gaps the student needs to work towards bridging. As inferred from one author, feedback involves the exchange of information from diverse sources (including instructors, classmates, texts, guardians, self-evaluation, or experiential learning) that helps individuals understand and improve their performance or knowledge (Schildkamp et al, 2020).

PMT 7 could not recall the formative assessment strategy he had recently used. He goes,

> Ermmm, I'm actually trying to remember, I'm actually trying to remember the last one I used because erm it was actually when I was having the primary five and six kids, errr and it was during their common entrance preparation class. I'm trying to remember.

> PMT 7

According to PMT 9, she has used more of verbal and written *feedback assessment* strategies in recent times. In other words, she provides feedback to the students in class about their work. She also claims she uses both self- and peer-assessment strategies in her work with students, albeit without knowing she was actually doing so. According to her,

> That's recently, right? I use emm... mostly I use verbal [feedback]. It works for me. But then I use others like emm, the self-assessment emm, recently the peer assessment because I just learnt about that. But then I found that I've actually been

doing that peer assessment. It's just that I didn't know the term for it. I've actually been doing it over the years. So, and is it working…Yes. It's been working, but more of verbal and written feedback.

<div align="right">PMT 9</div>

Next, the participants were asked whether they have consistently used written (or specific) feedback, self-assessment or peer assessment in their classroom practice in the last 6 months. Although some of the participants affirmed that they had done so, their assertions couldn't be substantiated, especially based on some of their previous responses. For instance, PMT 1, PMT 2 and PMT 4 claim they have always used these strategies.

According to PMT 1, *Yes, I consistently use them daily.* Similarly, PMT 2 asserts, *Oh, we have used all of the mentioned [strategies] and more.* Also, PMT 4 observes that he consistently uses these 3 strategies as his main classroom practices. However, PMT 3 admits that he has not used peer- and self-assessment before but notes that he uses feedback in the classroom. He elaborates by saying,

> In the last six months, I have used specific feedback, yes, specific feedback. Because we do a weekly test, and on this weekly test, I itemise areas, which need improvement, specifically on each child's script. And then sometimes, we read [the feedback] aloud in class. For example, Ryan, you struggle with adding negative numbers. So, he knows that this is the area that he needs to improve upon. For self-assessment, well I think, we've not really engaged that. Yes, we've not really engaged that a whole lot. I've not [also] used the peer assessment tool.

<div align="right">PMT 3</div>

PMT 5 showed evidence of using these strategies in his pedagogic work. For instance,

> Yes, I do. For the peer assessment, this is what I do. Now, for example, if I give them a task in class to do, I do it with them in class. So, I'll ask them to exchange their books and I'll ask them to go through their friend's work and then edit any errors and all of that. So, they do that. They just check their work themselves. Then at the end of the day, they will put a P.A in their books indicating that it's peer assessed and all of that. Then for the self-assessment, it's mostly done in spellings where when we do spellings in class, I'll tell them, okay, I'm going to be spelling the words on the board, check your own spelling if it's correct using what I put down on

the board and all of that. So, at the end of the day, they will put S.A which is *self-assessed* because they self-assessed themselves and all that.

PMT 5

In responding to the question under review, PMT 7 does not address the main issues raised in the question. However, he notes that 'written feedback can improve learning' a view which is supported by Ozan and Kincal (2018).

PMT 8 admits he uses more of written feedback but less of self-assessment and none of peer-assessment. According to this teacher, for *self-assessment*, he makes the children exchange their classwork randomly, and then grade each other. However, he doesn't mention if such grading is done against any given standards. In his words, *coming to written, I have consistently done written feedback. The self-assessment is occasional, … but majorly what I use is the written [feedback] and then the self-one is occasional. The Peer assessment, I hardly use that* (PMT 8). The importance of having a standard or evidence which guides students on what is expected in the self-assessment process is critical (Yan, 2022),

4.3.3a Documentary evidence

At this stage of the research, a formative assessment strategy involving the use of descriptive feedback (teacher to student) in the classroom was introduced into the study. This strategy sought to examine whether the implementation of this form of assessment could lead to improved learning outcomes and to what extent, particularly among low ability learners in the schools under investigation. First of all, the teachers of the selected classes were oriented on how to effectively deploy this formative assessment strategy by the researcher.

Going by the responses to gathered through the questionnaires and interviews so far conducted, participants seemed to know little or nothing about using a feedback strategy effectively, hence the reason for the orientation. For instance, in self and peer assessment, students assess their own or others' work against a set of agreed or standard criteria or checklist. Such standard would usually be tied to the learning objectives or success criteria for the lesson. The feedback model adopted in this strategy is based on that described by Black and Wiliam (1998). These authors emphasize that effective feedback provided to

students should focus on specific attributes of their work, accompanied by actionable guidance for improvement, while refraining from comparative evaluations with peers (Black & Wiliam, 1998).

Thus, feedback should be all about improvement. It should be deliberate and guide the student on what to do to secure such improvement. Furthermore, the authors note that feedback comprises 3 main components. In essence, when someone is in the process of learning, feedback on their efforts comprises three key elements: acknowledgment of the intended objective, assessment of their current status, and insight into bridging the gap between the two. Each of these components must be comprehended to a certain extent before an individual can take steps to foster deeper understanding and knowledge (Black & Wiliam, 1998). The participants received guidance on the purpose and application of feedback, with a focus on utilizing constructive feedback as an effective formative assessment strategy.

Undoubtedly, the significance of sharing learning goals at the outset of a lesson cannot be overstated. As such, this was also discussed as a basis for crafting constructive feedback. Feedback without any adequate reference to stated and shared learning goals is vague. To ensure the optimal effectiveness of formative assessment strategies, it's imperative for teachers to collaborate with students in establishing a mutual comprehension of the learning goals and defining criteria for attaining these objectives at different levels (Granberg et al., 2021). The idea of featuring what has worked well as well as the area(s) for improvement in feedback comments was equally discussed with the teachers.

The feedback strategy was carried out in the classrooms of three selected teachers from the interview stage. It was intended to test the effectiveness or otherwise of a formative assessment approach and also to triangulate data obtained through the questionnaires and interviews (Neuman, 2014; Robson, 2011). The feedback strategy lasted for 2 weeks and was used to generate documentary evidence for this study. The interviews continued at the end of the strategy.

Thus, the participants were asked the following question: How effective was the 2-week feedback strategy in helping to improve students' learning and learning outcomes?

While all the 3 teachers featured at this stage agree the feedback strategy was effective, one of these teachers (PMT 6) felt the method might not be sustainable due to its time demanding nature, a view which underscores the place and role of training and motivating teachers in order to lay a solid foundation for the proper implementation of ongoing assessment strategies for educators. To successfully implement a new formative assessment practice in the classroom, teachers require both the motivation to prioritise learning how to execute the practice and the commitment to implementing it effectively within the classroom (Anderson & Palm, 2018).

The following are the responses from the three participants.

> I like the feedback strategy. The children knew what they did well and the areas where they should improve. My students were excited about this method. The only problem is that it is time consuming. Apart from that, it is really effective.
>
> PMT 6

> Greatly. In fact, the children have become more responsible for their success by going back to try to carry out err…the teacher's feedback. They also know where the problem was. I wish I had known about this strategy before now.
>
> PMT 7

> Wow! Certainly, the written feedback strategy is the best, I think. My lower ability students now approach their work with greater confidence. Their performance has dramatically improved just in 2 weeks. Also, they now know where the issues are and how to tackle them. But it is not an easy method. I'm not sure it is sustainable.
>
> PMT 8

Furthermore, when these teachers were asked to rate the relationship between the feedback strategy and the learning outcomes of students who needed additional assistance on a scale of 1 - 10, PMT 6 provided a rating of 9, while PMT 7 and PMT 8 each gave a rating of 8.

Figure 39

Effect of a Formative Assessment Strategy on Learning Outcomes
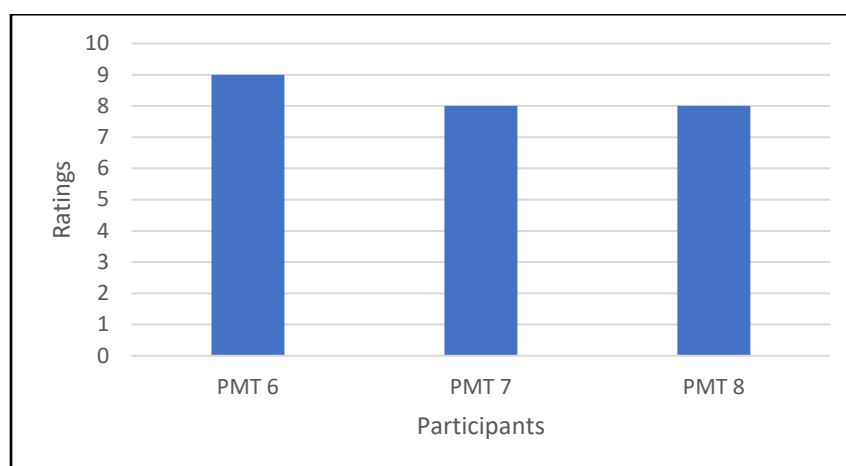
To complement the analysis, content analysis was further used to scrutinize the documentary evidence generated through the feedback strategy. Tables 7 and 8 show the data collected before and after the intervention. It should be noted that 3 students in School C were absent during the strategy period. While one of these three pupils had relocated to another state with her parents, the other two were ill.

Table 5

Documentary evidence (documentary analysis of mathematics exercise books before introducing the formative assessment strategy)

School	Number of pupils in the selected class	Number of low ability pupils (LAPs) in class	Percentage of LAPs with (written) constructive feedback	Percentage of LAPs without (written) constructive feedback	Percentage average in weekly test	Key words or phrases in feedback
A	40	17	0%	100%	42%	Poor, Very good
B	53	18	0%	100%	45%	Poor, Very Good
C	39	15	0%	100%	39%	Poor, Very Good

Table 6

Documentary evidence (documentary analysis of mathematics exercise books 2 weeks after introducing the formative assessment strategy)

School	Number of pupils in the selected class	Number of low ability pupils (LAPs) in class	2-week intervention period			Key words or phrases in feedback
			Percentage of LAPs with (written) constructive feedback	Percentage of LAPs without (written) constructive feedback	Percentage average in weekly test	
A	40	17	100%	0%	51%	Redo, practice, discuss, repeat, try, complete etc.
B	53	18	100%	0%	54%	Compare, construct, repeat, practice etc.
C	39	15	80%	20%	48%	Discuss, compare, calculate, draw, solve etc.

Considering that this study seeks to investigate teachers' views and opinions about assessment practices in Nigeria, it deemed it necessary to also check the effect of implementing a formative assessment strategy for mathematics in the schools investigated. The study went on to find out if primary schools in Nigeria should consider adopting formative assessment methods as part of their mathematics education? This question featured one way or another in the questionnaire and interview stages of the study.

The responses gathered here reveal that most teachers agree on the need to review the assessment policy in Nigeria based on different reasons. Specifically, when asked if there was any need to review the assessment policy in Nigeria to accommodate research based formative assessment strategies, the following responses emerged.

> Oh, actually yes, I don't know what the current assessment policy is, but I feel the formative should carry more marks, maybe 60 or 70 marks, then the summative should be like 30 marks because for me, learning is a continuous process. So, assessment should also be a continuous process. As you learn, you assess the child. How well is the child doing as the weeks and days go by? Not [that] at the end of three months, you assess the child [in] a 60-mark sitting. So, it should be reviewed in such a way that the formative should carry more mark because for me that is more important than the end of term assessment.

PMT 1

As a teacher practicing in Nigeria, I would say yes. I recall, even today I was giving a talk to a religious group of people… and then I mentioned the fact that the mode of assessment generally in our country today, is likened to bringing an elephant, an alligator, a snake, a monkey or a fish and they are all asked to climb a tree and that is… and that is what is obtainable in Nigeria – exactly! That is what's obtainable in Nigeria today. So, er… our mode of assessment should be reviewed with immediate effect.

PMT 2

Yeah, I think there's a need, there's a need for it. And this is my reason – I observed recently, that there are some learners that are afraid the moment it's a formal test or a formal written test. There is some tension that comes, and then they tend to forget some of the things they've learnt. Meanwhile, it obvious that this child knows this thing. So, so, so this 60/40 [system] doesn't really capture what the child does on a daily basis in class. So, there should be a provision, there should be a provision for those activities such as group discussions, practicals [and] projects in class.

PMT 3

For me, I feel we should review it because assessment to me is a continuous thing. Yes, it's a continuous thing. It's not something that we should just have like 20 20 marks at the end of the day. I feel like for every lesson, children should be assessed. And then certain marks should be given. So, at the end of the day, they could just maybe do like, um, just take the average of some of the whole assessments put together and then get the score for the overall assessment and all that. Because if it's a continuous thing, it establishes more understanding for every lesson learnt.

PMT 5

Yes, I think it's okay [to] review, we review and know what exactly we are assessing the learners for and even while we are assessing them, what are we looking out for? Teachers will need to trained on the introduced method of assessment so that the process can be sustainable.

PMT 6

I think there's need for improvement. I'll just say we move on with the improvement aspect of it and not changing the entire policy. It will be very good to improve on the one we have by mixing summative and formative assessment. I mean we should not remove the summative assessment completely.

<div align="right">PMT 7</div>

I'll say just improvement, not a total overhauling [of the assessment policy]. I actually believe in assessing children because how else would a teacher be able to tell if he or she has met learning objectives and all of that? But I think officially incorporating formative assessment strategies and all of that into the policy is a good idea provided we will be trained.

<div align="right">PMT 8</div>

Furthermore, PMT 2 and PMT 5 call for a total overhaul of the assessment policy in Nigeria without providing any particular reason other than it has been around for too long. For instance, PMT 2 notes, *I would say a complete er… overhaul with the aim of improving it. Okay so uhm, our assessment system has been in existence for God knows how long now.* According to PMT 5, *[the assessment policy] needs an overhaul, it needs overhaul in everything. Everything!*

It should be noted that the responses provided by the teachers who participated in the documentary evidence stage were more distinct and factual compared to those from the participants in the questionnaire and interview stages. See the responses from the three participants below.

I like the feedback strategy. The children knew what they did well and the areas where they should improve. My students were excited about this method. The only problem is that it is time consuming. Apart from that, it is really effective.

<div align="right">PMT 6</div>

Greatly. In fact, the children have become more responsible for their success by going back to try to carry out err…the teacher's feedback. They also know where the problem was. I wish I had known about this strategy before now.

<div align="right">PMT 7</div>

Wow! Certainly, the written feedback strategy is the best, I think. My lower ability students now approach their work with greater confidence. Their performance has dramatically improved just in 2 weeks. Also, they now know where the issues are and how to tackle them. But it is not an easy method. I'm not sure it is sustainable.

PMT 8

4.4 Evaluation of findings

The objective of this study is to critically evaluate the effectiveness of teachers' assessment practices and identify possible areas for improvement in selected public primary schools in Abuja using mathematics as the focal subject. The objectives were to:

- Explore the views of primary school mathematics teachers about assessment practices.

- Examine how effective the existing assessment strategies teachers use are in improving students' learning and academic achievement in mathematics.

- Evaluate the effect of formative assessment practices on learning outcomes in mathematics.

Furthermore, the central question guiding the research was *Can assessment practices improve the quality of teaching and learning in Nigerian schools?* Throughout the research process, stringent ethical considerations were applied to ensure the physical and emotional safety of participants. The following considerations were made in terms of securing ethical assurances for this study:

- UREC approval: Data collection only commenced upon receiving the UNICAF Research Ethics Committee's approval on December 21st 2022.

- Voluntary participation: Participants were given the option to either participate in or decline the study, and their decision was respected or aspects of it without coercion or reprimand.

- All participants provided informed written consent. 97% of the questionnaire respondents gave their informed consent while all 9 or 100% of the interviewed candidates also gave their informed consent.

- ▪ Anonymity – The researcher is unaware of the confidentiality and identities of the participants.

- ▪ Participants were not in danger of potential harm since the data collection processes was unharmful.

- ▪ The research is free of plagiarism and/or any misconducts, thus eliminating the tendencies of the results to be misleading.

The researcher proceeded to distribute the questionnaire to the participants after the UNICAF University Research Ethics Committee (UREC) validated the approved gatekeeper document (Appendix 3). Informed consent forms distributed to the participants through their respective school authorities, were signed by the participants. As children were not involved directly in the study, there was no requirement for completing or signing the Guardian informed consent.

This study is grounded in the behaviourist, cognitive and sociocultural theories of learning which were theorised by Ivan Pavlov, B.F. Skinner, Noam Chomsky, Jerome Bruner, Jean Piaget and Lev Vygotsky among others. Based on this premise, the work of Mary James (2006) where she itemises 3 broad clusters of theories of learning was reviewed among other literature sources.

The theories include the behaviourist, constructivist and the sociocultural theories of learning. The focus of this study was on all the three distinct categories of learning theories – the behaviourist, constructivist and sociocultural theories of learning. Whilst the behaviourist theories are based on the pioneering efforts of Ivan Pavlov, B.F. Skinner among others, the constructivist theories are based on the work of Noam Chomsky, Jerome Bruner (James, 2006) as well as Jean Piaget (Devi, 2019) among others. The sociocultural theories are based on the work of John Dewey and Lev Vygotsky (James, 2006) among others. Other frameworks which underpin the current study include the principle of formative assessment which has been extensively studied by reputable authors in both distant and recent times (Assessment Reform Group, 1999; Bhat & Bhat, 2019; Black & William, 1998; Brandmo et al, 2020; Hendrickson, 2012; Ozan & Kincal, 2018) etc.

4.4.1 Research Question 1: What are the views of primary school mathematics teachers about assessment practices?

From the questionnaire data, it is clear that many primary school mathematics teachers view assessment largely from an assessment of learning or summative assessment perspective. Traditional assessment, which is usually conducted at the culmination of a taught subject or program, aims to gauge students' achievement levels or the effectiveness of a program. Commonly conducted through external examinations or tests, it is often referred to as assessment of learning. Students often devote a significant portion of their school time to honing the specific knowledge and skills required for assessment, which subsequently shapes their acquired abilities (Amua-Sekyi, 2016).

This claim is substantiated by the fact that over 55% of the questionnaire respondents view assessment as an event for testing and ranking students. Furthermore, 45% of the primary school mathematics teachers believe a written test or exam which is summative in nature is the best form of assessment.

The crave for written or summative tests is also a common phenomenon in other parts of the world. For instance, in an investigation carried out in Ethiopia, the results of this study reveal a prevalent reliance on traditional written assessment methods among educators, whereas innovative and formative approaches, capable of capturing students' creative potential and proficiency, remain underutilized (Sewagegn, 2019).

Furthermore, as many as 81% of the surveyed teachers are in favor of students writing a summative exam at the end of each term in contrast to 27% who favor writing summative exams only once in a year. Compared to summative assessment, the emphasis of formative assessment is not on written tests, grades or exams, but on learning. Summative assessment events are typically crafted to facilitate a final evaluation of a learner's performance and potential future accomplishments within a program. They serve to certify achievement and confer qualifications, aid in decisions regarding entry to further learning programs, offer insights to inform selection decisions made by others, and furnish formal evidence of a learner's competence (Amua-Sekyi, 2016).

In opposition to traditional assessment methods, formative assessment focuses primarily on promoting student learning and improvement as opposed to merely judging the effectiveness of a program or gauging how much students have learned. In fact, formative assessment is an essential tool for learning improvement.

In formative assessment, evaluation is seamlessly integrated into the curriculum, constituting a vital component of the learning-teaching-assessment continuum. Its primary role is to facilitate schools in comprehending students' learning progression and requirements, along with identifying their strengths and weaknesses (Black & Wiliam, 1998). This information is instrumental in curriculum planning, instructional design, and the refinement of school-based assessment practices, all aimed at enhancing the efficacy of teaching and learning processes to facilitate more effective student learning (Lau & Sou, 2018).

Again, 56% of the teachers think that assessments ought to be teacher driven as opposed to being student-driven. A teacher driven assessment is one in which the teacher teaches or lectures, sets the exam and grades it. All the student does is to sit the exam. Such an approach is behaviourist in nature. The results of exams or tests provide valuable insights that guide decisions about student placement, progression, or program improvement.

Nearly half of the teachers also use tests and/or exams as their main methods of assessment. Furthermore, the study found that 55% of participants believed that assessment can be independent of learning. This is a strong contradiction to the principles of formative assessment which sees assessment as a tool for promoting learning. For instance, unlike many other countries, Finland does not administer national, standardized high-stakes tests to students until they complete secondary school, and only for those planning to pursue higher education. The focus of assessment in Finland is on promoting student learning and progress, fostering an environment that is inherently encouraging and supportive in nature (Hendrickson, 2012).

In other words, the first major summative high stakes test or assessment students take in Finland takes place only when they matriculate secondary school. This is because high stakes tests or exams are not viewed as a major tool for driving or enhancing learning

or improvement. The government-administered school-leaving exams in Finland are commonly referred to as the matric exams (Hendrickson, 2012). Consequently, students in their final year of high school, typically in grade 12, are known as matriculants or, more commonly, matrices. Upon successfully completing the Matric year, students are considered to have matriculated from high school or secondary school (Hendrickson, 2012)

Unlike Finland, the United States employs high-stakes assessments, such as summative tests, more frequently. The United States has implemented a range of educational reforms aimed at improving national achievement, including the introduction of annual high-stakes testing for students. Nevertheless, the dependence on high-stakes testing can result in the phenomenon known as teaching to the test, wherein classroom approaches are tailored mainly to readying students for a limited set of assessments (Hendrickson, 2012).

It is noteworthy to state that among the world's nations, Finland has consistently maintained a position as one of the highest-achieving countries in the popular Programme for International Students Assessment (PISA) tests.

Furthermore, the present study highlights a significant trend, where the majority of teachers surveyed confirmed that they were mainly assessed in their school days using grades and scores which are hallmarks of summative assessment. The experiences of these teachers back at school may not be unrelated to their present beliefs about teaching, learning and assessment.

The inclination of teachers towards summative assessment implies that they may have grown used to a behaviourist approach which gained prominence right into the time when most of these teachers were trained at school. As Mary James puts it, behaviourism remained a prevailing force in educational theory throughout the 1960s and 1970s, a period that corresponds with the formative training years of many contemporary educators (James 2006). Naturally, these teachers, being inheritors of a *summative framework* can only give students what they have.

Good enough, 92% of the surveyed teachers agree that teachers' assessment practices are often reflective of their deeper beliefs about the teaching and

learning process. For example, Azis highlights the significance of examining teachers' conceptions, as they are intricately linked to their underlying beliefs, which, in turn, shape teaching practices and assessment strategies (Azis, 2012). Little wonder 68% of the study participants think assessments without grades are meaningless.

Perhaps, teachers view grades as what motivates students to study hard. They think that without grades or numerical scores, children won't be motivated to work hard. In fact, Adaka and Ugo (2015) note that certain educators hold the assumption that high-stakes testing and grading practices, characterized by pressure to achieve superior test scores and grades, serve as a catalyst for better academic achievement (Adaka & Ugo, 2015).

In addition, 74% of the teachers think the country's policy on assessment which includes writing at least 3 summative assessments per term should be sustained. The tendency for teachers' practice to be influenced by policy is substantiated in the literature (Brown et al., 2019) and goes beyond the confines of Abuja or Nigeria. Research suggests that educational policy constitutes a significant factor influencing teachers' beliefs and perspectives on assessment, potentially shaping their pedagogical approaches, assessment practices, and underlying conceptions of learning (Brown et al., 2019).

In addition, about 60% of the teachers in the present study believe that a teacher's primary role is to share knowledge whereas the students should listen and learn from the teacher. This belief is also in line with the behaviourist point of view which underpins a summative assessment perspective (James, 2006). In other words, the behaviourists view learning as the result of an external factor such as a teacher. This forms the foundation of the theories of classical and operant conditioning, as proposed by Ivan Pavlov and B.F. Skinner, respectively.

Classical conditioning involves associating a specific stimulus with an innate response, resulting in a learned, conditioned response (Rehman et al., 2023), while operant conditioning, also known as instrumental conditioning, suggests that behavior is shaped by its outcomes or consequences (McLeod, 2023). Both theories agree that learning is externally facilitated.

Strangely though, but interestingly, 95% of the participants see the need for written feedback, which is an important component of formative assessment. In formative assessment, results are incomplete without feedback. In fact, 80% of them claim they already always use written feedback in their assessment practices. What is lacking however in this practice, is that such feedbacks are not concretely tied to the objectives of the lesson as advocated by Black and Wiliam (1998). Often times, they are vague and unable to guide students towards the desired goal.

However, is it possible that these teachers may be mixing up the comments written on summative assessments or those provided in termly report cards with the feedback comments that are required during the process of teaching and learning? Effective feedback should be tailored to address the unique features and attributes of a student's work, providing actionable advice for improvement without referencing peers. This targeted approach encourages self-reflection, fosters a growth mindset, and promotes individualized learning (Black & Wiliam, 1998).

Thus, feedback is not just about how well or poorly a student did on a test. It is not information about the child's performance in an exam. It is an attempt to close a learning gap between where the child is and where he or she ought to be.

Ideally, feedback pertaining to a child's effort typically encompasses three essential components: acknowledgment of the desired learning objective or goal, provision of specific, criterion-referenced evidence regarding the child's current performance or position and guidance on actionable strategies to narrow the disparity between existing and desired performance outcomes levels (Black & William, 1998).

Another surprising observation from the questionnaire data is that 79% of the participants in this survey claim they always use self and peer assessment, which are also formative assessment strategies, in their classroom work. Self-assessment is a formative assessment strategy in which a student uses a given standard to check their own work while peer assessment is also another formative assessment strategy in which students check each other's work against a given standard. Accordingly, "self-assessment is the act of

monitoring one's processes and products in order to make adjustments that deepen learning and enhance performance" (Andrade, 2019, p. 10).

Numerous effective innovations in education have integrated self-assessment and peer-assessment strategies, facilitating enhanced formative assessment practices. Empirical evidence suggests that these approaches have yielded positive outcomes among pupils across various age groups, particularly those aged 5 and above (Black & Wiliam, 1998).

Regardless of the level of education, self- and peer-assessment can be used to improve students' learning. Andrade (2019) lists the following as examples of self-assessment:

> …assigning a happy or sad face to a story just told, estimating the number of correct answers on a math test, graphing scores for dart throwing, indicating understanding (or the lack thereof) of a science concept, using a rubric to identify strengths and weaknesses in one's persuasive essay, writing reflective journal entries, and so on (Andrade, 2019, p. 1).

Self- and peer-assessments have been reported to influence student learning and achievement in positive ways (Black & William, 1998).

The findings above are not surprising given the outcome of earlier studies on assessment practices in schools in Nigeria (Modupe & Sunday, 2015; Raji et al., 2020; Sewagegn, 2019; Simobi & Anikeze, 2019). These authors note that the teachers in their studies use and rely almost exclusively on summative assessment practices. In a related study on teachers' assessment practices carried out in South Eastern Nigeria, Simobi & Anikeze's (2019) findings underscore the present study's findings. The authors note that, the assessment of students' learning outcomes primarily relies on traditional assessment instruments.

Traditional assessment, a conventional approach, typically entails teachers administering continuous tests, assignments, and examinations primarily focused on measuring students' learning outcomes within the cognitive domain, with limited attention given to the affective and psychomotor domains of learning (Simobi & Anikeze, 2019). Grading is a prominent feature in this type of assessment.

Despite the potential benefits of other forms of assessment, teachers often rely heavily on traditional written tests (Sewagegn, 2019).

4.4.2 Research Question 2: How effective are the existing assessment strategies teachers use, in improving students' learning and academic achievement in mathematics?

The primary objective of this research question was to evaluate the effectiveness of current assessment practices. Prior to delving into this inquiry, it is essential to acknowledge that numerous assessment practices utilized by mathematics teachers across various cultures often exhibit behavioristic characteristics, aligning with the concept of conditioned learning. For example, Burtenshaw (2023) notes that behaviorist theory posits that effective learning is predicated upon the exhibition of conditioned behaviors that are readily observable, quantifiable, and objectively measurable.

This perspective asserts that learning outcomes can be accurately assessed through the measurement of overt, observable responses (Burtenshaw, 2023). This view of behaviourism depicts a commitment to repetition, rote learning and the use of frequent testing among other behaviourist ideologies. Here are additional examples of behaviorist assessment ideologies commonly implemented and deeply ingrained in mathematics classrooms across various cultures:

- The continuous teach-test-teach-test cycle, where students are expected to showcase their fragmented and often superficial comprehension of a particular concept through short-term memorization (Eisenberg, 1975; Shepard, 2000 in Burtenshaw, 2023), potentially leading to the recurrence of reteaching the same concepts annually.

- Routine collection of data for the mere purpose of collecting data, frequently with limited chances to act upon or provide feedback to students (Black & Wiliam, 2004; Liljedahl, 2021 as cited in Burtenshaw, 2023). This encompasses inadequate utilization of collected data and the tendency to categorize or rank students using numerical or abstract grading systems (Clarke, 1997; Watt, 2005 as cited in Burtenshaw, 2023).

- Rigidity in learning objectives associated with transmission models of mathematics teaching, characterized by a focus on covering the curriculum and minimal differentiation (Shepard, 2000 as cited in Burtenshaw, 2023).

Many mathematics classrooms are characterized by frequent use of testing, the frequency of which depends solely on the teacher. Teachers believe that the more the tests, the likelier it is for learning to take place and for concepts to be remembered. In this respect, the author is aware of a math teacher who conducts mathematics tests each week. To show how engrained this behaviourist assessment practice is, his school believes he is doing a fantastic job and commends him highly for it.

It is also very true that the use of standardised testing is adjudged to be a better means of measuring learning or making educational decisions in many climes around the world, including Nigeria. Hence prospective parents trying to choose schools for their wards are often more interested in studying schools' performances in standardised tests compared to teachers' professional advice.

Most of the data gathered from summative assessments are rarely useful to the students. In many cases, such data are simply used for grading and ranking students from top to bottom. Students who score low grades in such assessments are simply regarded as low-ability or low-performing students.

Another example of the behaviourist ideology has to do with the streaming of students and classes. Streaming is the practice of placing students into classes based on their ability. This means students of the same ability are grouped together in the same class.

It is on the basis of the above ideologies that Research Question 2 seeks to determine the effectiveness or otherwise of the existing assessment practices which are largely summative or behaviouristic in nature. The study sought to answer this question by checking how well these assessment practices help to improve student learning and achievement. Particularly, to track any possible improvement these practices might generate, the study focused on checking how well the application of certain traditional instructional practices helped to improve learning for lower ability learners.

Lower ability learners are students who may not be able to learn at the same pace with their peers. Chappuis and Stiggins (2002) provide a description for this group of children. These children are often regarded as dull, unintelligent or below average learners. They are therefore left behind as the others progresses in their learning. As the teacher and the class advance, students who struggle to keep pace with the established rhythm and adhere to fixed timelines are often left behind, leading to their placement at the lower end of the rank order (Chappuis & Stiggins, 2002).

All the teachers interviewed agreed to having lower ability learners in their classes. They also seem to be largely united in their views about why a student should be classified as lower ability learner. Some of the descriptors used in identifying these learners include *slow learners, achieving way below class standards, dragging the class back, inability to assimilate or understand concepts, learning disability, low self-esteem, lack of confidence, below average performance* etc. Some of the existing interventions in use for low ability learners by the participants include the use of familiar learning styles, deploying visual aids, one on one tutorials, peer tutoring, teacher-learner interactions and note taking. These methods are summative in nature.

In terms of how effective the aforementioned traditional approaches have been, the teachers admitted to ratings which ranged from 5 – 9. Nearly 90% of the ratings however range from 5 – 7.

None of the participants confirmed using any notable formative assessment strategies such as self-, peer-assessment and constructive feedback as their main or preferred intervention strategies. In other words, the absence of these assessment strategies constitutes gaps in the assessment practices of the primary school mathematics. This suggests that contrary to the responses gathered through the questionnaire that nearly 80% of the sampled teachers use peer- and self-assessment, the use of these formative assessment strategies is still relatively uncommon in these schools. The literature is replete with numerous studies indicating teachers' preference for summative strategies as opposed to formative approaches in their classroom practices (Cheng et al., 2018; Raji et al.; Sewagegn, 2019).

Sewagegn (2019) observes a prevalent tendency among educators to favor traditional written assessment methods over innovative and alternative approaches such as formative assessments, which could potentially uncover students' creative capacities and proficiency in their respective disciplines especially as this relates to their learning.

In China, educators have been encouraged to adopt a more comprehensive approach to assessment, transitioning from an exclusive focus on test-based evaluations to a broader range of measures that capture student learning, including authentic assessments, project-based evaluations, peer and self-assessments and classroom observations (Cheng et al., 2018). This explains why educators in China are embracing a shift in assessment paradigms, moving beyond traditional testing methods to incorporate formative approaches that prioritize learning enhancement, stress reduction, and critical thinking development.

This innovative strategy aims to cultivate a more holistic and supportive educational environment, where students can thrive and reach their full potential. Raji et al. (2020) also report based on a study carried out in Nigeria, that the findings revealed that although teachers use a variety of assessment practices, they showed greater preference for summative assessment approaches.

The implication of these findings is that the assessment practices in use by the teachers do not promote *deep understanding, mastery* or understanding of concepts taught. Additionally, these practices fail to promote *soft skills* such as critical thinking, problem solving and creativity, leaving students as low ability learners, poor thinkers and weak problem solvers. This highlights a notable gap in existing assessment practices.

4.4.3 Research Question 3: What is the effect of formative assessment practices on learning outcomes?

Granberg et al (2021) conceive formative assessment as a process where teachers gather evidence of student learning to adapt instruction and feedback, and students also engage in self-assessment and peer assessment to meet their learning needs. This definition therefore serves as the basis for asking this research question.

The findings from this research question show that although the existing assessment strategies already in use by the public primary school mathematics teachers are helpful and

yield above average outcomes, there is still room for improvement. Therefore, the findings from the present study suggest that implementing formative assessment strategies in mathematics education at the elementary school level has the potential to enhance student learning outcomes. This outcome agrees with the existing literature's stance about formative assessment.

For example, to support the above claim, Yusron and Sudiyatno (2020), carried out a study using a quasi-experimental method to explain the success of formative assessment in enhancing the quality of learning and learning outcomes in elementary school mathematics. The results reveal a significant increase in average learning outcomes in the experimental class, as evidenced by higher post-test scores compared to pretest scores, suggesting that the application of formative assessment had a positive impact on student learning (Yusron & Sudiyatno, 2020).

Additionally, in a 2010 study carried out to check whether there is a better improvement in the quality of work produced following a formative assessment intervention, when similar abilities of students are paired together (Goodburn et al, 2010), it was discovered that the lowest performing students made the most remarkable improvement.

The findings in the 2 studies above show that using a formative assessment strategy offers remarkable learning improvement, especially to low ability students. The formative assessment strategy introduced into the present study revealed that the students' learning outcomes and achievement experienced greater improvements. The teachers observed the pupils' work over the 2-week period in question and provided appropriate feedback to help the pupils in closing the learning gap between where they were and where they ought to be. The teachers' observations and feedback provided the basis for adjusting teaching and learning, paving way for improved learning and learning outcomes (Granberg et al, 2021).

The generally better improvement in student learning and achievement is not only in line with the projections for this study but also adequately answers Research Question 3. Formative assessment strategies e.g. a feedback approach can significantly improve learning and learning outcomes in mathematics education. Furthermore, this result

demonstrates that supportive, positive feedback has a profound impact on student learning outcomes and self-efficacy beliefs, leading to significant enhancements in academic achievement, motivation and self-confidence (Goodburn et al, 2010, Granberg et al, 2021, Yusron & Sudiyatno, 2020).

Implication wise, the incorporation of formative assessment strategies into teachers' assessment practices is likely to close gaps in their assessment practices. It can also improve learning outcomes, enhance teacher-student relationship, promote student engagement, achieve targeted instruction and lead to better grades in both internal and external exams.

4.5 Summary

This chapter focused on 3 significant objectives which underpinned the present study. These objectives include:

- Explore the views of primary school mathematics teachers about assessment practices.
- Examine how effective the existing assessment strategies teachers use are in improving students' learning and academic achievement in mathematics.
- Evaluate the effect of formative assessment practices on learning outcomes in mathematics.

This study suggests ways to close the gaps in the assessment practices of public primary school mathematics teachers such that these practices can lead to better student learning and learning outcomes in both school based and high stakes tests and exams. It also corrects the notion that assessment is a mere tool for gingering students to score high or competitive grades. Below is a summary of the evaluations of the various findings based on the study's objectives and research questions.

Objective 1: Explore the views of primary school mathematics teachers about assessment practices.

Research Question 1: What are the views of primary school mathematics teachers about assessment practices?

This study explored how mathematics teachers in public primary schools in Abuja view and use assessment practices. Our findings revealed that most teachers hold a summative perspective on assessment, prioritizing testing and ranking students. Specifically, 45% of teachers preferred traditional written tests and exams, and 56% favored a teacher-driven approach.

Notably, teachers' past experiences as students, often involving grades and scores, appeared to shape their current assessment practices. Despite this, an overwhelming 95% of teachers recognized the importance of written feedback, with 80% claiming to use it, although its effectiveness in relation to lesson objectives is questionable. Furthermore, 79% of teachers reported using self and peer assessment, indicating a discrepancy between their stated practices and actual beliefs about assessment. These findings underscore the need for professional development to bridge the gap between teachers' understanding and implementation of formative assessment strategies.

Objective 2: Examine how effective the existing assessment strategies teachers use are in improving students' learning and academic achievement in mathematics.

Research Question 2: How effective are the existing assessment strategies teachers use, in improving students' learning and academic achievement in mathematics?

This study examined the effectiveness of existing assessment strategies used by public primary school mathematics teachers in Abuja, revealing a predominant reliance on summative and behavioristic approaches. Despite teachers' reported use of various interventions for lower-ability learners, such as visual aids and peer tutoring, these methods were largely summative in nature and yielded limited effectiveness, with nearly 90% of teachers rating their effectiveness between 5-7 out of 10.

Notably, formative assessment strategies like self-assessment, peer assessment, and constructive feedback were rarely used, highlighting a significant gap in assessment practices. The findings suggest that these traditional approaches fail to promote deep understanding, critical thinking, and problem-solving skills, leaving students as low-ability learners and weak problem solvers. This underscores the need for a shift towards more

formative and innovative assessment approaches that prioritize learning enhancement and student progress.

Objective 3: Evaluate the effect of formative assessment practices on learning outcomes in mathematics.

Research Question 3: What is the effect of formative assessment practices on learning outcomes in mathematics?

This study evaluated the effectiveness of formative assessment strategies in improving learning outcomes in mathematics. The findings suggest that implementing formative assessment practices can significantly enhance student learning outcomes, particularly for low-ability students. Studies have shown that formative assessment approaches, such as feedback and self-assessment, lead to remarkable learning improvements and better academic achievement. In line with existing literature, the present study found that formative assessment strategies yielded greater improvements in student learning outcomes and achievement over a short period. The findings imply that incorporating formative assessment strategies into teachers' practices can close gaps in assessment, improve learning outcomes, enhance teacher-student relationships, promote student engagement, and lead to better grades. Overall, the study underscores the potential of formative assessment to positively impact mathematics education at the elementary school level.

There is therefore no doubt that the right forms of assessment are likely to upgrade the standard of learning and teaching, ultimately boosting student achievement. The present study highlights a formative assessment approach as an effective assessment practice which primary school mathematics teachers can leverage to improve student learning and achievement. Therefore, this study provides a recipe which can lead towards better grades in national exams such as National Examination Council (NECO) and West African School Certificate (WASC).

CHAPTER 5: IMPLICATIONS, RECOMMENDATIONS, AND CONCLUSION

5.0 Implications of the research study

The rationale for the current research was to investigate the assessment practices of public primary school mathematics teachers. The study explores the views of these teachers in terms of their current assessment practices. It also explores a formative assessment strategy with a view to checking how this influences student learning and learning outcomes in public primary schools.

The research relies heavily on exploring the skills, views and thinking of public primary school mathematics teachers in Abuja regarding assessment practices, and learning. The study seeks to evaluate the effectiveness of current assessment practices in the primary schools investigated using mathematics as the focal subject. It probes to find out if there are other forms of unused or underused assessment practices that these teachers may not be aware of. It then checked the effectiveness or otherwise of a formative assessment approach in promoting student learning and learning outcomes.

The central research problem the study examines are the potential gaps in the knowledge, views and practices of public primary school mathematics teachers regarding their assessment practices. This problem was categorized into four areas as follows:

Many teachers are unfamiliar with providing constructive feedback to students, despite its importance in effective assessment and improving learning quality (Osiesi, 2023). Nigeria's educational policy emphasizes assessment-driven learning (FGN, 2014), but the current focus on grades often overshadows meaningful feedback (Assessment Reform Group, 1999). Effective feedback can significantly enhance learning (Harrison et al., 2015; Osiesi, 2023), and shifting emphasis from grades to the learning process can have far-reaching benefits. Therefore, building a strong feedback culture in Nigerian primary schools is crucial for improving teaching and learning standards (Harrison et al., 2015).

Second, many Nigerian primary school mathematics teachers have misconceptions about assessment, viewing it as a means to rank students and promote competitiveness rather than improve learning (Korb, 2018; Raji et al., 2021). This misconception can lead to faulty assessment practices, such as exam malpractice (Maeda, 2021). In reality, assessment is an

ongoing process aimed at academic enhancement, not just measuring learning but also promoting it (Raji et al., 2021). To improve assessment practices, teachers need to rethink their approach and focus on enhancing the quality of classroom assessments, aligning them with learning goals and norms (Guskey, 2003).

Third, the National Policy on Education in Nigeria (FGN, 2014) outlines a comprehensive assessment framework that includes both summative and formative assessments to improve learning standards and international competitiveness. However, the implementation of this policy appears to be lacking, with many teachers reducing continuous assessment to paper-and-pencil tests that prioritize numerical grades over meaningful feedback (Faleye & Adefisoye, 2015). As a result, the policy's goals of accurately measuring student abilities and enhancing learning are not being fully realized, highlighting the need for clearer purpose and workability of assessments to improve their quality and integrity.

Finally, many teachers are unfamiliar with alternative assessment methods that could potentially enhance students' learning and academic performance (Korb, 2018). This knowledge gap underscores the need for the present study, which aims to investigate the effectiveness of a formative assessment approach in public primary schools in Abuja.

The foregoing underscores the basis for which the main assumption or conceptual framework that underpins the present research is that using the appropriate assessment practices correctly can significantly improve learning and raise the academic achievements posted by students in both low- and high-stakes tests (Cheng et al., 2018; Elmahdi et al., 2018; Granberg et al., 2021).

Although this study focuses on assessment practices at the primary school level, this assumption covers the secondary school level of education too. Suffice it to say, the gaps created by the use of inadequate assessment practices can be filled by introducing adequate assessment strategies in both primary and secondary school classrooms. Such adequate assessment strategies include the employment of feedback which is constructive in nature, the application of peer assessment, self-assessment and rubrics among others.

The significance of effective assessment practices in primary school mathematics education cannot be overemphasised, especially in the developing world (UNESCO, 2020, paragraph 4). All hands must be on deck to support assessment practices that meet the requirements of the Sustainable Development Goals (SDGs). This is why this research is significant to strengthening this aspect of primary school mathematics.

Furthermore, in terms of leveraging formative assessment practices in Nigeria, the study provides researchers seeking to enrich the literature with a groundwork for further studies. Specifically, it provides researchers with a basis for developing the phenomenon of formative assessment within the Nigerian context.

Hopefully, the study should help to correct the gaps identified in the research problem. These include fundamental issues such as teachers' insufficient capacity to create and use constructive feedback, viewing assessment as a means to rank students and promote competitiveness rather than improve learning (Korb, 2018; Raji et al., 2021), reducing continuous assessment to paper-and-pencil tests that prioritize numerical grades over meaningful feedback (Faleye & Adefisoye, 2015) and non-familiarity with alternative assessment methods that could potentially enhance students' learning and academic performance (Korb, 2018).

In view of the foregoing, the implications of the current research work's discoveries are presented below on the basis of each of the research questions which guide the research. These implications bear thoughtful significance for practice in Education.

5.01 Research Question 1: What are the views of primary school mathematics teachers about assessment practices?

Data for the Research Questions was generated from the responses to the questionnaire, semi-structured interviews and analysis of documentary evidence. The questionnaire captured both demographic information and the views and beliefs of mathematics teachers in the primary school setting. Demographic information collected from participants in order of appearance on the questionnaire include (a) gender (b) teaching experience (c) age (d) years served in present workplace (e) age group taught (f) teaching

qualification and (g) educational qualification held as at the time of this study. A total of 115 male and female teachers completed and returned their questionnaires.

56% of the respondents are female participants while 43% are male participants. It is heartwarming to note that about 79% of the respondents have over 7 years of teaching experience meaning that most of the respondents are well experienced in their profession. This has positive implications for this study because it makes the views more credible and acceptable given majority of the views come from experienced educators.

Furthermore, 90% of the sampled teachers possess a teaching qualification. Of the 115 surveyed teachers, 69% are TRCN certified. The Teachers Registration Council of Nigeria (TRCN) is a regulatory body responsible for, defining the teaching profession's boundaries and criteria in Nigeria, establishing and maintaining standards for teacher qualification and competence, and periodically reviewing and enhancing these standards to ensure teacher excellence (TRCN, 2014). It was established in 2000 to restore the glory of the teaching profession in Nigeria.

About 44% of the primary school mathematics teachers (which constitute nearly half of the sampled population) view assessment not only as an event, but also as a tool to measure how much learning is taking place in their classrooms. Summative assessment is described as events which are created to foster making an ultimate decision about a pupil's achievement on a programme (Amua-Sekyi, 2016). This finding is corroborated by findings from similar studies, which indicate that most of the participants studied see and practice assessment from a summative point of view (Modupe & Sunday, 2015; Sewagegn, 2019).

On the contrary 42% see assessment as a process to improve learning (Cheng et al., 2018; Elmahdi et al., 2018; Granberg et al., 2021). Some 11% of the teachers however view assessment only as an event for testing and ranking students in the classroom or other educational setting. Guskey (2003) observes that if we solely utilize assessments as a method for ranking schools and students, we overlook their most impactful advantages.

The remaining 3% either see assessment as all of the aforementioned descriptions or as an event for passing judgement on an evaluation process. This means 58% of the teachers view assessment largely from a summative perspective rather than a formative one.

The fact that as many as 45% of the teachers believe that a written test or exam is the best form of assessment confirms the summative tendencies of nearly half of the participants. Some 9% of the teachers are not sure if written tests or exams are the best form of assessment. 56% of the primary school mathematics teachers believe assessment should be teacher driven.

In other words, the teacher ought to teach the material, set the test or exam, determine the mark scheme, do the grading and so on while the student simply listens, studies and takes the tests (Elmore, 2019). It is obvious that these teachers see tests and exams as the only forms of assessment as observed in Korb (2018). In fact, 46% of the participants use tests and exams as their main forms of assessment. This further reiterates the teachers' summative assessment stance.

However, it is heartwarming to note that 40% of the teachers think assessment should not necessarily be teacher driven. Surprisingly, a whopping 95% of the teachers believe that assessment outcomes should always be accompanied with a written or verbal feedback. Feedback is a main component of formative assessment (Cheng et al., 2018; Pandero & Hopfenbeck, 2020).

Based on the findings from the interview data, it is believed that these teachers may be mistaking the end of term or midterm report they provide to the summative tests written by students for the daily feedback engendered in a formative assessment classroom. Furthermore, the initial checks conducted on some selected students' exercise books reveal the absence of any written descriptive feedback in these materials.

About 78% of the teachers also claim they use self- or peer-assessment in their work with students. Again, the interview data in the present study suggest a majority of the teachers interviewed do not use these forms of formative assessment.

Only 27% of the teachers favor making a written exam an annual event as opposed to a triannual event.

The fact that 55% of the respondents who took part in the research believe that assessment must not always be related to learning suggests that these teachers view assessment as a test or exam written for reasons other than learning. No wonder Umar

and Majeed (2018) opine that educators have primarily emphasized summative assessment to gauge students' learning outcomes, often overlooking other facets of the learning journey.

Also, the fact that 82% of the questionnaire respondents were assessed through graded exams is another pointer to their summative assessment stance and tendencies. Lastly, 74% of the teachers are okay with students writing 2 summative tests and one end of term exam every term in line with Nigeria's education policy on assessment.

From the foregoing, the assessment of mathematics in the primary schools sampled is largely summative. The implication of this is that the learning needs of all students, especially the lower achieving ones in these schools are not adequately catered to. Gezer et al. (2021) differentiate between the implications of formative and summative assessments. According to these authors, utilizing formative assessment can be particularly advantageous in motivating low-achieving students in primary-grade mathematics classrooms.

As a result, the researchers recommend that teachers increase the frequency of formative assessment practices in classrooms with lower achievement levels (Gezer et al., 2021). This means the assessment practices of teachers in the present study are unlikely to benefit the lower achieving students as much as they do their higher achieving counterparts. The implication of the findings in Research Question 1 is the likelihood for weak learning, and poor learning outcomes among students. This explains why many students perform poorly in external exams in mathematics.

5.02 Research Question 2: How effective are the existing assessment strategies teachers use, in improving students' learning and academic achievement in mathematics?

In their responses to the questions posed about the intervention strategies employed by them in their classrooms, the teachers report a variety of strategies which all culminate in one summative test or another. It was clear that the aim of the strategies they use was to raise test scores in summative class tasks which include quizzes, midterm and end of term assessments. For instance, PMT 4 notes that he differentiates *the lessons in such a way that [students] are able to understand the basic concepts [needed] to answer questions ... to [score] the minimum pass mark required in the subject*.

It follows that the interventions used by these teachers are for the sole purpose of passing summative exams. Some of the strategies used by the teachers interviewed in the present study include learning support classes, tutorial classes, detailed teaching, peer tutoring, continuous assessment tests, quizzes, termly exams, one on one (intensive) coaching, repetitive drills and extra work. The use of peer tutoring, repetitive drills and assignment of extra work are more dominant among these strategies.

Table 7

Intervention strategies used by mathematics teachers

S/No	Intervention strategies used by teachers	Frequency
1	Learning support classes	1
2	Tutorial classes	1
3	Detailed teaching	1
4	Peer tutoring	4
5	Continuous assessment tests	1
6	Quizzes	1
7	End of term exams	1
8	One on one coaching	2
9	Repetitions	4
10	Extra work	3

From the above table, strategies such as peer tutoring, repetitions and extra work seem to be most frequently used strategies by the sampled teachers. These strategies are a major component of the behaviourist learning theories (James, 2006). The use of formative assessment strategies such as peer assessment, self-assessment, feedback etc. is not one of the strategies used by the teachers.

According to Martin et al. (2022), effective formative assessment strategies encompass a range of practices that facilitate student learning, including utilizing feedback to inform instruction and guide student progress, encouraging critical thinking and depth of understanding through extension activities, eliciting student reasoning and thought processes to reveal conceptual understanding, collaborative goal-setting to promote student

agency and self-directed learning and peer assessment opportunities to foster critical evaluation and reflection.

From the above, the student is active and plays an active role in his learning process. In short, the student is able to take responsibility for his own learning. Effective learning is facilitated when both teachers and students are actively involved in decision-making regarding subsequent learning objectives (Mogboh & Okoye, 2019). This collaborative approach promotes student agency and autonomy, enhances teacher-student relationships, and fosters a dynamic, adaptive learning environment.

By engaging in shared ownership of learning, teachers and students can work together to identify areas of improvement and develop personalized learning strategies. This, in turn, can lead to increased student motivation and engagement, improved teacher responsiveness to student needs, and the development of critical thinking and problem-solving skills.

The reality of the responses gathered in this research question is that mathematics teachers in this study use little or no formative assessment practices in their work with low ability learners. This affects the extent to which gaps in the learning of mathematics can be adequately covered, particularly for lower ability learners. In other words, such learners are likely to lack adequate understanding of mathematical concepts since formative assessment has been empirically shown to be a high-leverage teaching practice to support the mathematical development of all learners regardless of their abilities and backgrounds (Martina et al., 2022).

As already mentioned elsewhere in this study, some teachers lack the capacity to develop and use assessments which foster effective feedback and critical thinking. Feedback from teachers that is not supportive or informative can hinder students' academic progress and enthusiasm for learning (Akomolafe, 2021). It follows that adequate feedback and critical thinking can enhance the quality of learning and learning outcomes.

Beyond mathematics, the use of a feedback strategy encourages learners to reflect upon their work and to cover up any gaps in their learning. Adequate feedback serves as a comprehensive approach for addressing the diverse learning needs of all students, pointing

out what has worked well and areas for improvement (Tutunaru, 2023). Students can leverage feedback to improve not only academic challenges or misconceptions but also their holistic requirements, including social and emotional wellbeing.

This approach recognizes that students' needs extend beyond cognitive difficulties to include affective, social, and emotional dimensions. By adopting a holistic perspective, assessment should identify and respond to students' individual differences, learning styles, and motivational factors, ultimately fostering a more inclusive and supportive learning environment (Martina et al., 2022). Part of these needs is the ability to think constructively and self-regulate their own learning. In other words, students should be able to use feedback to improve future learning (Yan, 2022).

Unfortunately, the ability to think critically and solve problems is fast eroding away from many classrooms, and by extension, from our workforce. For instance, one University of Lagos research shows that the level of critical thinking of Nigerian senior secondary school science students is abysmally low (Okunuga et al., 2020). This situation suggests that schools in Nigeria may not be applying teaching methods which promote critical thinking and problem-solving skills. The implication of this is that the products of these schools will end up as poor thinkers and problem solvers. Poor critical thinking and problem-solving skills are traceable to poor assessment feedback practices.

Schools or systems which focus on only assessments without constructive feedback that foster critical thinking or problem-solving skills risk building a nation where these qualities are missing. A nation's economic and industrial development is inextricably linked to its population's critical thinking capabilities (Okunuga et al., 2020).

The cultivation of critical thinking skills is essential for fostering innovation, problem-solving, and adaptability, all of which are vital components of a competitive economy. Consequently, countries with populations lacking in critical thinking abilities are likely to face significant obstacles in achieving sustainable economic growth and industrial progress.

Effective development strategies must therefore prioritize education and training programs that emphasize critical thinking, analytical reasoning, and creative problem-solving to equip citizens with the skills necessary for driving national prosperity.

As stated in the evaluation section, the descriptors used in identifying low ability learners include *slow learning, achieving way below class standards, dragging the class back, inability to assimilate or understand concepts, learning disability, low self-esteem, lack of confidence, below average performance* etc. These descriptors suggest that students in this category are unlikely to contribute meaningfully to nation building through problem solving if the methods employed in assessing them lack any intentional feedback strategies.

Furthermore, it is clear that most of the teachers sampled neither have a working knowledge of feedback (or formative assessment) practices, talk less of using these adequately. This is not necessarily because they are unaware constructive feedback or formative assessment, but because they lack sufficient capacity to harness the skills involved. Teachers might stick to their old practices if they lack confidence, misunderstand the purpose of formative assessments, or aren't motivated by a supportive school environment (UNESCO, 2023).

The implication of this is that these teachers rely almost exclusively on summative assessment practices which thrives on grades rather than meaningful feedback which breeds critical thinking and problem-solving skills. Summative assessment or assessment of learning is assessment which measures how much learning has taken place. It is viewed as the traditional method of assessment because it is as old as education itself. Bacquet (2020) reports that the summative assessment process concludes with a definitive judgment on student learning. In other words, the emphasis of this type of assessment is on passing examinations and tests, and not necessarily on learning.

The Ethiopian study confirms a prevalent reliance on summative assessment methods among teachers, with findings indicating a strong emphasis on traditional written evaluations. Notably, the research suggests that teachers predominantly utilize conventional written assessments, neglecting innovative and alternative methods that could potentially

uncover students' creative capacities and proficiency in their respective fields of study (Sewagegn, 2019).

An overreliance on traditional assessment techniques may limit the ability to accurately groom a complete student or gauge their holistic learning outcomes. This underscores the need for teacher professional development and policy reforms to integrate more diverse and effective assessment strategies. Such policy reforms must focus on fostering assessment practices that emphasize the developmental *process in learning* beyond the end *product of learning* (Ajayi & Gbenga-Akanmu, 2018).

In summary, the implication of the findings from this research is that environments rife with summative approaches tend to produce students who often struggle to keep up with the established pace or require more time to master concepts are often left behind (Chappuis & Stiggins, 2002). Put differently, the assessment practices in use by the participants do not promote *deep learning* or *soft skills* such as critical thinking. This situation produces low ability learners, poor thinkers and weak problem solvers. It highlights gaps in existing assessment practices.

5.03 Research Question 3: What is the effect of formative assessment practices on learning outcomes in mathematics?

Part of the activities carried out in this study was to study the effect of a formative assessment strategy on students' learning and learning outcomes. The aim of this check was to confirm if this assessment strategy could improve learning and to what extent, particularly among low ability learners in the schools under investigation. The effect of this attempt showed that the students involved demonstrated greater confidence and involvement in their learning as a result of the formative assessment strategy.

Nonetheless, some of the teachers who participated in the intervention think the strategy might not be sustainable given its need for attention to details. In other words, effective feedback is the baseline for formative assessment, hence the reason for choosing this particular strategy. The positive impact of formative assessment on student learning is well captured in the literature (Elmahdi et al., 2018; Granberg et al., 2021; Leenknecht et

al., 2021; Ozan & Kincal, 2018; Prashanti & Ramnarayan, 2019; Xiao & Yang, 2019; Yan et al., 2021).

Studies also show that students taught using formative assessment strategies outperformed those taught using traditional assessment approaches. In a Khartoum study which compares the grades of students taught using summative assessment to those of students taught using formative assessment, the latter recorded higher grades. This suggests that formative assessment practices hold greater prospects for student learning and achievement (Umar & Majeed, 2018). It is observed also that students tend to prefer a formative assessment approach over a summative one having tested both methods (Buyukkarci & Sahinkarakas, 2021).

While this study does not advocate for summative assessment to be jettisoned, there is need for teachers to build formative assessment strategies into their assessment practices (Bhat & Bhat, 2019; Obilor, 2018). This is likely to cover gaps in the learning of all students, especially the lower ability ones. Results of both external and internal exams are likely to improve when the classroom practices of teachers deliberately incorporate the use of formative assessment strategies.

Literally all the teachers interviewed in the present study saw the need for mathematics to be taught using formative assessment strategies. Although formative assessment is captured in theory in the National Policy for Education, there is no convincing evidence that this form of assessment is in use in many Nigerian classrooms – the present study underscores this omission. This explains why Akomolafe (2021) recommends the use of adequate formative assessment practices, such as feedback as a powerful instrument through which education in Nigeria can be both developed and sustained.

According to the policy, the scope of assessment shall include (a) assessment designed to facilitate student learning and (b) assessment evaluating student learning outcomes (FGN, 2014). Assessment for learning here is also referred to as formative assessment (Martins et al., 2022). The findings from the present research show that formative assessment practices are largely absent in teachers' work with children, particularly in mathematics. However, the findings in the present study suggest teachers'

openness to adopting formative assessment methods in the teaching of mathematics in Nigeria.

If formative assessment practices are integrated into the country's assessment policy in *practical ways*, the chances are that students are more likely to record better grades in large-scale summative assessment tests such as the National Common Entrance Examination (NCEE) for primary school children seeking to be admitted into secondary schools in Nigeria. In other words, if traditional summative and modern formative assessment approaches are combined, students are more likely to record better grades in mathematics. As noted by Sewagegn (2019),

> Traditional assessment methods on their own are not sufficient to enhance the competency of the students' learning ability. Therefore, the use of various alternative assessment methods is crucial to enabling students to be more creative, proficient and productive in their study areas (Sewagegn, 2019, p. 619).

Formative assessment approaches, including feedback opportunities, cognitive extension, reasoning articulation, goal-setting, and peer assessment, are considered alternative assessment methods (Martins et al., 2022, p. 418). This explains why there are calls for mathematics teachers to possess proficiency and familiarity with formative assessment practices which involve assessing students, analyzing data, and determining subsequent instructional steps based on the collected data (Martins et al., 2022; Polly et al., 2016; NCTM, 2014).

Such policy modifications would ultimately help to close the gaps between low achieving and high achieving students. Indeed, using formative assessment practices correctly can improve student learning particularly in mathematics. Gezer et al.'s research underscores the importance of integrating formative assessment practices in primary grade classrooms, particularly in those with lower-achieving students (Gezer et al., 2021). Their findings suggest that frequent implementation of formative assessments can have a positive impact on student learning outcomes, especially in earlier educational stages.

By incorporating regular, informal evaluations and feedback, teachers can identify knowledge gaps, adjust instruction, and provide targeted support, ultimately enhancing academic achievement and bridging the gap for struggling students. This is because

formative assessment can help teachers to develop a better understanding of the learning needs of their students. It offers insights into students' misconceptions and frustrations in mathematics. For example, Through the strategic implementation of formative assessments, teachers can identify specific areas of difficulty in number sense development among low-achieving students (Gezer et al, 2021).

By administering frequent, informal evaluations and analyzing student responses, educators can pinpoint precise conceptual gaps or misconceptions that hinder mathematical understanding. This targeted insight enables teachers to tailor instruction, provide differentiated support, and adapt interventions to address the unique needs of struggling learners, ultimately fostering improved numeracy skills and enhanced academic outcomes.

No doubt, this will demystify seemingly difficult concepts in mathematics and ultimately improve students' grades in the subject across the country. The correct use of formative assessments also engenders the making of self-directed learners who are willing to take responsibility for their own learning (Bhardwaj et al., 2025).

In terms of contribution to the existing literature, this study shows that current assessment practices in mathematics do not really cater to the learning needs of lower achieving students as much as they do to those of the higher achieving ones. This is in addition to providing firsthand information about the nature of the assessment practices of public primary school mathematic teachers in Abuja. There is therefore urgent need to modify these practices to reflect and meet the learning needs of low ability students.

5.1 Recommendations for application

Bearing in mind the fact that the rationale for the current research was to attempt to discover alternative innovative practices which could improve the quality and end result of the assessment practices of primary school mathematics teachers in Nigerian primary schools, this study relied heavily on exploring the skills, views and thinking of mathematics teachers regarding their assessment practices and student learning. Specifically, the study sought to evaluate the effectiveness of current assessment practices in some public primary schools in Abuja using mathematics as the focal subject. It attempted to find out if teachers are aware of other forms of assessment e.g. formative assessment practices which teachers

may not be aware of, and how effective these forms are in promoting student learning and improvement.

Therefore, the central problem the study attempts to address is that of the potential gaps in the knowledge, views and practices of primary school mathematics teachers regarding assessment.

The recommendations in this study may be viewed as calls to action which could make positive differences to assessment practices especially in the classrooms of public primary schools. They are based on the research findings, and categorized into 3 areas which include (i) recommendations for improving practice (ii) recommendations for policy reviews and decision making and (iii) recommendations for future research.

5.1.1 Recommendation for improving practice

Questionnaire responses in the present study suggest that some teachers are familiar with formative assessment practices. Based on the responses to the questionnaires, it appears that the public primary school mathematics teachers in this study are familiar with formative assessment practices such as the use of feedback, peer-assessment and self-assessment practices. Nevertheless, interview data showed otherwise. According to the interviews, the teachers either rarely use these approaches or apply them incorrectly. In terms of the feedback strategy, interviews with teachers also suggest that they may be confusing report card comments, typically used for midterm or end-of-term evaluations, with feedback comments that are more suitable for daily formative assessment purposes.

In addition, some of the teachers in the present study tend to view formative assessment as frequent testing. For instance, these teachers equate the use of first and second *continuous* assessment tests followed by an end of term examination to a form of formative assessment process. Sure enough, this thinking tallies with the National Policy on Education. Suffice it to say, these teachers believe that the use of frequent testing and repeated practice is a type of formative assessment (James, 2006). Sadly, this belief seems to be achieving desired outcomes, especially for the high ability and above average students. The only problem here is that while the actual formative evaluation is concerned about the *process* of learning, traditional testing and practice or drills are largely geared towards the

product of learning. Additionally, the low ability students are placed at a disadvantage because the use of frequent testing tends to favor higher achieving students better.

This misconception clearly demonstrates that there is a gap in practice with respect to classroom assessment. Section 9C, subsection 150 of the National Policy on Education states that the assessment framework comprises two main components: Assessment for Learning (formative) to guide instruction and Assessment of Learning (summative) to evaluate achievement. Unfortunately, the policy does not say much about the administration of these forms of assessment making them subject to all forms of interpretation.

Many teachers in the present study are also not familiar with the assessment policy. This is in addition to the ambiguity posed by the policy statement on assessment. Neither does the policy detail any provision for teacher training on the use of classroom assessment. However, and commendably too, the policy outlines assessment goals aimed at accurately measuring student abilities, boosting the global competitiveness of Nigerian graduates, enhancing examination credibility, addressing issues with traditional paper-pencil tests, and ultimately improving learning outcomes, as stated by the Federal Government of Nigeria

Accordingly, two of the goals of assessment as set out in the policy include eliminating the endemic problems associated with paper and pencil tests and improving learning. While these goals tend to resonate with the intentions of formative assessment, many teachers still prefer to use the paper and pencil test approach which is largely summative. One reason for this preference is probably due to the fact that a lot of these teachers lack adequate understanding of formative assessment strategies.

Unfortunately, formative assessment is a complex and multifaceted approach that necessitates a gradual transformation of teaching and learning practices, rather than a straightforward or expedient strategy. Effective implementation requires a deliberate and sustained commitment of time, effort, and resources. It involves a paradigm shift from traditional assessment methods, embracing a cyclical process of continuous feedback, reflection, and adjustment. Perhaps this is the reason why many teachers resort to using only (or mostly) summative assessment approaches in the classroom.

According to a Kosovo study on the introduction and implementation of educational innovations into the country's education system, it was discovered that teachers were reluctant to adopt the newly introduced innovations which include formative assessment strategies (Ahmedi, 2019). The resistance to implementing formative assessment can be attributed to various factors, including teachers' entrenched habits and familiarity with traditional methods.

Specifically, teachers' prolonged exposure to established routines and practices can foster inertia, making them reluctant to deviate from their comfort zone. Additionally, extensive work experience within a static educational system, devoid of innovation, may contribute to an entrenched mindset, thereby hindering openness to novel approaches and pedagogical shifts.

As already noted in the implications section, the omission of formative assessment in the classroom has far reaching effects on the learning outcomes of low-achieving learners. The correct use of formative assessment practices can raise achievements for students of all abilities (including the lower ability learners). By integrating formative assessment, educators can systematically enhance the quality of instruction, foster a student-centered learning environment, and promote deeper understanding and academic achievement.

In light of the above, there is a need for *organised* teacher training in Nigeria on the proper use and application of formative assessment practices so that the quality of student achievement and learning outcomes can improve across schools, irrespective of their learning abilities. When teachers are trained to understand and leverage formative assessment strategies which include the employment of constructive feedback, peer-assessment and self-assessment among other self-regulated learning approaches, children are likely to take better ownership of their learning and thus develop better learning skills. The problems associated with assessments in Nigeria such as exam malpractices are also likely to be mitigated or even eradicated completely.

Such training will however need to be effective and properly organised. This is because teachers are likely to embrace innovative assessment strategies, provided they are given regular and sufficient training on how to navigate the new innovations. The training

also needs to be persistent as teachers are not unlikely to resist it initially. Teachers in Kosovo were at first hesitant towards a national teacher training program which was targeted at introducing the use of innovative assessment strategies to the country's educational system.

The following practical steps are suggested in order to ensure the sustainability of the recommended teacher training programme.

- Public primary school mathematics teachers should incorporate regular formative assessments into their daily practices to provide ongoing feedback and support to students.

- Public schools should allocate dedicated time for teachers to receive training and support on formative assessment strategies.

- To ensure compliance, the government should establish a monitoring and evaluation system to track progress and provide feedback to schools.

- Schools that fail to implement formative assessment strategies should face consequences, such as reduced funding or support.

- To address constraints in assessment resources, schools can explore partnerships with local organizations or businesses to access necessary technology and expertise.

- The government should establish a national framework that outlines clear guidelines and standards for assessment design, implementation, and evaluation in mathematics.

To further make the recommended training result-oriented, there would be need to apply Fullan et al.'s (2005) eight forces for implementing change in educational systems. Successful educational change initiatives are propelled by a combination of forces. Key strategies include engaging stakeholders' moral purposes, building capacity through professional development, and managing complex change. Essential elements also comprise cultivating a culture of continuous learning, embedding evaluation and assessment, and fostering transformational leadership. Furthermore, promoting coherence among policies,

practices, and resources, as well as tri-level development (individual, team, and organizational growth), are vital for achieving sustainable reform.

In a similar vein, another study suggests that governments would first need to put certain measures in place, such as exploring and appreciating the characteristics of effective learning environments, if the introduction of educational innovations to schools must be embraced by teachers. For instance, the introduction of formative assessment practices into public primary schools may be preceded by providing an assessment framework which details a clear purpose, scope and implementation guidelines for formative assessments, well defined learning objectives and standards for each grade level, aligning assessments with curriculum demands etc.

In addition to teacher training, grooming students to use self-regulated learning techniques such as peer-assessment and self-assessment will also go a long way in improving the quality and outcome of assessments. For instance, research conducted in Barbados revealed that high school students who received training in self-assessment demonstrated significant benefits.

Not only did these students report feeling more prepared for external examinations, they also achieved superior academic performance compared to their peers who did not receive any self-assessment training. This study highlights the positive impact of self-assessment skills on student confidence and academic outcomes, underscoring the value of integrating formative assessment strategies into school curricula.

5.1.2 Recommendation for policy review and decision making

The findings from the present study serve as a focal point for policy review and formulation which will ultimately improve educational assessment practices. They also provide guidance in decision making with respect to assessment practices, especially in government primary school mathematics. To ensure the implementation of formative assessment practices in Nigeria, government must establish a monitoring and evaluation system to track progress and provide feedback to schools. This is in addition to training teachers and grooming students in the application of this method of assessment. When

policy, decision making and implementation are guided, assessments are more likely to raise the present level of learning and teaching.

Some researchers have called for a departure from the overuse of paper and pencil tests, beckoning other researchers and policy makers to consider classroom-based assessments instead. Any isolated and uncoordinated teacher training efforts in the area of formative assessment practices is unlikely to achieve any meaningful national results until it is underpinned by adequate policy reforms. This would mean the policy going beyond only stating the goals of assessment to designing how these goals would be achieved.

According to Bali et al. (2019), effective policy design necessitates the creation of robust and durable frameworks that can withstand various challenges and yield sustainable outcomes. To achieve this, policymakers should strive to develop policies that: exhibit robustness: a) capable of withstanding external pressures and uncertainties, b) demonstrate durability: enduring over time, resistant to erosion or reversal and c) foster effectiveness: yielding intended outcomes, efficiently allocating resources (Bali, Capano and Ramesh, 2019). They advocate for policy makers to design policies which must withstand and address the current challenges faced by countries across the world.

To design effective policies, it's crucial to understand the underlying challenges and root causes of current assessment practices in Nigerian classrooms. This foundational knowledge enables policymakers to accurately diagnose issues, select suitable policy instruments, and optimize their implementation.

A potential challenge with the education policy in Nigeria may be its non-implementation, possibly due to two key reasons: unclear implementation criteria and lack of a conducive environment prior to policy introduction. Additionally, policymakers seeking to integrate formative assessment effectively should explicitly articulate their objectives and invest in teacher capacity-building.

Clarifying policy goals is crucial, as it provides a clear direction for implementation and enables evaluation of effectiveness. Policymakers should prioritize teacher professional development to equip educators with the skills and knowledge needed to effectively utilize formative assessment. This dual approach fosters a supportive environment, empowering

teachers to harness the potential of formative assessment to enhance teaching and learning outcomes. This means a policy review process should be accompanied with appropriate measures that empower the stakeholders to succeed at using the policy.

Governments at all levels should consider implementing reforms to integrate formative assessment practices into Nigerian schools, drawing inspiration from countries that have successfully adopted such approaches. For example, one country has eliminated high-stakes testing until after secondary education, reducing pressure on students and teachers and freeing up time to focus on enhancing learning skills and outcomes. By adopting similar policies, Nigeria can potentially improve its educational landscape. To wrap up this section, it is crucial to emphasize that this study does not advocate for the elimination of summative assessment practices from Nigeria's educational system.

A balanced approach that combines both summative and formative assessment practices in classrooms is recommended for optimal learning outcomes. This refers to combining both forms of assessment in the classroom since each form has its own role to play. Teachers should strive for a balance between summative and formative assessment practices to produce well-rounded students who can adapt to various assessment contexts.

Furthermore, to bridge the gap between policy and classroom practice, the following comprehensive reform is recommended for the various stakeholders in Nigeria's education system:

To the Government and Policymakers

The evidence presented in this study highlights the pressing need for bold, urgent, and comprehensive reform of Nigeria's educational policies, particularly in the area of assessment. The current National Policy on Education (NPE) is considered inadequate because it merely outlines broad objectives without providing the critical operational details or "how-to" strategies necessary for effective classroom implementation. In the absence of such guidance, teachers and schools are left to interpret policies in fragmented ways, leading to inconsistency, weak accountability, and suboptimal student outcomes.

It is therefore imperative that government leaders and policymakers move beyond simply identifying the challenges within the education sector and instead adopt a solution-

driven approach that directly addresses the persistent gaps between policy intentions and classroom realities.

1. Policy reform for 21st-century skills

The study emphasizes the need for a revision of the National Policy on Education to make it more practical, specific, and future-oriented. Such a revision should include an explicit mandate for the use of modern assessment strategies that foster critical thinking, creativity, collaboration, communication, and problem-solving—skills essential for the 21st-century learner.

Embedding formative assessment as a compulsory and integral element of teaching at all levels, especially in primary education, would provide learners with continuous feedback that supports growth rather than relying solely on high-stakes, summative tests. A clearly articulated policy framework would ensure consistency, accountability, and a shared vision across the education system.

2. Investment in teacher capacity

The study further reveals that teachers remain the most critical factor in the successful implementation of assessment reforms. However, a significant gap exists in their knowledge and competence regarding the design and application of meaningful assessment practices. Addressing this requires that the government allocate substantial resources to continuous and mandatory professional development programs for public primary school teachers.

These programs should build practical competencies in creating and applying assessment tools that encourage higher-order thinking skills (HOTS). Such capacity-building efforts would empower teachers not only to evaluate learning more effectively but also to cultivate deeper engagement and achievement among students beyond rote memorization.

3. Funding for research and innovation

The study also stresses that educational policy decisions should be grounded in robust and context-specific evidence. The establishment of a dedicated national fund for

educational research is therefore recommended to enable sustained investigation into effective assessment practices within the Nigerian context. This fund should support research aimed at identifying best practices, testing innovative approaches, and examining the adaptability of international models.

Comparative studies with successful education systems, such as those in Finland and Singapore, could generate valuable insights that are tailored to Nigeria's realities. Additionally, investments in pilot projects, experimental programs, and collaborative research involving universities and teacher-training institutions would strengthen the system's ability to innovate and evolve.

To School Managers and Administrators

School managers and administrators serve as the linchpins of educational transformation, acting as the bridge between government policies and classroom realities. While policymakers design frameworks and directives, it is ultimately at the school level that these ideas either flourish or fail. Their leadership, vision, and commitment to change are therefore essential in ensuring that reforms in assessment practices translate into meaningful improvements in teaching and learning. By creating the right environment, motivating teachers, and aligning practices with modern approaches, school managers and administrators hold the power to shape schools into vibrant centers of learning.

1. Cultivating a culture of learning

One of the most important responsibilities carried by school managers and administrators is the fostering of a school culture that prioritizes learning over narrow measures of academic performance. Too often, schools become consumed with examination scores and rankings, reducing education to a competition rather than a developmental process. As leaders, they must intentionally shift this narrative by encouraging teachers to view assessment not as a one-off event for grading, but as a continuous and integral component of the teaching–learning process.

This cultural transformation involves promoting practices that emphasize constructive feedback, where students are guided on how to improve rather than judged solely on what they have achieved. Such an approach motivates learners, builds confidence,

and helps them take ownership of their learning journeys. By celebrating progress alongside achievement, schools are able to nurture resilience, creativity, and a deeper passion for knowledge.

2. Facilitating professional development

The principle that *teachers cannot give what they do not have* underscores the importance of professional growth. For teachers to effectively implement innovative assessment strategies, ongoing professional development must become a central pillar of school management. Administrators are therefore expected to take an active role in sourcing, organizing, and facilitating professional learning opportunities for their staff. These opportunities could take the form of workshops on project-based learning, training sessions on formative assessment techniques, or peer-mentoring programs where experienced teachers guide their colleagues.

Furthermore, schools are encouraged to recognize and reward teachers who successfully integrate innovative methods into their practice. Such acknowledgment—whether through formal awards, leadership opportunities, or public recognition within the school—creates strong incentives for other teachers to adopt progressive approaches. By cultivating an environment where professional growth is encouraged, supported, and celebrated, administrators empower teachers to consistently deliver higher-quality learning experiences.

3. Diversifying assessment methods

The research highlights a persistent challenge in Nigerian schools: an over-reliance on traditional assessment methods such as tests and homework. While these approaches hold value, they provide only a limited perspective on what students know and can do. As school leaders, managers and administrators bear the responsibility of encouraging and institutionalizing a broader spectrum of assessment strategies that offer a more holistic view of student learning.

By promoting practices such as group projects, oral presentations, peer assessments, reflective journals, portfolios, and hands-on problem-solving activities, students are given the chance to demonstrate a wider range of skills—including collaboration, creativity, and

critical thinking. Beyond capturing academic performance, these alternative approaches also reflect real-life problem-solving contexts, thereby preparing learners to thrive in the modern world. Diversifying assessment methods not only makes learning more engaging but also creates meaningful opportunities for students with different strengths to excel.

To teachers

Teachers are positioned at the heart of educational transformation, and their commitment, creativity, and willingness to adapt will ultimately determine whether reforms in assessment succeed or fail. The findings of this research acknowledge that many of the current limitations in assessment practices are systemic issues, shaped by inadequate policy guidance, limited training opportunities, and entrenched traditions within the education system. These shortcomings are therefore not a reflection of personal failure but rather a collective call to action. Teachers possess the power to directly shape students' learning experiences, creating classrooms where assessment is not simply about grades but about growth, discovery, and lifelong learning.

1. Integrating assessment into instruction

The research emphasizes that it is time for a reframing of how assessment is perceived within classrooms. Instead of being treated as a task that follows instruction—something separate from teaching—assessment should be woven into daily practice as a continuous process. This involves using formative assessment techniques that allow teachers to check student understanding in real time. For example, quick quizzes, exit tickets, class discussions, or digital polling tools can provide immediate feedback on how well students are grasping new concepts. With this information, teachers can adjust instructional strategies—reteaching, extending, or differentiating as necessary—ensuring that no learner is left behind. By embedding assessment into instruction, classrooms are transformed into dynamic environments where teaching and evaluation work hand in hand to support meaningful learning.

2. Challenging beliefs

The study indicates that many teachers' beliefs about assessment have been shaped by their own educational experiences, which were heavily oriented toward summative

methods such as final examinations and standardized tests. While these methods have a role, they often restrict learning to memorization and reproduction of facts. Teachers are therefore encouraged to critically reflect on these assumptions and consider whether they truly serve the needs of contemporary learners.

The central questions become: *What is the purpose of assessment? Is it to rank and sort students, or to help them grow?* By adopting a more balanced perspective—where summative and formative assessments complement one another—teachers can better appreciate how modern approaches empower both educators and learners. Developing an understanding of the rationale ("why") behind innovative assessment practices provides teachers with the confidence and motivation needed for meaningful implementation.

3. Becoming designers of learning

Teachers' roles extend far beyond preparing students for tests; they are, in essence, designers of learning experiences. This requires moving beyond a "teaching to the test" mentality and instead creating opportunities for learners to engage in tasks that demand critical thinking, creativity, and problem-solving. For instance, rather than requiring students to recall a list of facts, teachers might design projects where learners must apply knowledge to real-world problems, collaborate with peers, or present findings in creative and practical formats.

In addition, the study encourages teachers to integrate alternative assessment strategies such as self-assessment and peer-assessment. These methods not only deepen student reflection and accountability but also foster a sense of ownership over the learning process. When learners evaluate their own work or that of their peers, they develop skills such as self-regulation, constructive criticism, and independence.

By embracing the mindset of a learning designer, teachers shift from merely transmitting information to facilitating enriching experiences that inspire curiosity, develop resilience, and equip students with the competencies they need for lifelong success.

To students

Students are at the very center of all educational reforms and innovations. Every recommendation directed at policymakers, administrators, and teachers ultimately exists to improve their learning experience and future opportunities. While these changes may be guided and implemented by adults, it is the students' understanding of them—and their willingness to actively engage—that will determine their true success. Recognizing their role as empowered, responsible learners is key to unlocking their full potential and ensuring that education serves as a lifelong tool rather than a short-term obligation.

1. Seeing beyond the grade

It is natural for students to care about the marks they score on tests and assignments, but grades are only one small piece of the broader learning journey. True progress emerges when they focus on the feedback their teachers provide. Feedback highlights strengths, identifies areas for improvement, and offers practical strategies for growth. Instead of viewing a test score as a final judgment, students are encouraged to see it as an opportunity to ask: *What can I learn from this? How can I improve next time?* This shift in mindset enables them to value the process of learning more than the product, equipping them to continuously improve regardless of whether their grade is high or low at a given time.

2. Engaging in deeper learning

When teachers assign group work, projects, or creative tasks, students may sometimes perceive these as "extra work." In reality, such tasks are intentionally designed to build essential lifelong skills—collaboration, communication, problem-solving, and adaptability. For example, working in a team teaches students how to listen to others, share ideas, and resolve disagreements—skills that will prove vital in workplaces, communities, and personal relationships. By approaching these opportunities with enthusiasm rather than reluctance, students not only enhance their academic performance but also prepare themselves for real-world challenges beyond the classroom.

3. Taking ownership of education

Education is not something that simply happens to students; it is a partnership between them, their teachers, peers, and even their families. To benefit fully, they must take an active role in the process. This involves asking questions whenever they are uncertain, seeking clarification, and refusing to remain passive when difficulties arise. By practicing self-assessment—regularly reflecting on what they understand, what remains confusing, and what goals they want to set for themselves—students cultivate independence and confidence.

When students take ownership of their learning, they begin to see themselves as more than just learners completing tasks. They transform into lifelong learners who are curious, motivated, and prepared for the challenges of the future. This mindset not only supports academic success but also equips them with the resilience and adaptability needed to thrive in a rapidly changing world.

5.2 Conclusion

This study's key finding reveals that primary school mathematics educators heavily rely on summative assessment methods. By exploring the assessment techniques used by public primary school mathematics teachers in Abuja, this research contributes to the existing literature. The survey and interview results are consistent with previous studies in this area. Teachers' perceptions are influenced by the historical, cultural, social, and policy contexts in which they operate.

This study aimed to investigate how teachers in this region perceive and utilize assessment, with a focus on mathematics. The finding that formative assessment methods, such as peer assessment, portfolios, and rubrics, are underutilized among mathematics teachers is consistent with prior research. A 2015 study in Gombe, northeastern Nigeria, found that teachers in the Gombe Local Government Area were not adopting alternative assessment practices, which hindered the attainment of Universal Basic Education goals. The study's authors suggested that teachers should complement traditional assessments with alternative methods to better evaluate learning outcomes (Adaka & Ugo, 2015).

The findings from the present study, vis-à-vis the literature and research problem are discussed below.

The study's findings with regards to teachers' views about assessment tally with the existing knowledge on assessment in the literature. Over half of the teachers in the present study view assessment as an event for measuring learning or tool for ranking students, as opposed to a process for improving learning. This view is depicted in the literature as summative assessment which is done after a period of teaching (and learning) with the intention of measuring how much learning has happened within the said period.

Summative assessments function as a yardstick to evaluate student learning outcomes after a lesson or course has been completed. Unlike formative assessments, summative evaluations take place at the end of the instructional period. As noted by Amua-Sekyi (2016), this type of assessment provides a comprehensive evaluation that culminates in a final judgment about a student's achievement in a particular program.

The prevalence of summative assessment is evident in Nigeria, with 55% of surveyed teachers viewing assessment primarily as a summative tool. This finding aligns with previous research on assessment practices in Nigeria. For instance many teachers in Nigeria perceive assessment as a periodic ritual, conducted every 3-4 weeks, highlighting their focus on assessment as an event rather than an ongoing process.

This highlights the need for comprehensive training programs to enhance primary school mathematics educators' understanding of assessment purposes and applications. There is a significant gap in in-service training and workshops for primary school teachers on effective assessment practices. Research shows that teachers are likely to adopt innovative assessment strategies if provided with regular and sufficient training.

Another noteworthy observation is that more than half of the teachers in this study believe that assessment should be teacher-driven. This perspective implies that the teacher assumes the role of the assessor, relegating the student to merely being the object of assessment. On the contrary, assessment should go far beyond only the teacher's actions by incorporating the activities and actions of the student as well.

The term assessment encompasses a broad range of activities undertaken by teachers and students to gather information that informs teaching and learning practices. These activities, which include self-assessment by students, provide valuable feedback that is used to modify and refine teaching strategies and learning experiences. Hence, assessment should ideally be a collaborative effort between teachers and students. In this approach, both parties play pivotal roles, with students gradually taking ownership of their learning journey.

Formative assessment, in particular, emphasizes active student involvement through practices like self- and peer-assessment, and the integration of teacher feedback for improvement. However, it became apparent during the interview phase of this study that many teachers had misconceptions regarding the concepts of self-assessment, peer assessment, and the utilization of feedback, all fundamental components of formative assessment.

For instance, some teachers seemed to equate the report card comments they provide at the end of each term or half-term to *feedback* when actually, feedback in a formative sense refers to an *ongoing process* as opposed to a periodic event. Teachers play a crucial role in facilitating student learning by providing timely, constructive, and ongoing feedback (Martin et al., 2022).

Similarly, using peer- and self-assessment in a formative sense would usually require the use of a rubric or *mark grid* which serves as the template against which students can compare their efforts. In peer-assessment for instance, students assess each other's work using a rubric. Peer assessment provides students with valuable feedback from classmates, promoting critical thinking, reflection, and collaborative learning. This strategy develops students' evaluative skills, exposes them to diverse perspectives, and refines their work.

Effective implementation of peer assessment requires well-defined criteria, structured feedback, and teacher guidance. Peer assessment has a significant positive impact on students with lower abilities. Students who participate in peer assessment exhibit notable progress, underscoring its ability to bridge performance disparities and promote a more inclusive educational experience. This suggests that effective evaluation

can emerge from collaborative approaches, not solely from traditional teacher-led methods.

The study also revealed the importance the teachers attached to writing paper and pencil tests or exams and their propensity for this mode of assessment. Almost all of the teachers embraced the idea of students taking at least 3 major exams per year, and by implication, 6 other smaller exams or tests within the same year. No doubt, these teachers operate in a context of high-stakes testing and rely more on the use of summative assessment practices (Azis, 2012).

This accounts for the teachers' reliance on frequent testing as an assessment method. Given that nearly half of the public primary school mathematics teachers believe written tests or exams are the most effective form of assessment, this approach is not unexpected. Research supports this trend, indicating that many teachers heavily rely on summative assessment strategies, including paper-and-pencil tests (Modupe & Sunday, 2015; Raji et al., 2020; Sewagegn, 2019). Summative assessment has become a standard practice in this region, with teachers finding it unusual to evaluate student learning without these tests. As Obilor (2018) notes, this assessment method has been widely accepted by teachers, students, and parents.

This perspective is unsurprising given that the National Policy on Education mandates the use of continuous assessment, often in the form of summative tests, and school examinations as the criteria for progression from one grade to another in both public and private schools. In other words, the school system in Nigeria is founded on the belief that summative tests and exams form the basis for promotion between classes. There have been cases where children who do not pass exams or score up to certain grades in such exams are made to repeat classes.

Studies point out the danger in subjecting children to only summative tests (Obilor, 2018; Sewagegn, 2019). One study highlights the detrimental effects of using testing as a basis for grade placement or school retention for children under the age of eight, emphasizing the potential harm it can cause to their educational and personal development (Stevens & DeBord, 2001 as cited in Ajayi & Gbenga-Akanmu, 2018). Another reason why

this practice is not so surprising is because most of today's teachers passed through an education system that relied extensively on frequent summative testing. In the present study, almost all the surveyed teachers fall in this category.

For the record, nearly all of the surveyed teachers confirmed they were mainly assessed through graded written tests and exams. Furthermore, well over half of them believed that assessments are meaningless without scores or grades from summative tests.

Another stunning discovery from the present study is the notion by teachers that assessment is not always fundamentally about learning. Their purpose for carrying out assessment was therefore, mainly to generate scores or grades. For instance, over half of the surveyed teachers didn't think that assessment ought to always be about learning. This perspective starkly contrasts with the call in academic literature to reimagine the nature and objectives of assessment, advocating for assessment to primarily focus on enhancing learning rather than solely measuring it (Ozan & Kincal, 2018; Umar & Majeed, 2018). This approach regards assessment primarily as a means to enhance learning. Thus, the central focus of assessment is on facilitating learning above all else.

When assessment primarily aims to enhance learning, there's a tendency to prioritize rigorous learning over frequent testing. This is exemplified in countries like Finland, where the primary goal of assessment is to support and enhance learning (Hendrickson, 2012). In Finland, the education system adopts a more relaxed and holistic approach to learning, characterized by fewer standardized tests and assessments, and less pressure on teachers to solely prepare students for narrow examinations. Instead, the focus is on fostering critical thinking, creativity, and individualized learning, with teachers enjoying more autonomy and flexibility in their teaching methods. This approach allows for a more enjoyable and inclusive learning environment, where students can develop a love for learning and grow into well-rounded individuals.

Furthermore, the present study discovered that teachers saw themselves as the custodian of knowledge whose job it is to impart knowledge to students. In this wise, these teachers perceived their role as knowledge givers whilst students were receivers of knowledge. Three fifths of these teachers think students should receive knowledge

passively from the teacher. This notion renders students inactive in the learning process. Thus, the teacher's primary responsibility is to train students in responding correctly and efficiently to directions. Many teachers have adopted this strategy because it is the principal way they were brought up in school.

The current investigation also revealed that the teaching methods employed by teachers lacked any worthwhile evident utilization of formative assessment strategies. The strategies in this case include the use of feedback, self- and peer-assessment, setting achievable goals etc. Moss and Brookhart (2019) identify 6 elements or activities that characterize a typical formative assessment class. These activities encompass shared learning objectives and success criteria, feedback that guides future learning, self-assessment and peer assessment by students, student goal setting, strategic questioning by teachers, and active student participation in asking pertinent questions.

When asked what formative assessment was, it is pertinent to note that the teachers offered an array of answers which largely showed a departure from the ideals in the above definition. Such responses placed the bulk of the responsibility of the assessment process on the teacher rather than on both teacher and student. Whatmore, the teachers' descriptions of what were supposedly formative assessment strategies further revealed their ignorance of the approach. Their responses include *research assessment, written tests, open book tests, workbooks, worksheets, class observation, listening to students, feedback from students* just to name a few.

The feedback strategy in the present study also confirmed the teachers' lack of practical awareness of the concept of formative assessment. Their thoughts about this stage of the research revealed their excitement about the capabilities inherent in a formative assessment approach despite that this strategy required greater efforts from teachers and students. Their rating of the impact of formative assessment on a scale of 1 – 10 ranged from 8-9 or 80 to 90% in terms of percentage. The significance of this realization lies in the awareness it raises on the need for immediate adjustments in terms of implementing a formative assessment approach to public primary schools.

Finally, the study highlighted the need for an assessment policy review in Nigeria. This move is necessary since teachers' beliefs and practices are shaped by policy contexts among other factors (Brown et al., 2019). Studies indicate that formative assessment is a beneficial practice that enhances mathematics learning for students across all ability levels (Martins et al., 2022). Interestingly, most of the teachers in the present study also saw a need for a policy review in this area.

A review of the assessment policy would require a robust framework for implementing formative assessment strategies, particularly in mathematics. Although the current policy mentions formative assessment, it lacks clear guidelines for implementation. A policy review could significantly impact Nigeria's assessment landscape. Decision-makers, including local school boards and head teachers, would need to implement these changes. Notably, teachers participating in the feedback strategy also advocated for a review of the assessment policy in Nigeria.

A potential limitation of this study lies in researcher bias stemming from the author's mathematics teaching background, which may affect the findings' validity and reliability. To address this, the researcher acknowledged the bias, utilized data triangulation, and participated in peer debriefing via regular Research Degree Committee meetings to mitigate these threats.

References

Abd Gani, N. I., Rathakrishnan, M., & Krishnasamy, H. N. (2020). A pilot test for establishing validity and reliability of qualitative interview in the blended learning English proficiency course. *Journal of Critical Reviews, 7*(5), 140–143.

Abejehu, S. B. (2016). The practice of continuous assessment in primary schools: The case of Chagni, Ethiopia. *Journal of Education and Practice, 7*(31), 24–30.

Abu Musa, M., & Islam, M. R. (2020). The problems that teachers face in applying formative assessment in the classroom. *International Journal of Scientific & Technology Research, 9*(1), 1–6.

Abuge, I. D. (2021). Learners' attitude and senior secondary school students' achievement in mathematics in Bayelsa State, Nigeria. *International Journal of Education, Learning and Development, 9*(10), 21–34.

Adaka, T. A., & Ugo, A. E. (2015). The extent of alternative assessment practices in inclusive classrooms among junior secondary school (JSS) teachers in Gombe LGA. *University of Jos Institutional Repository.* https://irepos.unijos.edu.ng/jspui/bitstream/123456789/1678/1/THE%20EXTENT%20OF%20ALTERNATIVE.pdf

Adediwura, A. A. (2012). Teachers' perception of school-based assessment in Nigerian secondary schools. *Mediterranean Journal of Social Sciences, 3*(1), 99–109.

Adesoji, F. A., & Yara, P. O. (2007). Some school environment factors as correlates of mathematics achievement in Southwestern Nigeria. *Journal of Educational Research, 5*(2), 132–140.

Adie, L. E., Willis, J., & van der Kleij, F. M. (2018). Diverse perspectives on student agency in classroom assessment. *The Australian Educational Researcher, 45*(1), 1–12. https://doi.org/10.1007/s13384-018-0262-2

Adom, D., Hussein, E. K., & Agyem, J. A. (2018). Theoretical and conceptual framework: Mandatory ingredients of quality research. *International Journal of Scientific Research, 7*(1), 438–441.

Aduloju, M. O., Adikwu, O., & Agi, C. I. (2016). School-based assessment: Implication for national development. *Open Access Library Journal, 3*, 1–8. https://doi.org/10.4236/oalib.1102391

Afemikhe, A., & Omo-Egbekuse, J. (2011). Classroom assessment in secondary schools in Nigeria. *Benin Journal of Educational Studies, 12*(1–2), 1–15.

Agarkar, S. C. (2019). Influence of learning theories on science education. *Resonance, 24*(8), 847–859. https://doi.org/10.1007/s12045-019-0853-9

Ahmad, S., Sultana, N., & Jamil, S. (2020). Behaviorism vs. constructivism: A paradigm shift from traditional to alternative assessment techniques. *Journal of Applied Linguistics and Language Research, 7*(2), 19–33.

Ahmedi, V. (2019). Teachers' attitudes and practices towards formative assessment in primary schools. *Journal of Social Studies Education Research, 10*(3), 161–175.

Ahn, J. N., Hu, D., & Vega, M. (2020). "Do as I do, not as I say": Using social learning theory to unpack the impact of role models on students' outcomes in education. *Social and Personality Psychology Compass, 14*(2), e12517. https://doi.org/10.1111/spc3.12517

Ajayi, H. O. (2019). Analysis of the pre-primary school children assessment procedure in Nigeria. *Asia-Pacific Journal of Research in Early Childhood Education, 13*(1), 1–18.

Ajayi, H. O., & Gbenga-Akanmu, T. O. (2018). Right assessment of children, right development in children: What schools should know. *Journal of Nursery and Primary Education Instructors in Nigeria, 1*, 27–34.

Ajayi, S. A. (2006). Christian missions and evolution of the culture of mass education in Western Nigeria. *Journal of Philosophy and Culture, 3*(2), 33–54.

Akomolafe, O. D. (2021). Sustaining a viable education system in Nigeria: The role of formative assessment and feedback. *[Journal title not specified], 10*(2), 39–43.

Akpınar, E., & Ergin, Ö. (2020). The role of science teachers in constructivist theory. *Elementary Education Online, 4*(2), 55–65.

Al-Shammari, Z. N., Faulkner, P. E., & Forlin, C. (2019). Theories-based inclusive education practices. *Education Quarterly Reviews, 2*(2), 287–295. https://doi.org/10.31014/aior.1993.02.02.64

Alsubaiai, H. S. (2021). Teachers' perception towards formative assessment in Saudi universities' context: A review of literature. *English Language Teaching, 14*(7), 107–116. https://doi.org/10.5539/elt.v14n7p107

Amua-Sekyi, E. T. (2016). Assessment, student learning and classroom practice: A review. *Journal of Education and Practice, 7*(21), 1–6.

Anderson, C., & Palm, T. (2018). Reasons for teachers' successful development of a formative assessment practice through professional development: A motivation perspective. *Assessment in Education: Principles, Policy & Practice, 25*(6), 576–597 https://doi.org/10.1080/0969594X.2018.1430685

Andrade, H. L. (2019). A critical review of research on student self-assessment. *Frontiers in Education, 4*, 87 https://doi.org/10.3389/feduc.2019.00087

Andrade, H., Buff, C., Terry, J., Erano, M., & Paolino, S. (2009). Assessment-driven improvements in middle school students' writing. *Middle School Journal, 40*(4), 4–12. https://doi.org/10.1080/00940771.2009.11461712

Aribisala, B. S., Dosunmu, O. A., Akanbi, M. A., & Shittu, I. O. (2018). Comparative analysis of university matriculation examination and post-university matriculation examination admission

models in Lagos State University. *Ethiopian Journal of Science and Technology, 11*(2), 129–143. https://doi.org/10.4314/ejst.v11i2.5

Assessment Reform Group. (1999). *Assessment for learning: Beyond the black box.* Qualifications and Curriculum Authority.

Ayua, G. A. (2012). Implication of continuous assessment in Nigerian education system. In Agogo (Ed.), *Continuous education assessment in Nigerian system* (pp. 144–155). Ibadan, Nigeria: Optimum Press.

Azis, A. (2012). Teachers' conceptions and use of assessment in student learning. *Indonesian Journal of Applied Linguistics, 2*(1), 40–52. https://doi.org/10.17509/ijal.v2i1.73

Azuka, B. F. (2014). Assessment in primary school mathematics classrooms in Nigeria. *International Journal of Education, Learning and Development, 2*(2), 50–58.

Bacquet, J. N. (2020). Implications of summative and formative assessment in Japan: A review of the current literature. *International Journal of Education and Literacy Studies, 8*(2), 28–35. https://doi.org/10.7575/aiac.ijels.v.8n.2p.28

Bandura, A., & Hall, P. (2018). Albert Bandura and social learning theory. In *Learning theories for early years practice* (p. 63). Sage. Barnes, J. (2007). *Cross-curricular learning 3–14.* Sage.

Bell, J. (2010). *Doing your research project: A guide for first-time researchers* (5th ed.). McGraw-Hill Education.

Bell, L., & Stevenson, H. (2006). *Education policy: Process, themes and impact.* Routledge.

Bell, R., Warren, V., & Schmidt, R. (2022). The application of concurrent or sequential mixed-methods research designs and their methodological implications: Investigating tacit knowledge, its use, and application in automotive development. *SAGE Open, 12*(2), 1–14. https://doi.org/10.1177/21582440221093364

Bhandari, P. (2023). *What is qualitative research? Methods & examples.* Scribbr. https://www.scribbr.com/methodology/qualitative-research/

Bhardwaj, V., Zhang, S., Tan, Y. Q., & Pandey, V. (2025). Redefining learning: Student-centered strategies for academic and personal growth. *Frontiers in Education, 10*, 1518602. https://doi.org/10.3389/feduc.2025.1518602

Bhat, B. A., & Bhat, G. J. (2019). Formative and summative evaluation techniques for improvement of learning process. *European Journal of Business & Social Sciences, 7*(5), 776–785.

Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2003). *Assessment for learning: Putting it into practice.* Open University Press.

Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education: Principles, Policy & Practice, 5*(1), 7–74. https://doi.org/10.1080/0969595980050102

Blonder, R. (2018). Student-curated exhibitions: Alternative assessment in chemistry education in Israel. In I. Eilks & A. Hofstein (Eds.), *International perspectives on chemistry education research and practice* (pp. 39–55). American Chemical Society. https://doi.org/10.1021/bk-2018-1280.ch003

Bouchrika, I. (2020, August 4). *How to write a research question: Types, steps, and examples.* Research.com. https://research.com/education/how-to-write-a-research-question

Brandmo, C., Panadero, E., & Hopfenbeck, T. N. (2020). Bridging classroom assessment and self-regulated learning. *Assessment in Education: Principles, Policy & Practice, 27*(4), 319–331. https://doi.org/10.1080/0969594X.2019.1666281

Broadbent, J., Panadero, E., & Boud, D. (2018). Implementing summative assessment with a formative flavour: A case study in a large class. *Assessment & Evaluation in Higher Education, 43*(2), 307–322. https://doi.org/10.1080/02602938.2017.1343455

Brookhart, S. M., & Nitko, A. J. (2019). *Educational assessment of students* (8th ed.). Pearson.

Buchholtz, N. F., Krosanke, N., Orschulik, A. B., & Vorhölter, K. (2018). Combining and integrating formative and summative assessment in mathematics teacher education. *ZDM – Mathematics Education, 50*(4), 715–728. https://doi.org/10.1007/s11858-018-0944-5

Burkhardt, H., & Schoenfeld, A. H. (2019). Formative assessment in mathematics. In H. L. Andrade & G. J. Cizek (Eds.), *Handbook of formative assessment in the disciplines* (pp. 35–67). Routledge.

Burnell, I. (2019). Widening participation for non-traditional students: Can using alternative assessment methods level the playing field in higher education? *Widening Participation and Lifelong Learning, 21*(3), 162–173. https://doi.org/10.5456/WPLL.21.3.162

Burtenshaw, R. (2023). *The deeply engrained behaviourist assessment ideologies constraining school mathematics.* Mathematics Education Research Group of Australasia. https://merga.net.au/Public/Publications/Annual_Conference_Proceedings

Busayo, I. O. (2010). Post-UME screening examination in Nigerian universities: The University of Education, Ikere-Ekiti (TUNEDIK) experience. *Library Philosophy and Practice, 352*, 1–25.

Buyukkarci, K., & Sahinkarakas, S. (2021). The impact of formative assessment on students' assessment preferences. *The Reading Matrix: An International Online Journal, 21*(1), 91–106.

Chappuis, S., & Stiggins, R. J. (2002). Classroom assessment for learning. *Educational Leadership, 60*(1), 40–44.

Cheng, L., DeLuca, C., Braund, H., & Yan, W. (2018). Grading policies in Canada and China: A comparative study. *Comparative and International Education, 47*(1), 1–18.

Cherry, K. (2019, July 8). *How social learning theory works.* Verywell Mind. https://www.verywellmind.com/social-learning-theory-2795074

Cherry, K. (2019, September 12). *What is operant conditioning and how does it work: How reinforcement and punishment modify behavior.* Verywell Mind. https://www.verywellmind.com/operant-conditioning-a2-2794863

Christou, C., & Pitta-Pantazi, D. (2021). Mathematics classroom assessment: A framework for designing assessment tasks and interpreting students' responses. *European Journal of Investigation in Health, Psychology and Education, 11*(3), 1088–1106. https://doi.org/10.3390/ejihpe11030100

Clements, J. (2021, May 20). *What are the benefits of using interviews in research?* MOS Transcription Company. https://www.mos-company.com/blog/benefits-of-using-interviews-in-research/

Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education* (5th ed.). Routledge.

Cong-Lem, N. (2019). Portfolios as learning and alternative-assessment tools in the EFL context: A review. *CALL-EJ, 20*(2), 165–180.

Connelly, L. M. (2013). Demographic data in research studies. *Medsurg Nursing, 22*(4), 269–271.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.

Creswell, J. W., & Plano Clark, V. L. (2011). Choosing a mixed methods design. In *Designing and conducting mixed methods research* (2nd ed., pp. 53–106). SAGE Publications.

Dado, M., Spence, J. R., & Elliot, J. (2023). The case of contradictions: How prolonged engagement, reflexive journaling, and observations can contradict qualitative methods. *International Journal of Qualitative Methods, 22*, 16094069231189372. https://doi.org/10.1177/16094069231189372

Daily Trust. (2021, March 5). Parents' preference boosts private school business in FCT. *Daily Trust.* https://dailytrust.com/parents-preference-boosts-private-school-business-in-fct/

Daneshfar, S., & Moharami, M. (2018). Dynamic assessment in Vygotsky's sociocultural theory: Origins and main concepts. *Journal of Language Teaching and Research, 9*(3), 600–607. https://doi.org/10.17507/jltr.0903.17

Danish, J. A., & Gresalfi, M. (2018). Cognitive and sociocultural perspectives on learning: Tensions and synergy in the learning sciences. In F. Fischer, C. E. Hmelo-Silver, S. R. Goldman, & P. Reimann (Eds.), *International handbook of the learning sciences* (pp. 34–43). Routledge.

Darling-Hammond, L., Schachner, A., & Edgerton, A. K. (2020). *Restarting and reinventing school: Learning in the time of COVID and beyond.* Learning Policy Institute. https://learningpolicyinstitute.org/product/restarting-reinventing-school-report

Dawadi, S. (2021). Thematic analysis approach: A step-by-step guide for ELT research practitioners. *Journal of NELTA, 25*(1–2), 62–71. https://doi.org/10.3126/nelta.v25i1-2.40902

Delandshere, G., & Jones, J. H. (1999). Elementary teachers' beliefs about assessment in mathematics: A case of assessment paralysis. *Journal of Curriculum and Supervision, 14*(3), 216–240.

Demosthenous, E., Christou, C., & Pitta-Pantazi, D. (2021). Mathematics classroom assessment: A framework for designing assessment tasks and interpreting students' responses. *European Journal of Investigation in Health, Psychology and Education, 11*(3), 1088–1106. https://doi.org/10.3390/ejihpe11030100

Denscombe, M. (2007). Communities of practice: A research paradigm for the mixed methods approach. *Journal of Mixed Methods Research, 2*(3), 270–283. https://doi.org/10.1177/1558689808316807

Devi, K. S. (2019). Constructivist approach to learning based on the concepts of Jean Piaget and Lev Vygotsky. *Indian Educational Review, 44*(4), 5–19. National Council of Educational Research and Training (NCERT).

Dökmecioğlu, B., Taş, Y., & Yerdelen, S. (2020). Predicting students' critical thinking dispositions in science through their perceptions of constructivist learning environments and metacognitive self-regulation strategies: A mediation analysis. *Educational Studies, 58*(4), 421–438. https://doi.org/10.1080/03055698.2020.1735672

Eisenberg, T. A. (1975). Behaviourism: The bane of school mathematics. *International Journal of Mathematical Education in Science and Technology, 6*(2), 163–171. https://doi.org/10.1080/0020739750060207

Ekong, A. H. (2012). Issues and challenges of mathematics education in Nigeria: The need for restructuring. In *Proceedings of the National Conference on Education, School of Education, Federal College of Education, Kano* (pp. 1–15). Nigerian Journal of Educational Publication of School of Education, FCE Kano.

Elmahdi, I., Al-Hattami, A., & Fawzi, H. (2018). Using technology for formative assessment to improve students' learning. *Turkish Online Journal of Educational Technology (TOJET), 17*(2), 182–188.

Elmore, R. F. (2019). The future of learning and the future of assessment. *ECNU Review of Education, 2*(3), 328–341. https://doi.org/10.1177/2096531119878962

Emler, T. E., Zhao, Y., Deng, J., Yin, D., & Wang, Y. (2019). Side effects of large-scale assessments in education. *ECNU Review of Education, 2*(3), 279–296. https://doi.org/10.1177/2096531119878964

Esere, M. O., & Idowu, A. I. (2013). *Continuous assessment practices in Nigerian schools: A review.* Ilorin, Nigeria: Indemac Publications.

Esomonu, N. P. M., Esomonu, M. N., & Eleje, L. I. (2020). Assessment big data in Nigeria: Identification, generation, and processing in the opinion of the experts. *International Journal*

of Evaluation and Research in Education, 9(2), 345–351. https://doi.org/10.11591/ijere.v9i2.20592

Ezewu, E. E., & Okoye, N. N. (1986). *Principles and practice of continuous assessment.* Ibadan, Nigeria: Evans Publishers.

Farrugia, P., Petrisor, B. A., Farrokhyar, F., & Bhandari, M. (2010). Research questions, hypotheses, and objectives. *Canadian Journal of Surgery, 53*(4), 278–281. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2912019/

Federal Government of Nigeria. (2014). *National policy on education* (6th ed.). Nigerian Educational Research and Development Council (NERDC) Press.

Federal Ministry of Education. (2023). *National digital learning policy* (Final Draft 2.0). https://education.gov.ng/national-digital-learning-policy

Fisher, M. J., & Marshall, A. P. (2009). Understanding descriptive statistics. *Australian Critical Care, 22*(2), 93–97. https://doi.org/10.1016/j.aucc.2008.11.003

French, S., Dickerson, A., & Mulder, R. A. (2023). A review of the benefits and drawbacks of high-stakes final examinations in higher education. *Higher Education, 88*(5), 893–918. https://doi.org/10.1007/s10734-023-00986-1

Fullan, M., Cuttress, C., & Kilcher, A. (2005). 8 forces for leaders of change. *National Staff Development Council, 26*(4), 54–64.

Gezer, T., Wang, C., Polly, A., Martin, C., Pugalee, D., & Lambert, R. (2021). The relationship between formative assessment and summative assessment in primary grade mathematics classrooms. *International Electronic Journal of Elementary Education, 13*(5), 673–685. https://doi.org/10.26822/iejee.2021.210

Goodburn, R., Higgins, S., Hartley, T., & Wall, K. (2010). *Learning to learn for life 3: Research and practical examples for secondary schools.* Bloomsbury Publishing.

Grady, M., Watkins, S., & Montalvo, G. (2012). The effect of constructivist mathematics on achievement in rural schools. *The Rural Educator, 33*(3), 37–46. https://doi.org/10.35608/ruraled.v33i3.417

Granberg, C., Palm, T., & Palmberg, B. (2021). A case study of a formative assessment practice and the effects on students' self-regulated learning. *Studies in Educational Evaluation, 68*, Article 100955. https://doi.org/10.1016/j.stueduc.2020.100955

Grant, C., & Osanloo, A. (2014). Understanding, selecting, and integrating a theoretical framework in dissertation research: Creating the blueprint for your "house." *Administrative Issues Journal: Connecting Education, Practice, and Research, 4*(2), 12–26. https://doi.org/10.5929/2014.4.2.9

Gunawan, J. (2015). Ensuring trustworthiness in qualitative research. *Belitung Nursing Journal, 1*(1), 10–11. https://doi.org/10.33546/bnj.4

Guskey, T. R. (2003). How classroom assessments improve learning. *Educational Leadership, 60*(5), 6–11.

Ha, C., & Lee, S. Y. (2019). Elementary teachers' beliefs and perspectives related to smart learning in South Korea. *Smart Learning Environments, 6*(1), 1–15. https://doi.org/10.1186/s40561-019-0100-7

Halinen, I. (2018). *The new educational curriculum in Finland.* In *Improving the quality of childhood in Europe* (Vol. 7). Alliance for Childhood. https://www.allianceforchildhood.eu/files/Improving_the_quality_of_Childhood_Vol_7/QOC%20V7%20CH06%20DEF%20WEB.pdf

Hampson, T., & McKinley, J. (2023). Problems posing as solutions: Criticising pragmatism as a paradigm for mixed research. *Research in Education*, *119*(3), 237–253. https://doi.org/10.1177/00345237231160085

Harrison, C. J., Könings, K. D., Schuwirth, L., Wass, V., & Van der Vleuten, C. (2015). Barriers to the uptake and use of feedback in the context of summative assessment. *Advances in Health Sciences Education*, *20*(1), 229–245. https://doi.org/10.1007/s10459-014-9524-6

Hartas, D. (2010). Quantitative research as a method of inquiry in education. In D. Hartas (Ed.), *Educational research and inquiry: Qualitative and quantitative approaches* (pp. 84–96). Continuum International Publishing Group.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, *77*(1), 81–112. https://doi.org/10.3102/003465430298487

Hendrickson, K. A. (2012). Assessment in Finland: A scholarly reflection on one country's use of formative, summative, and evaluative practices. *Mid-Western Educational Researcher*, *25*(1–2), 33–43.

Higgins, S., Hartley, T., Goodbourn, R., & Wall, K. (2010). *Learning to learn for life 3: Research and practical examples for secondary schools.* Continuum International Publishing Group.

Hollis, L. P. (2019). Lessons from Bandura's Bobo Doll experiments: Leadership's deliberate indifference exacerbates workplace bullying in higher education. *Journal for the Study of Postsecondary and Tertiary Education*, *4*, 85–102. https://doi.org/10.28945/4279

Hopfenbeck, T. N. (2018). Classroom assessment, pedagogy and learning—Twenty years after Black and Wiliam (1998). *Assessment in Education: Principles, Policy & Practice*, *25*(6), 545–550. https://doi.org/10.1080/0969594X.2018.1553695

Huang, R., & Jiang, L. (2021). Authentic assessment in Chinese secondary English classrooms: Teachers' perception and practice. *Educational Studies*, *47*(6), 633–646. https://doi.org/10.1080/03055698.2020.1749031

Igbokwe, C. O. (2015). Recent curriculum reforms at the basic education level in Nigeria aimed at catching them young to create change. *American Journal of Educational Research*, *3*(1), 31–37. https://doi.org/10.12691/education-3-1-7

IIEP-UNESCO. (2020). *Will we ever go back to normal when it comes to student assessments?* Education for Safety, Resilience and Social Cohesion. https://learningportal.iiep.unesco.org/en/blog/will-we-ever-go-back-to-normal-when-it-comes-to-student-assessments

Ilany, B. S., & Shmueli, N. (2021). "Three-stage" alternative assessment. *Creative Education*, *12*(7), 1702–1725. https://doi.org/10.4236/ce.2021.127130

Inayah, N., Komariah, E., & Nasir, A. (2019). The practice of authentic assessment in an EFL speaking classroom. *Studies in English Language and Education*, *6*(1), 152–162. https://doi.org/10.24815/siele.v6i1.12410

Iofciu, F., Miron, C., & Antohe, S. (2012). Constructivist approach of evaluation strategies in science education. *Procedia – Social and Behavioral Sciences*, *31*, 292–296. https://doi.org/10.1016/j.sbspro.2011.12.058

James, M. (2006). Assessment, teaching, and theories of learning. In J. Gardner (Ed.), *Assessment and learning* (1st ed., pp. 47–60). Sage.

Jensen, E. (2005). *Teaching with the brain in mind.* ASCD.

John, M. O., & Aliyu, U. (2024). The role of teacher training in enhancing educational outcomes in Nigeria. *Iconic Research and Engineering Journals*, *8*(5), 682–686.

Johnson, J. L., Adkins, D., & Chauvin, S. (2020). A review of the quality indicators of rigor in qualitative research. *American Journal of Pharmaceutical Education*, *84*(1), 7120. https://doi.org/10.5688/ajpe7120

Kerma, M., & Ouahmiche, G. (2018). Teachers' perceptions of classroom assessment practices in the Algerian primary school. *Traduction et Langues*, *17*(1), 124–137.

Kivunja, C., & Kuyini, A. B. (2017). Understanding and applying research paradigms in educational contexts. *International Journal of Higher Education*, *6*(5), 26–41. https://doi.org/10.5430/ijhe.v6n5p26

Korb, A. K. (2018). *An introduction to early childhood education.* Fab Anieh Nigeria Ltd.

Koutroubas, V., & Galanakis, M. (2022). Bandura's social learning theory and its importance in the organizational psychology context. *Psychology*, *13*(6), 315–322. https://doi.org/10.4236/psych.2022.136023

Lau, F. M., & Sou, G. (2018). Assessment for learning: Hong Kong needs territory-wide system assessment (TSA) or not. *Public Administration and Policy*, *21*(2), 134–143. https://doi.org/10.1108/PAP-06-2018-004

Lee, E., & Lee, S. (2009). Effects of instructional rubrics on class engagement behaviors and the achievement of lesson objectives by students with mild mental retardation and their typical peers. *Education and Training in Developmental Disabilities*, *44*(3), 396–408.

Lee, I., Mak, P., & Yuan, R. E. (2019). Assessment as learning in primary writing classrooms: An exploratory study. *Studies in Educational Evaluation*, *62*, 72–81. https://doi.org/10.1016/j.stueduc.2019.05.001

Leenknecht, M., Wijnia, L., Köhlen, M., Fryer, L., Rikers, R., & Loyens, S. (2021). Formative assessment as practice: The role of students' motivation. *Assessment & Evaluation in Higher Education*, *46*(2), 236–255. https://doi.org/10.1080/02602938.2020.1765228

Lessani, A., Md. Yunus, A. S., Abu Bakar, K., & Zahedi Khameneh, A. (2016). Comparison of learning theories in mathematics teaching methods. *Proceedings of the Fourth 21st CAF Conference*, *9*(1).

Light, D., & Pierson, E. (2013). A critical component of improving education in less-developed countries: Assessment for learning. *International Journal for Cross-Disciplinary Subjects in Education (IJCDSE)*, *4*(4), 1302–1309. https://doi.org/10.20533/ijcdse.2042.6364.2013.0183

Maarouf, H. (2019). Pragmatism as a supportive paradigm for the mixed research approach: Conceptualizing the ontological, epistemological, and axiological stances of pragmatism. *International Business Research*, *12*(9), 1–12. https://doi.org/10.5539/ibr.v12n9p1

Macaulay, T. A. (2021). *African cultural values and inter-communal relations: The case with Nigeria*.

MacBeath, J., & Dempster, N. (Eds.). (2008). *Connecting leadership and learning: Principles for practice.* Routledge.

Maeda, M. (2019). Exam cheating among Cambodian students: When, how, and why it happens. *Compare: A Journal of Comparative and International Education*, *49*(5), 825–841. https://doi.org/10.1080/03057925.2018.1423473

Manohar, N., MacMillan, F., Steiner, G. Z., & Arora, A. (2019). Recruitment of research participants: A review of challenges and strategies. *International Journal of Social Research Methodology*, *22*(6), 625–638. https://doi.org/10.1080/13645579.2019.1617230

Mardjuki, M. S. (2018). English teachers' perception on the use of authentic assessment in 2013 curriculum. *IJELTAL (Indonesian Journal of English Language Teaching and Applied Linguistics)*, *2*(2), 151–163. https://doi.org/10.21093/ijeltal.v2i2.57

Martin, C., Mraz, M., & Polly, D. (2022). Examining elementary school teachers' perceptions of and use of formative assessment in mathematics. *International Electronic Journal of Elementary Education*, *14*(3), 417–425. https://doi.org/10.26822/iejee.2022.248

Matilda, U. O., & Helen, A. O. (2019). Effect of formative classroom assessment on students' academic achievement in junior secondary school basic science in Egor Local Government Area of Edo State. *Journal of Education and Practice*, *10*(15), 184–189.

Mazana, M. Y., Montero, C. S., & Casmir, R. O. (2020). Assessing students' performance in mathematics in Tanzania: The teacher's perspective. *International Electronic Journal of Mathematics Education*, *15*(3), em0589. https://doi.org/10.29333/iejme/7994

McLeod, S. (2023a). Classical conditioning: How it works with examples. *Simply Psychology.* https://www.simplypsychology.org/classical-conditioning.html

McLeod, S. (2023b). Operant conditioning: What it is, how it works, and examples. *Simply Psychology.* https://www.simplypsychology.org/operant-conditioning.html

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Sage.

Mike, R. (2017). How to determine the sample size for your study. *Unstick.me.* https://unstick.me/determine-the-sample-size-study/

Modupe, A. V., & Sunday, O. M. (2015). Teachers' perception and implementation of continuous assessment practices in secondary schools in Ekiti State, Nigeria. *Journal of Education and Practice*, *6*(29), 17–20.

Mokhtar, K., & Ghania, O. (2018). Teachers' perceptions of classroom assessment practices in the Algerian primary school. *Revue de Traduction et Langues*, *17*(1), 124–137.

Monteiro, V., Mata, L., & Santos, N. N. (2021). Assessment conceptions and practices: Perspectives of primary school teachers and students. *Frontiers in Education*, *6*, 55. https://doi.org/10.3389/feduc.2021.639161

Moss, C. M., & Brookhart, S. M. (2019). *Advancing formative assessment in every classroom: A guide for instructional leaders* (2nd ed.). ASCD.

Muhajirah, M. (2020). Basic of learning theory: Behaviorism, cognitivism, constructivism, and humanism. *International Journal of Asian Education*, *1*(1), 37–42. https://doi.org/10.46966/ijae.v1i1.18

Murphy, S., & Ferrara, S. (2023). The future of educational assessment (pp. 3–14). *Cognia.*

Mushtaq, S., & Mash'hadi, A. F. (2021). Relationship between students' perception of assessment, their exam preparation strategies and their CGPA at university level. *Journal of Education and Educational Development*, *8*(1), 38–53. https://doi.org/10.22555/joeed.v8i1.4049

Ndubueze, M. O., Iyoke, J. O., Okoh, S. C., & Beatrice, N. A. (2015). Trends in educational evaluations in Nigeria: Issues and challenges. *Journal of Education and Practice*, *6*(21), 71–76. https://files.eric.ed.gov/fulltext/EJ1079144.pdf

Neuman, L. W. (2014). *Social research methods: Qualitative and quantitative approaches* (7th ed.). Pearson Education.

Newman, S. (2018). Vygotsky, Wittgenstein, and sociocultural theory. *Journal for the Theory of Social Behaviour*, *48*(3), 350–368. https://doi.org/10.1111/jtsb.12175

Ng'andu, S. K., Haambokoma, N. M., & Milingo, T. L. (2013). The contribution of behavioural theories of learning to education. *Journal of Education and Practice*, *4*(5), 115–121.

Nortvedt, G. A., & Buchholtz, N. (2018). Assessment in mathematics education: Responding to issues regarding methodology, policy, and equity. *ZDM – Mathematics Education*, *50*(4), 555–570. https://doi.org/10.1007/s11858-018-0931-9

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods*, *16*, 1–13. https://doi.org/10.1177/1609406917733847

Nweke, F. U. (2025). Paradigm shift in assessment: From summative assessment to formative assessment to ensure quality higher education and national development in Nigeria. *International Journal of Research Publication and Reviews*, *6*(5), 3528–3535.

Obilor, E. I. (2018). *Classroom assessment: Getting the right balance. International Journal of Innovative Psychology & Social Development, 6*(3). https://seahipaj.org/journals-ci/sept-2018/IJIPSD/full/IJIPSD-S-8-2018.pdf

Organisation for Economic Co-operation and Development (OECD). (2019). *OECD future of education and skills 2030: Conceptual learning framework – Concept note: Student agency for 2030.* OECD Publishing.

Ogange, B. O., Agak, J. O., Okelo, K. O., & Kiprotich, P. (2018). Student perceptions of the effectiveness of formative assessment in an online learning environment. *Open Praxis, 10*(1), 29–39. https://doi.org/10.5944/openpraxis.10.1.705

Okon, E. (2018). Teacher shortages and their impact on education quality in Nigeria. *African Journal of Teacher Education, 7*(2), 54–69.

Okunuga, R. O., Awofala, A. O. A., & Osarenren, U. (2020). Critical thinking acquisition of senior secondary school science students in Lagos State, Nigeria: A predictor of academic achievement. *Journal of Curriculum and Instruction, 13*(1), 44–56.

Olaoye, D. D., Olaoye, O. T., & Ayandele, J. K. (2021). Paradigm shift in educational assessment: Formative assessment as a pointer to educational reform in Nigeria school system. *Lafiagi Journal of Science, Technical and Vocational Education, 2*(1). e-ISSN 2705-2532.

Osadebe, P. U., & Abel, U. O. (2018). Assessment of teachers' implementation of continuous assessment in senior secondary schools in Delta Central Senatorial District. *Advances in Social Sciences Research Journal, 5*(7). https://doi.org/10.14738/assrj.57.4891

Ozan, C., & Kıncal, R. Y. (2018). The effects of formative assessment on academic achievement, attitudes toward the lesson, and self-regulation skills. *Educational Sciences: Theory & Practice, 18*(1), 85–118. https://doi.org/10.12738/estp.2018.1.0216

Pakpahan, F. H., & Saragih, M. (2022). Theory of cognitive development by Jean Piaget. *Journal of Applied Linguistics, 2*(2), 55–60.

Pathan, H., Memon, R. A., Memon, S., Khoso, A. R., & Bux, I. (2018). A critical review of Vygotsky's socio-cultural theory in second language acquisition. *International Journal of English Linguistics, 8*(4), 232–238. https://doi.org/10.5539/ijel.v8n4p232

Prakoso, B. H., Ramdani, Z., & Rahmah, B. (2021). Teacher's perception on Merdeka Belajar policy. *Indonesian Journal of Educational Assessment, 3*(2), 1–10.

Prashanti, E., & Ramnarayan, K. (2019). Ten maxims of formative assessment. *Advances in Physiology Education, 43*(2), 99–102. https://doi.org/10.1152/advan.00024.2019

Price, J. K., Pierson, E., & Light, D. (2011, March). *Using classroom assessment to promote 21st-century learning in emerging market countries.* Paper presented at Global Learn Asia Pacific, Melbourne, Australia.

Rababah, E. Q. (2021). From theory to practice: Constructivist learning practices among Jordanian kindergarten teachers. *Cypriot Journal of Educational Sciences, 16*(2), 612–626. https://doi.org/10.18844/cjes.v16i2.5693

Rahmatirad, M. (2020). A review of socio-cultural theory. *Siasat, 5*(3), 23–31. https://pdfs.semanticscholar.org/b3d4/faf5ef4f516100d4b0162d5a0060647c37bd.pdf

Raji, M. O., Daramola, D. S., & Oladele, J. I. (2020). Teachers' conceptions and choices of assessment tasks in a Nigerian postgraduate teacher training programme. *Asian Journal of Assessment in Teaching and Learning, 10*(2), 108–119. https://doi.org/10.37134/ajatel.vol10.2.9.2020

Rehman, I., Mahabadi, N., Sanvictores, T., & Rehman, C. I. (2023). Classical conditioning. In *StatPearls*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK470558/

Robson, C. (2011). *Real world research* (3rd ed.). John Wiley & Sons.

Rolfe, V. (2000). How do we assess mathematics in a constructivist way? *Teachers and Curriculum, 4*, 63–70. https://doi.org/10.15663/tandc.v4i1.602

Rose, J., & Johnson, C. W. (2020). Contextualizing reliability and validity in qualitative research: Toward more rigorous and trustworthy qualitative social science in leisure research. *Journal of Leisure Research, 51*(4), 432–451. https://doi.org/10.1080/00222216.2020.1722042

Santiago, P., Donaldson, G., & Herman, J. (2011). *OECD reviews of evaluation and assessment in education: Australia.* OECD Publishing. https://eric.ed.gov/?id=ED528253

Schildkamp, K., Van der Kleij, F. M., Heitink, M. C., Kippers, W. B., & Veldkamp, B. P. (2020). Formative assessment: A systematic review of critical teacher prerequisites for classroom practice. *International Journal of Educational Research, 103*, 101602. https://doi.org/10.1016/j.ijer.2020.101602

Schoch, K. (2020). Case study research. In *Research design and methods: An applied guide for the scholar-practitioner* (pp. 245–258). Sage.

Sewagegn, A. A. (2019). A study on the assessment methods and experiences of teachers at an Ethiopian university. *International Journal of Instruction, 12*(2), 605–622. https://files.eric.ed.gov/fulltext/EJ1211023.pdf

Shah, R. K. (2019). Effective constructivist teaching learning in the classroom. *Shanlax International Journal of Education, 7*(4), 1–13. https://doi.org/10.34293/education.v7i4.629

Shaheen, M., & Pradhan, S. (2019). Sampling in qualitative research. In *Qualitative techniques for workplace data analysis* (pp. 25–51). IGI Global. https://doi.org/10.4018/978-1-5225-7856-7.ch002

Sharanya, V. S. (2021). *Theories of teaching and learning.*

Shepard, L. A., Diaz-Bilello, E. K., Penuel, W. R., & Marion, S. F. (2020). *Classroom assessment principles to support teaching and learning.* Center for Assessment, Design, Research and Evaluation, University of Colorado Boulder.

Sia, C. J. L., & Lim, C. S. (2018). Cognitive diagnostic assessment: An alternative mode of assessment for learning. In K. L. Leong, & T. P. Liew (Eds.), *Classroom assessment in mathematics* (pp. 123–137). Springer. https://doi.org/10.1007/978-3-319-91155-2_8

Simobi, O. R., & Anikeze, C. O. (2019). Portfolio as a tool for assessing students' affective learning outcomes in economics in Ebonyi State secondary schools. *American Journal of Educational Research, 7*(5), 343–348. http://article.scieducationalresearch.com/pdf/education-7-5-1.pdf

Solso, D. (2009). *The effect of constructivist and traditional teaching methods on students' mathematical achievement* [Doctoral dissertation, Evergreen State College]. ProQuest Dissertations Publishing.

Stahl, N. A., & King, J. R. (2020). Expanding approaches for research: Understanding and using trustworthiness in qualitative research. *Journal of Developmental Education, 44*(1), 26–28.

Statista. (2021). *Number of primary school teachers in Nigeria by state 2022.* https://www.statista.com/statistics/1268542/number-of-primary-school-teachers-in-nigeria-by-state/

Steele, D. F. (2001). Using sociocultural theory to teach mathematics: A Vygotskian perspective. *School Science and Mathematics, 101*(8), 404–411.

Stiggins, R. (2007). Assessment through the student's eyes. *Educational Leadership, 64*(8), 22–26.

Suhendi, A. (2018). Constructivist learning theory: The contribution to foreign language learning and teaching. *KnE Social Sciences, 3*(4), 87–95. https://doi.org/10.18502/kss.v3i4.1921

Tabuena, A. C. (2019). Effectiveness of classroom assessment techniques in improving performance of students in music and piano. *Global Researchers Journal, 6*(1), 68–78.

Taneja, A. K. (2017). Study of theory of connectionism and its components/stages in the process of learning. *Universal Research Reports, 4*(2), 53–58.

Thomas, S. (2023). Assessment and evaluation of learning in a constructivist paradigm. *International Journal for Multidisciplinary Research, 5*(2).

Thomas, G., Martin, D., & Pleasants, K. (2011). Using self- and peer-assessment to enhance students' future learning in higher education. *Journal of University Teaching & Learning Practice, 8*(1), 1–19. https://doi.org/10.53761/1.8.1.4

Tutunaru, T. (2023). Improving assessment and feedback in the learning process: Directions and best practices. *Research and Education, 8*, 38–60. https://doi.org/10.51865/EJES.2023.8.38

Umar, A. T., & Majeed, A. (2018). The impact of assessment for learning on students' achievement in English for specific purposes: A case study of pre-medical students at Khartoum University, Sudan. *English Language Teaching, 11*(2), 15–25. https://doi.org/10.5539/elt.v11n2p15

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2020). *SDG 4: Education | Global Education Monitoring Report.* https://en.unesco.org/gem-report/sdg-goal-4

UNESCO International Institute for Educational Planning (IIEP). (n.d.). *Formative assessment.* UNESCO Learning Portal. https://learningportal.iiep.unesco.org/en/issue-briefs/improve-learning/assessment/formative-assessment

Van de Watering, G., Gijbels, D., Dochy, F., & Van der Rijt, J. (2008). Students' assessment preferences, perceptions of assessment, and their relationships to study results. *Higher Education, 56*(6), 645–658. https://doi.org/10.1007/s10734-008-9116-6

Vannak, H. (2012). The application of behaviourism in the classroom in primary and secondary schools. *Cambodian Journal of Education Studies, 4*(1), 1–10.

Vintere, A. (2018). A constructivist approach to the teaching of mathematics to boost competences needed for sustainable development. *Rural Sustainability Research, 39*(334), 1–7. https://doi.org/10.2478/plua-2018-0005

Vygotsky, L. S. (1978). *Mind in society: The development of higher mental processes* (E. Rice, Ed. & Trans.). Harvard University Press.

Wiggins, G. P., & McTighe, J. (2005). *Understanding by design* (Expanded 2nd ed.). ASCD.

Willis, J. (2009). Assessment for learning: A sociocultural approach. In *Proceedings of the Australian Association for Research in Education International Education Research Conference: Changing Climates: Education for Sustainable Futures* (pp. 1–10). Australian Association for Research in Education. https://www.aare.edu.au/data/publications/2009/wil08348.pdf

Wiyaka, W., Prastikawati, E. F., & Adi, A. P. K. (2020). Higher-order thinking skills (HOTS)-based formative assessment: A proposed model for language learning assessment. *Vision: Journal for Language and Foreign Language Learning, 9*(2), 115–130. https://doi.org/10.21580/vjv9i25169

Wragg, E. (1994). Conducting and analysing interviews. In N. Bennett, R. Catter, & R. Levacic (Eds.), *Improving educational management* (pp. 123–134). Paul Chapman Publishing.

Xiao, Y., & Yang, M. (2019). Formative assessment and self-regulated learning: How formative assessment supports students' self-regulation in English language learning. *System, 81*, 39–49. https://doi.org/10.1016/j.system.2019.01.004

Xu, F. (2019). Towards a rational constructivist theory of cognitive development. *Psychological Review, 126*(6), 841–864. https://doi.org/10.

Xu, Z., & Shi, Y. (2018). Application of constructivist theory in flipped classroom: Take college English teaching as a case study. *Theory and Practice in Language Studies, 8*(7), 880–887. https://doi.org/10.

Yan, Z., & Boud, D. (2021). Conceptualizing assessment-as-learning. In Z. Yan & D. Boud (Eds.), *Assessment as learning* (pp. 11–24). Routledge.

Yan, Z., Li, Z., Panadero, E., Yang, M., Yang, L., & Lao, H. (2021). A systematic review on factors influencing teachers' intentions and implementations regarding formative assessment. *Assessment in Education: Principles, Policy & Practice, 28*(3), 228–260. https://doi.org/10.1080/0969594X.2021.1892818

Yashim, A. U., & Jibrin, S. K. (2020). Continuous assessment in education: Problems and prospects. *Journal of Educational Assessment and Pedagogical Process (JEAPP), 1*(1), 1–10.

Yusron, E., & Sudiyatno, S. (2021). The impact of assessment for learning (AfL) on mathematics learning in elementary schools. *Jurnal Prima Edukasia, 9*(1), 75–84.

Yin, R. K. (2014). *Case study research: Design and methods* (5th ed.). Sage Publications.

Zaborek, P. (2009). Application of multiple case study method in doctoral dissertation: Selected methodological issues for doctoral students. *Social Sciences for Doctoral Students, 1*, 1–19.

Zain, D. I., Uno, H. B., & Salim, S. (2021). Modeling learning theory development: Social Bandura in learning for mathematics class V students at SDN 30 Paguyaman. *Journal NX, 7*(1), 376–381.

Appendix 1: Questionnaire

Research Question 1

Assessing the Effectiveness of The Assessment Practices of Primary School Mathematics Teachers in Abuja, Nigeria

This study assesses the effectiveness of the assessment practices of teachers in Nigerian schools. The anonymity of all participants in this survey is assured. The information provided in this survey will be treated confidentially. This survey is being conducted among the staff of Morgan Group of Schools (MGS).

Research Question 1: What are the views of primary school mathematics teachers about assessment practices?

Instructions

Please respond to each item as appropriate. Select only one answer per item.

The first research question examines how teachers view and use assessment practices (Questionnaire).

Demographics

1) I give my informed consent to participate in this research.
   - Yes
   - No
   - Not sure

2) Please state your gender.
   - Male
   - Female
   - Other
   - Prefer not to state

3) Please select a correct range for your years of teaching experience.
   - 1 – 3 years
   - 4 – 6 years
   - 7 years and above

4) Please state your actual age. _____

5) How long have you worked in your current school as a teacher? Please state your answer in weeks or months or years as appropriate. _____

6) Which one of these groups best describes the class(es) you teach?

- Primary
- Junior secondary
- Senior secondary
- All of the above

7) Do you have a teaching qualification yet (e.g. B.Ed., NCE, PGDE?)

- Yes
- No
- Not sure

8) Have you attended any training on assessment in the last 12 months?

- Yes
- No
- Not sure

9) Which of these qualifications best describes your highest educational qualification?

- PhD
- M.Sc.
- B.Sc./B.Ed.
- NCE

Views and uses of assessment

10) In your view, what is the most important meaning of an assessment?

- An event to measure learning
- A process to improve learning
- An event to test and rank students

11) The best form of assessment is a written test or exam.

- Yes
- No
- Not sure

12) Assessment should be teacher driven.

- Agree
- Disagree

- Not sure

13) Tests and exams are the only forms of assessment I use.

- Agree

- Disagree

- Not sure

14) Assessment outcomes should always go with a written or verbal feedback.

- Agree

- Disagree

- Not sure

15) I always use observation of students' disposition in class as an assessment tool.

- Agree

- Disagree

- Not sure

16) I usually provide written feedback for every assessment I give.

- Agree

- Disagree

- Not sure

17) I always allow my students to self- and peer assess.

- Agree

- Disagree

- Not sure

18) Students should only write final exams at the end of each school year.

- Agree

- Disagree

- Not sure

19) Students should write final exams at the end of each term.

- Agree

- Disagree

- Not sure

20) Assessment must not always be related to learning.

- Agree

- Disagree

- Not sure

21) Back at school, we were assessed mainly through graded written exams.

- Agree
- Disagree
- Not sure

22) Teachers' beliefs about teaching and learning can influence their view of assessment.

- Agree
- Disagree
- Not sure

23) Nigeria's policy on assessment (1st & 2nd CATs followed by terminal exams) should be retained.

- Agreed
- Disagree
- Not sure

24) Assessment is meaningless without grading.

- Agree
- Disagree
- Not sure

25) A teacher's work is to impart knowledge whereas the students should listen and learn from the teacher.

- Agree
- Disagree
- Not sure

Thank you for your time.

Appendix 2: Interviews

Research Questions 2 - 3

Assessing the Effectiveness of The Assessment Practices of Primary School Mathematics Teachers in Abuja, Nigeria

This study assesses the effectiveness of the assessment practices of teachers in Nigerian schools. The anonymity of all participants in this survey is assured. The information provided in this survey

will be treated confidentially. This survey is being conducted among the staff of Morgan Group of Schools (MGS).

Research Question 2: How effective are the existing assessment strategies teachers use, in improving students' learning and academic achievement in mathematics?

Based on the questionnaire data, the second research question considers how effective traditional assessment practices are with regards to improving students' learning and academic achievement.

Please, use only your low ability group students to respond to the questions.

1) Do you have lower ability learners in your class?
2) What yardstick qualifies these students as low ability learners?
3) When did you discover that these students are low ability learners?
4) What assessment or intervention strategies have you used to support them?
5) Did these strategies help, and to what extent have they improved learning on a scale of 1 - 10?
6) Having used the strategies above, would you say the low ability students recorded any notable improvement?

Research Question 3: What is the effect of formative assessment practices on learning outcomes in mathematics?

Based on the questionnaire data, the third research question focuses on determining the impact of formative assessment practices on learning outcomes in mathematics?

1) What is the main purpose of formative assessment?
2) Which formative assessment strategies have you used recently?
3) How effective was the 2-week feedback intervention strategy in helping to improve lower ability learners?
4) How would you rate your proficiency in the use of formative assessment?
5) Kindly rate the effectiveness of the feedback strategy on the learning outcomes of the lower ability students on a scale of 1 - 10
6) Can written feedback improve learning? How?
7) Is there a need to review the assessment policy in Nigeria?
8) Does our assessment system need overhaling or just improvement?
9) What do you understand by alternative assessment?

Thank you for your time.

Appendix 3: Sample of non-completed consent form

UNICAF UNIVERSITY

UU_IC - Version 2.1

Informed Consent Form

Part 2: Certificate of Consent

This section is mandatory and should to be signed by the participant(s)

Student's Name:

Student's E-mail Address:

Student ID #:

Supervisor's Name:

University Campus: Choose from the list

Program of Study:

Research Project Title:

I have read the foregoing information about this study, or it has been read to me. I have had the opportunity to ask questions and discuss about it. I have received satisfactory answers to all my questions and I have received enough information about this study. I understand that I am free to withdraw from this study at any time without giving a reason for withdrawing and without negative consequences. I consent to the use of multimedia (e.g. audio recordings, video recordings) for the purposes of my participation to this study. I understand that my data will remain anonymous and confidential, unless stated otherwise. I consent voluntarily to be a participant in this study.

Participant's Print name:

Participant's Signature:

Date:

If the Participant is illiterate:

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had an opportunity to ask questions. I confirm that the aforementioned individual has given consent freely.

Witness's Print name:

Witness's Signature:

Date:

2

Appendix 4: UREC Final Decision

UNIC AF UNIVERSITY

Unicaf University Research Ethics Committee Decision

Student's Name: Olufemi Olawale Folaponmile

Student's ID #: R1812D7056018

Supervisor's Name: Dr Chrispen Chiome

Program of Study: UUZ: EdD Doctoral of Education

Offer ID /Group ID: O45420G46329

Dissertation Stage: 3

Research Project Title: Assessing the Effectiveness of Assessment Practices in Nigerian Schools: A Case Study

Comments: No comments.

Decision*: A. Approved without revision or comments

Date: 21-Dec-2022

*Provisional approval provided at the Dissertation Stage 1, whereas the final approval is provided at the Dissertation stage 3. The student is allowed to proceed to data collection following the final approval.

Appendix 5: REAF

UNICAF UNIVERSITY

REAF_DS - Version 3.1 AP

UNICAF UNIVERSITY RESEARCH ETHICS APPLICATION FORM DOCTORAL STUDIES	UREC USE ONLY: Application No: Date Received:

Student's Name: Olufemi Olawale Folaponmile

Student's E-mail Address: folaponmile12@gmail.com

Student's ID #: R1812D7056018

Supervisor's Name: Dr Chrispen Chiome

University Campus: Unicaf University Zambia (UUZ)

Program of Study: UUZ: EdD Doctorate of Education

Research Project Title: Assessing the Effectiveness of Assessment Practices in Nigerian Schools: A Case Study

1. **Please state the timelines involved in the proposed research project:**

Estimated Start Date: 21-Nov-2022   Estimated End Date: 1-Jul-2023

2. **External Research Funding (if applicable):**

2.a. **Do you have any external funding for your research?**

☐ YES   ☑ NO

If YES, please answer questions **2b** and **2c**.

2.b. List any external (third party) sources of funding you plan to utilise for your project. You need to include full details on the source of funds (e.g. state, private or individual sponsor), any prior / existing or future relationships between the funding body / sponsor and any of the principal investigator(s) or co-investigator(s) or student researcher(s), status and timeline of the application and any conditions attached.

2.c. If there are any perceived ethical issues or potential conflicts of interest arising from applying or and receiving external funding for the proposed research then these need to be fully disclosed below and also further elaborated on, in the relevant sections on ethical considerations later on in this form.

3. The research project

3.a. Project Summary:

In this section fully describe the purpose and underlying rationale for the proposed research project. Ensure that you pose the research questions to be examined, state the hypotheses, and discuss the expected results of your research and their potential.

It is important in your description to use plain language so it can be understood by all members of the UREC, especially those who are not necessarily experts in the particular discipline. To that effect ensure that you fully explain / define any technical terms or discipline-specific terminology (use the space provided in the box).

Assessing the Effectiveness of Assessment Practices in Nigerian Schools: A Case Study, is a proposed dissertation topic which plans to evaluate the extent to which the assessment system in Nigerian schools is helpful. The research seeks to determine if there are gaps in the assessment practices in Nigerian schools and how such gaps can be filled. In addition, the research seeks to determine if teachers have misconceptions about assessment practices and proposes ways of filling these gaps or correcting such misunderstandings.

The proposed study is based on the following research problem and questions: Can assessment practices improve the quality of teaching and learning in schools in Nigeria? The research questions to be examined are
I. How do teachers view and use assessment practices? II. How do these views affect students learning and academic achievements? III How well could gaps in teachers' assessment practices be filled? IV. Should Nigerian schools consider alternative assessment methods? If so, why? In other words, if teachers leverage on the ideal understanding of how assessment practices work, the learning bar across schools is likely to be raised. This will in turn raise student academic achievement.

This study will include an intervention stage between Research Questions 2 and 3, which allows the participants to review their practices in light of findings from the research.

3.b. Significance of the Proposed Research Study and Potential Benefits:

Outline the potential significance and/or benefits of the research (use the space provided in the box).

Ultimately, the proposed research will improve the quality of learning and teaching in Nigerian Schools. The research will focus on assessment practices at the classroom level, but its overall aim is to help teachers to review how they prepare students for external examinations such as the West African School Certificate (WASC) exams, through their assessment practices. If the gaps and misconceptions in teachers' assessment views and practices are filled and corrected, teachers will do a better job in terms of assessing students and helping them to learn.

In specific terms, the research will address the following perceived problems:

I. Correct any misconceptions in teachers' views about assessment practices.
II. Close any gaps in the assessment practices in Nigerian schools.
III. Raise the learning bar, and ultimately the academic achievement level among students and pupils in Nigerian schools.

4. **Project execution:**

4.a. **The following study is an:**

- [✓] experimental study (primary research)
- [ ] desktop study (secondary research)
- [ ] desktop study using existing databases involving information of human/animal subjects
- [ ] Other

If you have chosen 'Other' please Explain:

4.b. Methods. The following study will involve the use of:

Method	Materials / Tools

Qualitative:
- ☑ Face to Face Interviews
- ☐ Phone Interviews
- ☐ Face to Face Focus Groups
- ☐ Online Focus Groups
- ☐ Other *

Quantitative:
- ☐ Face to Face Questionnaires
- ☑ Online Questionnaires
- ☐ Experiments
- ☐ Tests
- ☐ Other *

*If you have chosen 'Other' please Explain:

5. **Participants:**

   5 a. Does the Project involve the recruitment and participation of additional persons other than the researcher(s) themselves?

     ☑ YES   **If YES, please complete all following sections.**

     ☐ NO   **If NO, please directly proceed to Question 7.**

5 b. Relevant Details of the Participants of the Proposed Research

State the number of participants you plan to recruit, and explain in the box below how the total number was calculated.

Number of participants   60

It is planned that 60 participants will complete the questionnaire. 10 of the 60 participants will be further interviewed. All 60 participants can provide informed consent for themselves. Individuals who have a mental disability and are not in a position to provide their own consent will not participate in the study.

Describe important characteristics such as: demographics (e.g. age, gender, location, affiliation, level of fitness, intellectual ability etc). It is also important that you specify any inclusion and exclusion criteria that will be applied (e.g. eligibility criteria for participants).

Age range   From   25   To   60

Gender   ✓ Female
             ✓ Male

Eligibility Criteria:

- Inclusion criteria   The participants are teachers working at Morgan Group of Schools and who teach children in classes leading up to one external exam or another. These include teachers who teach upper primary and secondary classes only.

- Exclusion criteria   Teachers in lower primary or nursery are excluded from the research.

Disabilities   None of the proposed participants is living with any visible disability.

Other relevant information (use the space provided in the box):

UNICAF
UNIVERSITY

5 c. Participation & Research setting:

Clearly describe which group of participants is completing/participating in the material(s)/ tool(s) described in 5b above (use the space provided in the box).

It is planned that 60 participants who are teachers working with children from Years 4 - 6 (Upper Primary school), and Years 7 - 12 (Secondary school) will complete the questionnaire. 10 of these same participants who teach children in Years 10 - 12 will be further interviewed to provide generate data for Research Questions 2 and 3.

5 d. Recruitment Process for Human Research Participants:

Clearly describe how the potential participants will be identified, approached and recruited (use the space provided in the box).

The potential participants will be drawn from teachers at Morgan Group (MGS) of Schools. MGS is a public school based in Abuja and which has both primary and secondary school levels. The school uses the Nigerian curriculum and has over 500 learners and 110 teachers. For teachers, samples will be taken from those who teach students in Upper Primary, Junior and Senior Secondary Sections respectively. This is because students in this group are already being prepared for one external exam or another. In addition, these teachers would have a minimum teaching experience of two years. This is to ensure they have at least 2 years of school-based assessment experience. MGS is being considered because of the following reasons: i) proximity to the researcher ii) ease of gaining research approval iii) easier access to school and participants. Recruitment will be done by the researcher by writing the school

5 e. Research Participants Informed Consent.

Select below which categories of participants will participate in the study. Complete the relevant Informed Consent form and submit it along with the REAF form.

Yes	No	Categories of participants	Form to be completed
✓	☐	Typically Developing population(s) above the maturity age *	Informed Consent Form
☐	✓	Typically Developing population(s) under the maturity age *	Guardian Informed Consent Form

* Maturity age is defined by national regulations in laws of the country in which the research is being conducted.

5 f. **Relationship between the principal investigator and participants.**

Is there any relationship between the principal investigator (student), co-investigators(s), (supervisor) and participant(s)? For example, if you are conducting research in a school environment on students in your classroom (e.g. instructor-student).

☐ YES   ☑ NO

If YES, specify (use the space provided in the box).

6. **Potential Risks of the Proposed Research Study.**

6 a. i. Are there any potential risks, psychological harm and/or ethical issues associated with the proposed research study, other than risks pertaining to everyday life events (such as the risk of an accident when travelling to a remote location for data collection)?

☐ YES   ☑ NO

If YES, specify below and answer the question 6 a.ii.

6 a.ii Provide information on what measures will be taken in order to exclude or minimise risks described in 6.a.i.

Not applicable

6 b. Choose the appropriate option

		Yes	No
i.	Will you obtain written informed consent form from all participants?	✓	☐
ii.	Does the research involve as participants, people whose ability to give free and informed consent is in question?	☐	✓
iii.	Does this research involve participants who are children under maturity age? **If you answered YES to question iii, complete all following questions.** **If you answered NO to question iii, do not answer Questions iv, v, vi and proceed to Questions vii, viii, ix and x.**	☐	✓
iv.	Will the research tools be implemented in a professional educational setting in the presence of other adults (i.e. classroom in the presence of a teacher)?	☐	☐
v.	Will informed consent be obtained from the legal guardians (i.e. parents) of children?	☐	☐
vi.	Will verbal assent be obtained from children?	☐	☐
vii.	Will all data be treated as confidential? If NO, explain why confidentiality of the collected data is not appropriate for this proposed research project, providing details of how all participants will be informed of the fact that any data which they will provide will not be confidential.	✓	☐
viii.	Will all participants /data collected be anonymous? If NO, explain why and describe the procedures to be used to ensure the anonymity of participants and/or confidentiality of the collected data both during the conduct of the research and in the subsequent release of its findings.	✓	☐

		Yes	No
ix.	Have you ensured that personal data and research data collected from participants will be securely stored for five years?	✓	
x.	Does this research involve the deception of participants? If YES, describe the nature and extent of the deception involved. Explain how and when the deception will be revealed, and who will administer this debrief to the participants:		✓

6 c. i. Are there any other ethical issues associated with the proposed research study that are not already adequately covered in the preceding sections?

☐ Yes   ✓ No

If YES, specify (maximum 150 words).

6.c.ii Provide information on what measures will be taken in order to exclude or minimise ethical issues described in 6.c.i.

Not applicable

6 d. Indicate the Risk Rating.

☐ High   ☐ Low

Olufemi Olawale Folaponmile   R1812D705601   9

7. **Further Approvals**

Are there any other approvals required (in addition to ethics clearance from UREC) in order to carry out the proposed research study?

☑ YES   ☐ NO

If YES, specify (maximum 100 words).

> Although the research will be carried out on another campus of Morgan Group of Schools, the student has no direct relationship with the staff on this campus. Therefore, a letter seeking approval to do the research in this campus will be written to the school through the School Principal. Furthermore, the student will request the school management to select teachers who will participate in the research if necessary. This will

8. **Application Checklist**

Mark √ if the study involves any of the following:

☐ Children and young people under 18 years of age, vulnerable population such as children with special educational needs (SEN), racial or ethnic minorities, socioeconomically disadvantaged, pregnant women, elderly, malnourished people, and ill people.

☐ Research that foresees risks and disadvantages that would affect any participant of the study such as anxiety, stress, pain or physical discomfort, harm risk (which is more than is expected from everyday life) or any other act that participants might believe is detrimental to their wellbeing and / or has the potential to / will infringe on their human rights / fundamental rights.

☐ Risk to the well-being and personal safety of the researcher.

☐ Administration of any substance (food / drink / chemicals / pharmaceuticals / supplements / chemical agent or vaccines or other substances (including vitamins or food substances) to human participants.

☐ Results that may have an adverse impact on the natural or built environment.

9. **Further documents**

Check that the following documents are attached to your application:

		ATTACHED	NOT APPLICABLE
1	Recruitment advertisement (if any)	☐	☑
2	Informed Consent Form / Guardian Informed Consent Form	☑	☐
3	Research Tool(s)	☑	☐
4	Gatekeeper Letter	☑	☐
5	Any other approvals required in order to carry out the proposed research study, e.g., institutional permission (e.g. school principal or company director) or approval from a local ethics or professional regulatory body.	☐	☑

10. **Final Declaration by Applicants:**

(a) I declare that this application is submitted on the basis that the information it contains is confidential and will only be used by Unicaf University for the explicit purpose of ethical review and monitoring of the conduct of the research proposed project as described in the preceding pages.

(b) I understand that this information will not be used for any other purpose without my prior consent, excluding use intended to satisfy reporting requirements to relevant regulatory bodies.

(c) The information in this form, together with any accompanying information, is complete and correct to the best of my knowledge and belief and I take full responsibility for it.

(d) I undertake to abide by the highest possible international ethical standards governing the Code of Practice for Research Involving Human Participants, as published by the UN WHO Research Ethics Review Committee (ERC) on http://www.who.int/ethics/research/en/ and to which Unicaf University aspires to.

(e) In addition to respect any and all relevant professional bodies' codes of conduct and/or ethical guidelines, where applicable, while in pursuit of this research project.

> ✓ **I agree with all points listed under Question 10**

Student's Name: Olufemi Olawale Folaponmile

Supervisor's Name: Dr Chrispen Chiome

Date of Application: 20-Dec-2022

Important Note:
Save your completed form (we suggest you also print a copy for your records) and then submit it to your UU Dissertation/project supervisor (tutor). **In the case of student projects, the responsibility lies with the Faculty Dissertation/Project Supervisor.** If this is a student application, then it should be submitted via the relevant link in the VLE. Please submit only electronically filled in copies; **do not** hand fill and submit scanned paper copies of this application.

Appendix 6: Gatekeeper letter

UNICAF

UU_GL - Version 2.0

Gatekeeper letter

Address:

Date: 09-Jan-2023

Subject: REQUEST TO CARRY OUT SURVEY/INTERVIEWS

Dear Head Teacher,

I am a doctoral student at Unicaf University, Zambia. As part of my degree I am carrying out a study on EVALUATING THE EFFECTIVENESS OF THE ASSESSMENT PRACTICES OF PRIMARY SCHOOL MATHEMATICS TEACHERS IN ABUJA, NIGERIA.

I am writing to seek approval to let me carry out a survey, and also interview your mathematics teachers in Years 2 - 6 in the course of this research. An intervention stage involving the analysis of pupils mathematics exercise books will also be carried out if necessary.

Based on the approval by the Unicaf Research Ethics Committee (UREC), this study will include data collection, analysis and interpretation.

EVALUATING THE EFFECTIVENESS OF THE ASSESSMENT PRACTICES OF PRIMARY SCHOOL MATHEMATICS TEACHERS IN ABUJA, NIGERIA is a proposed dissertation topic which plans to evaluate how effective the assessment practices of mathematics teachers in Nigerian schools are. 121 teachers will complete the questionnaires while 11 out these teachers will also be interviewed. The estimated timeframe for the data collection is about 3 - 5 weeks.

My supervisor's name is Professor Chrispen Chiome.

Thank you in advance for your time and for your consideration of this project. Kindly please let me know if you require any further information or need any further clarifications.

Yours Sincerely,

Olufemi Folaponmile

Student's Name: Olufemi Folaponmile
Student's E-mail: folaponmile12@gmail.com
Student's Address and Telephone: 6 Mercy Street, G/Gora Kaduna. +2348065535460
Supervisor's Title and Name: Professor Chrispen Chiome
Supervisor's Position: Professor of Educational Leadership and Policy; Faculty member, UNICAF Universi
Supervisor's E-mail: c.chiome@unicaf.org

Appendix 7: Informed Consent

UNICAF UNIVERSITY

UU_IC – Version 2.1

| **Informed Consent Form** |
| **Part 2: Certificate of Consent** |

This section is mandatory and should to be signed by the participant(s)

Student's Name: Olufemi Folaponmile

Student's E-mail Address: folaponmile12@gmail.com

Student ID #: R1812D7056018

Supervisor's Name: Professor Chrispen Chiome

University Campus: Unicaf University Zambia (UUZ)

Program of Study: UUM: EdD - Doctorate of Education

Research Project Title: Assessing the Effectiveness of Assessment Practices in Nigerian Schools: A Case Study

I have read the foregoing information about this study, or it has been read to me. I have had the opportunity to ask questions and discuss about it. I have received satisfactory answers to all my questions and I have received enough information about this study. I understand that I am free to withdraw from this study at any time without giving a reason for withdrawing and without negative consequences. I consent to the use of multimedia (e.g. audio recordings, video recordings) for the purposes of my participation to this study. I understand that my data will remain anonymous and confidential, unless stated otherwise. I consent voluntarily to be a participant in this study.

Participant's Print name: Boyo Martins

Participant's Signature: _(signature)_

Date: 16/1/23

If the Participant is illiterate:

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had an opportunity to ask questions. I confirm that the aforementioned individual has given consent freely.

Witness's Print name:

Witness's Signature:

Date:

Appendix 8: Gatekeeper Approval

UNICAF

Gatekeeper letter

Address: LEA Primary School, Apo Resettlement

Date: 09-Jan-2023

Subject: REQUEST TO CARRY OUT SURVEY/INTERVIEWS

Dear Head Teacher,

I am a doctoral student at Unicaf University, Zambia. As part of my degree I am carrying out a study on EVALUATING THE EFFECTIVENESS OF THE ASSESSMENT PRACTICES OF PRIMARY SCHOOL MATHEMATICS TEACHERS IN ABUJA, NIGERIA.

I am writing to seek approval to let me carry out a survey, and also interview your mathematics teachers in Years 2 - 6 in the course of this research. An intervention stage involving the analysis of pupils mathematics exercise books will also be carried out if necessary.

Based on the approval by the Unicaf Research Ethics Committee (UREC), this study will include data collection, analysis and interpretation.

EVALUATING THE EFFECTIVENESS OF THE ASSESSMENT PRACTICES OF PRIMARY SCHOOL MATHEMATICS TEACHERS IN ABUJA, NIGERIA is a proposed dissertation topic which plans to evaluate how effective the assessment practices of mathematics teachers in Nigerian schools are. 121 teachers will complete the questionnaires while 11 out these teachers will also be interviewed. The estimated timeframe for the data collection is about 3 - 5 weeks.

My supervisor's name is Professor Chrispen Chiome.

Thank you in advance for your time and for your consideration of this project. Kindly please let me know if you require any further information or need any further clarifications.

Yours Sincerely,

Olufemi Folaponmile

APPROVED
School Name... LEA Apo Primary School
Sign...
Date... 12th Jan

Student's Name: Olufemi Folaponmile
Student's E-mail: folaponmile12@gmail.com
Student's Address and Telephone: 6 Mercy Street, G/Gora Kaduna. +2348065535460
Supervisor's Title and Name: Professor Chrispen Chiome
Supervisor's Position: Professor of Educational Leadership and Policy; Faculty member, UNICAF Univers
Supervisor's E-mail: c.chiome@unicaf.org