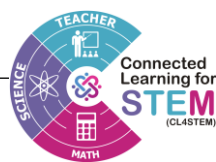# SITUATION ANALYSIS - NIGERIA

Ibrahim Babangida University, Lapai
Niger State, Nigeria

The Connected Learning for Science, Technology, Engineering, and Mathematics (CL4STEM) project aims to pilot an innovation and research its effectiveness and potential scaling for building capacities of secondary school teachers in Science and Maths for fostering higher-order thinking with inclusion and equity in their classrooms. The CL4STEM pilot engages teachers in curated OERs based modules in Science and Maths and participation in online communities of practice. It is a South-South collaboration among higher education institutions to adapt and pilot the Connected Learning Initiative (CLIx, https://clix.tiss.edu) in Tanzania, Nigeria, and Bhutan. CLIx has been successfully implemented at scale in India.

The associated research studies focus on two broad areas. First, the Impact Study, analyses the impact of innovation on teachers knowledge, attitudes, and practice for higher-order teaching and learning of science and maths in an inclusive and equitable manner. Second, the Innovation Diffusion Study, generates knowledge on the processes of adoption of the innovation for specific local contexts and the conditions that support scaling.

Knowledge generated from this project would be disseminated to stakeholders in federal/provincial ministries of education and relevant regulatory and professional bodies to seed it into the policy agenda of these countries. Further, key insights from this project would be shared with other researchers and opinion leaders in the spirit of creating global public goods.

This study is funded by IDRC under the Global Partnership for Education Knowledge and Innovation Exchange (https://www.gpekix.org). Centre for Applied Sciences and Technology Research, Ibrahim Badamasi Babangida University, Lapai, Nigeria, is the lead of the CL4STEM project consortium which includes Samtse College of Education, Bhutan and Open University of Tanzania as the country partners. Tata Institute of Social Sciences, India is the technical consultant to the project.

Report is available for download at https://www.connectedlearningforstem.org/
Any questions, suggestions or queries may be sent to us at: info.cl4stem@clixindia.org

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List of Abbreviations

ABU	Ahmadu Bello University
B.A.	Bachelor of Arts
BEC	Basic Education Certificate
BMAS	Benchmark Minimum Academic Standards
CASTER	Centre for Applied Sciences and Technology Research
CETE	Centre of Excellence in Teacher Education
CK	Content Knowledge
CL4STEM	Connected Learning for Science, Technology, Engineering, and Mathematics
CLIx	Connected Learning Initiative
COVID	Corona Virus Disease
CPD	Continuous Professional Development
ECCDE	Early Childhood Care Development and Education
FCT	Federal Capital Territory
FGN	Federal Government of Nigeria
FME	Federal Ministry of Education
FMOE	Federal Ministry of Education
FRN	Federal Republic of Nigeria
GPE	Global Partnership for Education
HOD	Heads of Department
IBB	Ibrahim Badamasi Babangida
IBBUL	Ibrahim Badamasi Babangida University, Lapai
ICT	Information and Communication Technology
IDP	Internally Displaced Persons
IDRC	International Development Research Centre
ISTE	In-Service Teacher Education
IT	Information Technology
ITE	Initial Teacher Education
JSS	Junior Secondary School
KAP	Knowledge, Attitudes, and Practice

KERD	Kano Educational Resource Department
KIX	Knowledge and Innovation Exchange
KSSSMB	Kano State Secondary Schools Management Board
KSTSB	Kano Science and Technical Schools Board
LGEA	Local Government Education Authority
MAN	Mathematics Association of Nigeria
MLA	Monitoring Learning Achievement
MOE	Ministry of Education
MTN	Mobile Telephone Network
NCC	Nigerian Communications Commission
NCCE	National Commission for Colleges of Education
NCE	National Certificate in Education
NDA	Nigerian Defense Academy
NEDS	Nigeria Education Data Survey
NECO	National Examination Council
NERDC	National Education Research and Development Council
NITDA	Nigeria Information Technology Development Agency
NPE	National Policy on Education
NQT	Newly Qualified Teacher
NSEMTSS	Niger State Education Medium-Term Sector Strategy
NTI	National Teachers' Institute
NUC	National Universities Commission
OER	Open Education Resources
OUT	Open University of Tanzania
PCK	Pedagogical Content Knowledge
PK	Pedagogical Knowledge
PTA	Parent Teacher Association
SAME	State Agency for Mass Education
SCE	Samtse College of Education
SME	States Ministry of Education
SSC	Senior Secondary Certificate
SSS	Senior Secondary School
STAN	Science Teachers' Association of Nigeria
STEM	Science, Technology, Engineering, and Mathematics

STM	Science, Technology, and Mathematics
STSB	Science and Technical Schools Board
SUBEB	State Universal Basic Education Board
TISS	Tata Institute of Social Sciences
TPACK	Technological Pedagogic and Content Knowledge
TRCN	Teacher Registration Council of Nigeria
TSE	Technical and Science Education
UBE	Universal Basic Education
UBEC	Universal Basic Education Programme
UNESCO	United Nations Education, Science and Culture Organization
UNICEF	United Nations Children's Fund
WAEC	West Africa Examination Council
WASSCE	West African Senior School Certificate Examination

1. Introduction

This document provides country-specific background information to plan, design, and execute the activities of the Connected Learning for STEM (CL4STEM) pilot in Nigeria. This report is collated from secondary literature and through key informant interviews with education functionaries. Participant information was collected through a survey of participating districts, secondary schools, and teachers in the country.

1.1   About CL4STEM

CL4STEM aims to pilot an innovation and research its effectiveness and potential scaling for building the capacities of newly qualified teachers (NQTs) of middle and secondary school in science and mathematics and for fostering higher-order learning in their classrooms inclusively and equitably. It is a South-South collaboration among higher education institutions to adapt and pilot the Connected Learning Initiative (CLIx) (https://clix.tiss.edu), which is already developed and scaled in India, to new contexts in Bhutan, Nigeria, and Tanzania.
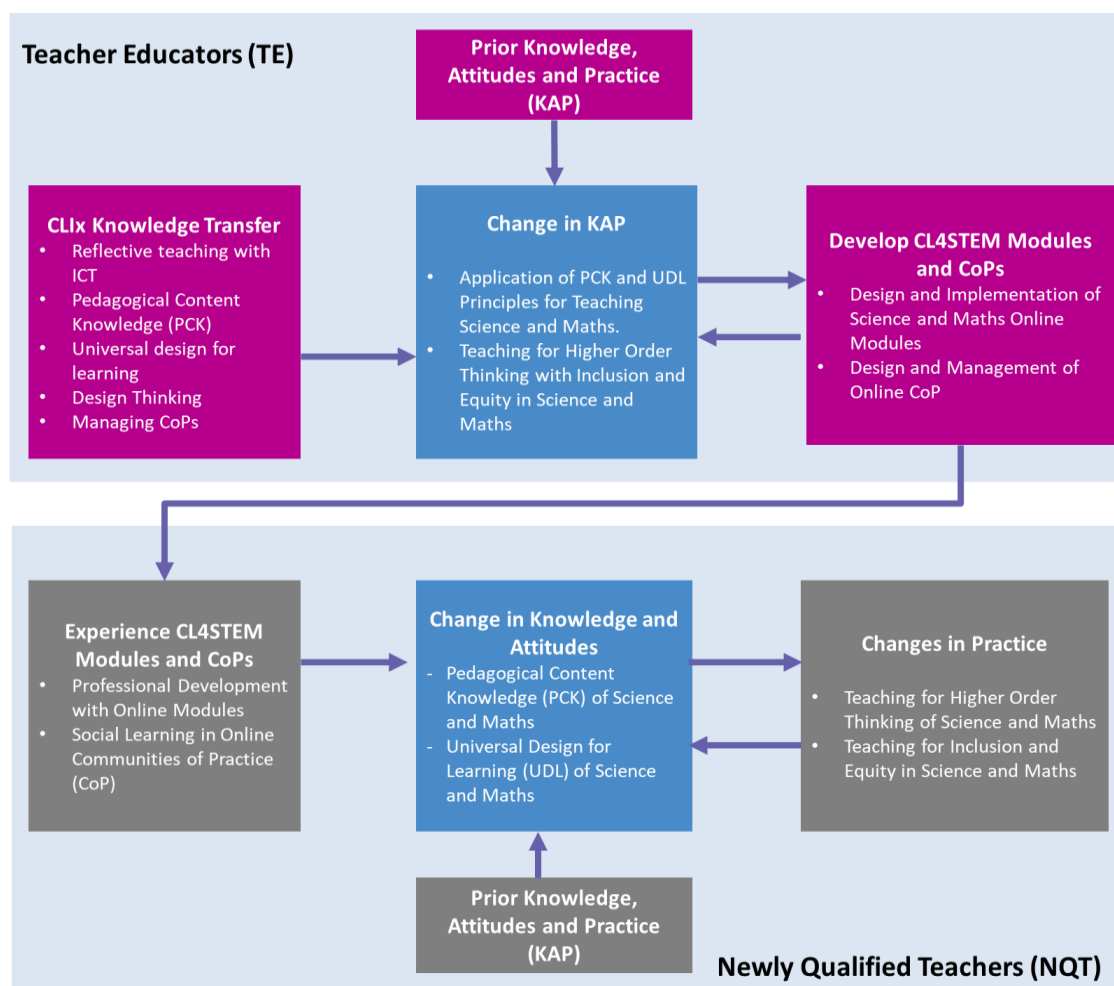

Figure 1.1: Theory of Change

The pilot involves the building of teachers' professional capacities through their engagement with curated modules based on Open Education Resources (OER) and through their participation in online communities of practice. It also involves a knowledge transfer of CLIx to teacher educators in partner institutions to build their capabilities to design and curate OERs and to design and manage online communities of practice.

The associated research studies focus on two broad areas. First, the Impact Study, analyses the impact of innovation on teachers Knowledge, Attitudes, and Practice for higher-order teaching and learning of science and maths inclusively and equitably. Second, the Innovation Diffusion Study, generates knowledge on the processes of adoption of the innovation for specific local contexts and the conditions that support scaling.

Knowledge generated from this project would be disseminated to stakeholders in federal/provincial ministries of education and relevant regulatory and professional bodies to seed it into the policy agenda of these countries. Further, key insights from this project would be shared with other researchers and opinion leaders in the spirit of creating global public goods.

1.2   Project Partners

The present study is funded by the International Development Research Centre (IDRC) under the Global Partnership for Education Knowledge and Innovation Exchange (GPE-KIX). Centre for Applied Sciences and Technology Research (CASTER), Ibrahim Badamasi Babangida University, Lapai (IBBUL), Nigeria is the lead of the CL4STEM project consortium, which includes Samtse College of Education, Bhutan (SCE) and Open University, Tanzania (OUT) as country partners; and the Tata Institute of Social Sciences, India (TISS) as the technical consultant.

The Ibrahim Badamasi Babangida University Lapai (ibbu.edu.ng) is registered and accredited higher education institution with a mandate to train teacher educators, student-teachers, and in-service teachers within and outside Nigeria. IBBUL is involved with the process of Vision 2020 policy on education and collaborates with the state government viz. the State Ministry of Education (SMOEs), Science and Technical School Boards, Secondary Education Boards, Education Resource Centre, and Teachers' Registration Council of Nigeria.

Samtse College of Education, Royal University of Bhutan (www.sce.edu.bt) is the only teacher education college that trains teachers for secondary schools in the Bhutanese education system. SCE plays a strategic role in building quality STEM teachers (including ICT-enabled approaches) that are academically sound and professionally competent enough to prepare the younger generation of Bhutanese children to brace the challenges of the 21st century.

The Open University of Tanzania (OUT) (www.out.ac.tz) is an autonomous and accredited public University, which offers certificate, diploma, and undergraduate and postgraduate degree programs through open and distance learning in Tanzania. OUT is the key site for the delivery of ICT based pre and in-service teacher education in Tanzania and has an extended mandate through the UNESCO Chair on teacher education and curriculum. OUT has existing relationships with key stakeholders in the teacher education space in Tanzania, such as the Tanzania Institute of Education that develops and oversees curricula and learning materials for secondary schools, other teachers' training institutions,

and the two ministries of the central and local government that deal with education at secondary school level.

Tata Institute of Social Sciences, Mumbai, India (www.tiss.edu) is among South Asia's premier research and teaching universities in social sciences. The Centre of Excellence in Teacher Education (CETE), an Independent Centre on the TISS Mumbai Campus, engages in teaching, research, and field action, and it has multidisciplinary expertise in the use of ICT in Education for quality reform at scale. CETE was awarded the UNESCO King Hamad Prize for Excellence for using ICTs in education in 2018 for its flagship 'Connected learning initiative'.

The leadership team for the CL4STEM project is as follows:

- Principal Investigator: Prof. Nuhu George Obaje, IBBUL
- Principal Technical Consultant: Prof. Padma Sarangapani, TISS
- Lead Investigator – Bhutan: Prof. Rinchen Dorji, SCE
- Lead Investigator – Tanzania: Dr Edephonce Nfuka, OUT
- Lead Technical Consultant – Knowledge Transfer: Prof. Mythili Ramchand, TISS
- Lead Technical Consultant – Innovation Diffusion Study: Dr Vikas Maniar, TISS
- Nodal Officer: Mr. Abdullahi Abubakar Kawu, IBBUL
- Advisor: Prof. Steve Nwokeocha, IBBUL.

1.3 Importance Of CL4STEM In Nigeria

Science and technology have been identified as the key drivers for growth and sustainable socio-economic and industrial development and transformation of any nation (Uza, 2013; Olawuwo, 2019). Therefore, the introduction of Science, Technology and Mathematics (STM) subjects into the school curriculum hold the keys to achieving science and technology literacy to produce individuals with desirable skills and competencies required for scientific, technological, and overall national development (FRN, 2004; Mustapha, 2009). Successive Nigerian governments at national and state levels have recognized the significance of science and technology in the overall national development and have therefore developed policies and programs in this regard (Mustapha, 2009). The provisions of the National Policy on Education (FGN, 2004) support the scientific development and the utilization of science and technology-based programs at all levels of the Nigerian education system. These provisions evidence the recognition of the role played by STM education in the national, scientific, and technological development serving as a gateway to socio-economic advancement, industrial development, and self-reliance (Mustapha, 2009; Olawuwo, 2015; Badmus and Omosewo, 2018).

In Nigeria, STM is taught in all schools from the basic level through to the university. The quality and standard of the national STM curricula being used in schools are locally relevant, globally accepted, and among the best in the world (Jegede, 1996; Ivowi, 2000; NERDC, 2009). However, the teaching of STM in Nigerian schools has been generally described as ineffective and students' achievements in terms of knowledge and skills are yet to meet expectations (Maduabum, 1990; Torton, 1990; Kosemoni, 2000; Ayeni, 2021). Science teachers and the manner in which science is taught are identified as part of the problems (Olawuwo, 2015; Ayeni, 2021).

The methods and strategies employed by STEM teachers in most of the Nigerian schools have hitherto remained teacher-centered and textbook-oriented (Mustapha, 2009; Olawuwo, 2015). This is contrary to the recommended inquiry-based teaching strategies recommended by the national STEM curriculum that emphasizes learner-centered and inquiry-based teaching strategies and methods that involve hands-on and minds-on learning activities. Most of the STEM teachers are not familiar with effective teaching strategies and they do not possess the knowledge and competencies required for using inquiry-based teaching in implementing the Nigeria STEM curriculum (Mustapha, 2012; Badmus and Omosewo, 2018). Thus, STEM teachers need to be reformed to acquire the required levels of knowledge, skills, and competencies for teaching STEM subjects efficiently (Olawuwo, 2015; Badmus and Omosewo, 2018).

In addition, a good number of teachers and support staff in the school system are far from being computer literate and are incapable of applying technology in teaching science (FMOE, 2013; Shittu; Kareem & Tukura, 2019). Researchers have reported that most teacher education courses do not provide meaningful contexts for applying ICT to enhance teaching and learning and even though ICT is included in the teacher education program, teachers are not sufficiently trained to use ICT in the instructional setting (Tayo, 2015; Bello, 2018; Richard, 2021). Subsequently, newly qualified teachers (NQT) of STEM and STEM teachers require further ICT-compliant education and training to enable them to function in the technology-driven classroom in the 21st century. In addition, science teachers need continuous training to enhance their knowledge of the subject matter, ICT competence, and pedagogy (FGN, 2013; Olawuwo, 2015; Oyelekan, 2018).

Therefore, the CL4STEM project essentially focuses on developing the capabilities of STEM teachers and emphasizes the pedagogical and techno-pedagogical content knowledge requirements of STEM teachers in Nigeria. The CL4STEM project is in tune with the strategic plans of national and state governments for addressing the challenges of teachers' continuous professional development (FGN, 2013). The CL4STEM project aims at building capacities of middle and secondary school NQTs in science and mathematics to foster higher-order learning in classrooms and enable their ICT competencies. The project is most relevant to the general circumstances of Science and Mathematics NQTs in Nigeria.

1.4 CL4STEM In Nigeria: A SWOT Analysis

Strengths

- Pro-active institutional management.
- A pool of ICT- support learned faculties.
- A well-structured STEM educational system that allows selection of diverse study samples (faculties, core educators,).
- Dedicated and committed project consultants and partners (in- and out-country).
- Dedicated and well-qualified faculty with many years of teaching experience.
- A reasonable pool of ICT facilities and STEM laboratories
- National and regional government willingness to integrate expected results in designing future educational curricula and policies.

Weaknesses

- Weak electrical power infrastructure.
- Undependable internet network provision.
- Inadequate computer hard wares at the secondary school institutions
- Low ICT knowledge and skills/competence of schoolteachers and students.
- Insufficient experience in curation of OERs by some core teacher educators

Opportunities

- A high rating of multidisciplinary international partnership projects.
- A push upward by the national and regional governments for e-learning and the digital economy.
- High level of cooperation by schools and teachers and other relevant stakeholders to key into CL4STEM.
- Domestication of the principle of OERs by educators in the production of online resources and training of pre-service and NQT STEM teachers.
- A drive in the direction of implementation of OERs in accelerating learning and intelligent quotient of pupils, students and teachers.
- High enthusiasm and positive disposition of school Principals towards CL4STEM project

Threats

- Instability in global financial transactions.
- Frequent national policy revisions.
- Occasional flashes of insecurity to life and properties.
- Closure of schools and restriction of travels may result from recurring corona virus pandemic and insecurity.
- Inadequacy of STEM laboratories and ICT laboratories and facilities in secondary schools

1.5 Brief Background On Data Collection

The present situation analysis study explores Nigerian education and STEM education for implementing the CL4STEM project. It is a survey of three Northern Nigerian states, namely, Niger, Kaduna, and Kano, which are selected for the CL4STEM project. The states of Kaduna and Kano are members of the Global Partnership for Education (GPE) while the state of Niger is selected based on the geographical location of IBB University, the lead partner of the CL4STEM project. Each state has educational zones into which schools are distributed approximately and evenly for equity and access. Ten senior secondary schools from each of the three states (total 30 schools) served as the sources of primary data. The sample schools in each state were selected through the multistage sampling technique. In the first stage, cluster sampling was used to group the schools according to the three senatorial areas in each state. In the second stage, stratified sampling was used to take care of gender, location, and socioeconomic status (single and mixed boys and girls in rural, urban, and semi-urban areas).

The selected schools in the three states were under the administration of their respective Ministry of Education (MOE). The state MOEs have a common administrative structure and functions. Each MOE designates specific Secondary Schools Boards and Technical Schools Boards to manage secondary

education/science and technical schools, respectively. The administrative structure of academic programs in schools follows a common administrative organogram, which includes Principal, Vice Principals (Academic and Administration), Heads of Department (HOD), heads of subject units (Biology, Chemistry, Physics, Mathematics, etc.), examination officers, laboratory technologists, etc.

Study data were sourced from Principals, HODs, and teachers through the following processes:

i. Visiting the sampled schools to observe and assess science laboratories and ICT facilities of schools
ii. Meeting science and ICT teachers at the respective schools to administer teachers' profile questionnaire
iii. Meeting and interviewing principals and the heads of science department of schools with a focus on the state of science education in schools

During the process, qualitative and quantitative data were collected after the administering of the interview guide and staff profile questionnaire. Documentary literature reviews of policy documents and research publications based on the study objectives were undertaken.

In the survey, 30 Principals/Vice Principals, 30 heads of science departments, and 154 STEM teachers were the sources of data collection. Based on the human resources, STEM and ICT facility index of schools, location, and security consideration, 20 schools (10 schools in Niger, 5 schools each in Kano and Kaduna) were eventually identified to participate in the project implementation. The selected schools are depicted in the following table.

Table 1.1: Demographic information of the 20 selected schools

States	Name of Schools	School Status	School Location
Niger	FGC, Minna	Public	Urban
	GGSS, Kontagora	Public	Urban
	GSC, Kutigi	Public	Semi-Urban
	MBGC, Minna	Public	Urban
	MKSS, Lapai	Public	Semi-Urban
	Govt Science College, IZOM	Public	Semi-Urban
	GGSS, Bida	Public	Urban
	Girls Science Secondary School, PAIKO	Public	Semi-Urban
	Government Science College, Kagara	Public	Semi-urban
	Government Science College, Wushishi	Public	Semi-Urban
Kaduna	Capital School, Kaduna	Public	Urban
	Queen Amina College, Kaduna	Public	Urban
	GSS, Kaduna	Public	Urban
	GC, Kaduna	Public	Urban
	GSSS, Rigachikun	Public	Semi-Urban
Kano	GSS, R/Zaki	Public	Urban
	Government College, Kano	Public	Urban
	FLC, Mariri	Public	Urban
	FGC, Kano	Public	Urban
	GGSS, Gezawa	Public	Semi-Urban

The security situation in the states limits the balance of urban, semi-urban, and rural spread in the selection of schools.

2. Mapping The Context

2.1 Country Context

2.1.1 Geography, demography, politics, and administration

Nigeria is officially known as the Federal Republic of Nigeria (FRN). It is located on the coast of West Africa and the South of Sahara. It shares borders with the Gulf of Guinea in the South, Cameroon in the East, Niger and Chad in the North, and the Benin Republic in the West. Nigeria occupies a land mass of 924,000 square kilometres. Its vegetation ranges from the mangrove swampland of the Niger Delta along the Atlantic Coast in the South to the rain forest and the Sahara Desert on the extreme fringes of the North. It has favourable climatic conditions with predominantly arable land, and it is endowed with a rich bio-diversity of bountiful flora and fauna. Nigeria is abundantly rich in yet untapped solid mineral resources, and it is recognized as one of the largest oil-producing countries of the world, with its economy being the largest in Africa.

Nigeria is the most populous country in Africa. It had a population of 45.2 million during its independence in 1960. The population has grown exponentially. Based on its average yearly growth rate of 2.65%, the population is unofficially quoted to be over 200 million. The Worldmeter (2021) projection quotes the Nigerian population as 211,996,970 in August 2021, while the United Nations projected it as 211,400,708 in July 2021. One million two hundred and twenty-one people representing 52.0% of the population is based in urban areas and 45 per cent of the population is made up of children aged less than 15 years. Male to female population is quite even with 1.04 males to 1 female. The Nigerian population is equivalent to 2.64% of the total world population and it is the seventh most populated country in the world (UN data).

Politically, Nigeria became independent on October 1, 1960. It adopted the presidential form of government, headed by the Executive President. Administratively, Nigeria operates a federal system of government made up of 36 states, a federal capital territory (FCT) known as Abuja, and 774 local governments.

Nigeria has a feature of ethnocultural diversity, having over 350 distinct ethnic groups with over 500 indigenous languages (FGN, NPE, 2013). Therefore, Nigeria is a nation of diverse cultures, different ethnic groups, and various languages. Three languages, namely, Hausa, Igbo, and Yoruba are widely spoken, while English is the official language and medium of instruction in schools. Hausa, Igbo, and Yoruba served as the language of instruction in the early years of basic education (primary 1-3), (FGN, 2004).

Nigeria is a religious nation with Islam and Christianity being predominant. Religious knowledge of both Islam and Christianity is included in the school curriculum as school subjects.
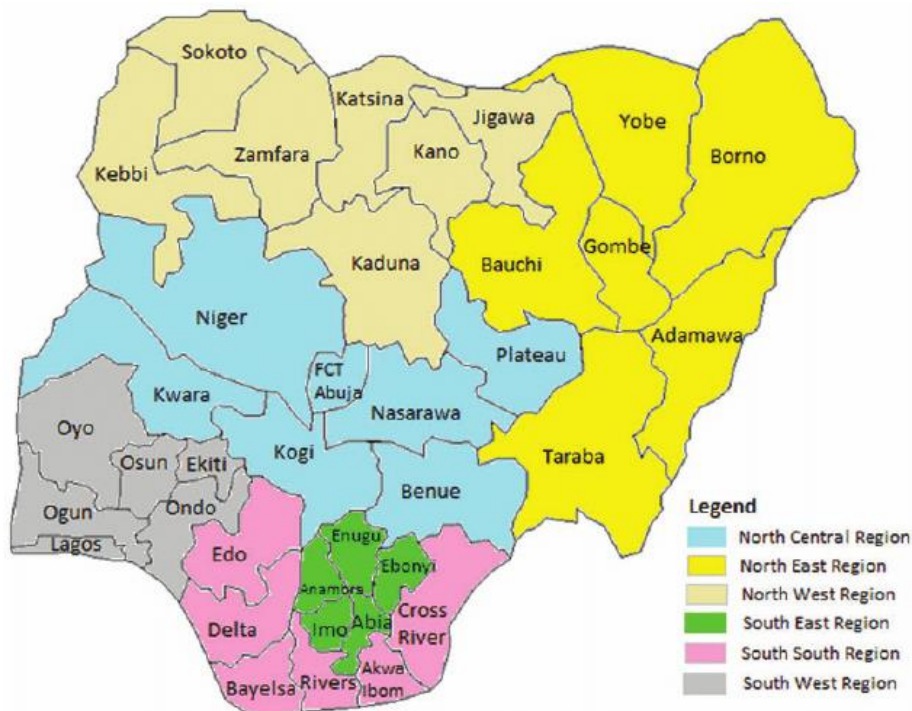
Figure 2.1: Map of Nigeria showing the 36 states and the FCT, Abuja

Note: Niger, Kaduna, and Kano are the participating states in this project

Niger is one of the Nigerian states situated in the north-central geographical zone with Minna being the state capital. The state of Niger has a landmass of approximately 8.6 million hectares comprising 25 local government areas and constituting about 9.3% of the country's total land area. The climate is characterized by a rich profile of annual rainfall with a distinct dry and wet season. Approximately, 85% of the state's land area is suitable for agricultural activities and 85% of the population are farmers, making agriculture the highest employer of labour (NSBS, 2014).

According to the 2006 National Census, the population of Niger state was just under 4 million people. It is projected that the population must have grown by 40% to 5.53 million people in 2016. The current population is approximately above 6 million.

The State Ministry of Education, Science and Technology, is jointly responsible with a number of other government departments and agencies – which include the state universal basic education board (SUBEB) – for the management of education and implementation of both federal and local education policies within the state. The Science and Technical Schools Board (STSB) and the Secondary Education Board are the agencies involved in discharging the statutory responsibilities of the education system in the state. Totally, 3,084 pre-primary and primary schools, 408 junior secondary schools, 16 science and technical schools, 260 senior secondary schools, and 11 tertiary institutions are under the supervision of these agencies and the ministry (Annual School Census, 2015; MTSS, 2015).

The Niger state education sector operates within the contexts of a number of international, national, and state frameworks. Nonetheless, the revised National Policy on Education (NPE), Sustainable Development Goals (SDGs), Niger State Education Sector Strategic Plan 2009-2018 (SESP), Niger State Education Medium-term Sector Strategy (NSEMTSS), and the Niger State Vision 3:2020 are the extant frameworks.

Kaduna state is located in north-central Nigeria. Zaria and Jemaa are its major traditional emirates with a total land area of 46,053 km², a total population of 9.48 million (2020 estimate), and 23 local government area councils.

The major tribes in Kaduna are Hausa and Fulani inhabitants in the south. However, about 30 other ethnic groups that include the largest group called Gbari (Gwari) reside in the state. The Nok Culture is one of the earliest civilizations found in Kaduna state.

Kaduna has maintained a reputation as a state with a huge pull factor from the colonial era to the contemporary period. Numerous tribes around Nigeria have settled in Kaduna. The state continues to be a hub for cosmopolitanism.

"The Centre of Learning" is the state slogan because Kaduna is home to several prestigious institutions. The Nigerian Defense Academy (NDA), Ahmadu Bello University (ABU), Nigerian College of Aviation, Barewa College and Nuhu Bamalli Polytechnic, and the Kaduna State University are some of the institutions located in Kaduna.

The Nigerian Geological Survey Agency has a research centre and a geology museum in Kaduna. The National Museum exhibits the culture of the northern Nigerian states. The Nigerian Institute for Trypanosomiasis Research (1961) and the National Eye Centre is located in Kaduna.

The total enrolment of public Junior Secondary Schools (JSS) was 297,139 in Kaduna State as of 2019; out of which 142,021 were girls, constituting 48% of the enrolment. The public JSS enrolments of school-age (12-14 years) stood at 212,022; out of which 101,911 were girls, constituting 48% of the enrolment.

The total enrolment of public Senior Secondary School (SSS) was 142,157; out of which 72,170 were girls, constituting 51% of the enrolment. The public SSS enrolments of school-age (15-17 years) stood at 101,626; out of which 52,547 were girls, constituting 52% of the enrolment.

The combined public and private SSS enrolments of school-age (15-17 years) stood at 126,485; out of which 64,869 were girls, constituting 51% of the enrolment.

The public Science and Technical JSS enrolments of school-age (12-14 years) stood at 3,051; out of which 1,025 were girls, constituting 34% of the enrolment. The public Science and Technical SSS enrolments of school-age (15-17 years) stood at 2,913; out of which 802 were girls, constituting close to 28% of the enrolment.

The percentage of qualified primary school teachers with a minimum qualification of NCE was 84% in public primary schools. The percentage of qualified teachers in public JSS was 91%. The percentage of qualified teachers in public SSS was 89%. Such statistics are encouraging for quality education in Kaduna (ASC Report, 2019) (Kaduna State website (2021) https://kdsg.gov.ng/about-kaduna/) (Kaduna State Annual School Census Report 2018/2019. Publication of the Ministry of Education Kaduna State, dated February 2020.)

Kano state is located in Northern Nigeria. The state shares borders with Katsina state to the north-west, Jigawa State to the north-east, Bauchi State to the south-east, and Kaduna State to the south-

west. Kano is the capital of Kano state, and it is mostly populated by Hausa people. Hausa is the most spoken language; although Fulani language is also spoken.

Kano state is the second industrial centre after Lagos state and it is Northern Nigeria's largest commercial centre for textiles, cosmetics, plastics, pharmaceuticals, etc. Kano state is the centre of commerce with a daily trade volume of over 20 billion. Kano is one of the leading states for agricultural production, possessing large irrigation facilities for dry season farming.

Kano state has the highest population in Nigeria. According to the 2006 census, Kano state had a population of 9,383,682. Based on the State Annual Growth Rate of 3.36%, the projected population of the state is expected to be 13,169,042 in 2018 (NPC, 2018). The state, based on the National Population Commission and UBEC projections, has a total of 4,546,082 (Male=2,422,211 and Female=2,123,871) school-going pupils aged between 6 and 11 years. Out of these, 3,556,848 (Male=1,673,743 and Female=1,883,105) pupils are in primary schools and 989,234 (Male=748,468 and Female=240,766) pupils are out of school (UBEC-NPA, 2018).

The Ministry of Education is statutorily responsible for the development and implementation of basic and secondary education in the state. The ministry supervises and coordinates the activities of its parastatals, which include the State Universal Basic Education Board (SUBEB), Kano Science and Technical Schools Board (KSTSB), Kano State Secondary Schools Management Board (KSSSMB), Kano State Agency for Mass Education (SAME), Kano Educational Resource Department (KERD), etc.

KSTSB is concerned with the management of science and technical colleges while KSSMB is concerned with the management of all conventional secondary schools in the state.

2.1.2   Country specific risks

Climate change

Nigeria has two main seasons, namely, dry and wet. Like every country, climate change has affected several factors, such as seasonal variability, daily weather conditions, temperature, rains, heavy storms, and heavy rainfalls, in Nigeria. Several cases of floods are reported annually in Nigeria. Areas prone to floods have caused schools to close, resulting in a loss of learning hours.

Climate change had adversely affected agricultural practices and food production, resulting in food insecurity and poverty. Consequently, incomes of the rural farming populace dwindle, and inflation rise in urban towns. As a result, many parents struggle to provide nourishment and they are unable to provide for their children's educational needs and learning resources.

Insecurity

Nigeria is currently faced with insecurity that is ravaging and destroying households and destabilizing institutions. Nigeria is experiencing insecurity, due to Boko Haram terrorism, kidnapping by bandits, civil violence arising from ethnoreligious crises, and sometimes, political conflicts. National unity is being threatened due to agitation for self-determination by ethnic groups and their sit-at-home orders with a tendency to prevent the movement of persons. All these bring associated risks, hindrances, and security threats to Nigerian education. Schools are affected adversely by the Boko Haram terrorists

who have prohibited western education and have serially attacked schools and facilities (Financial Intelligence, 2014; Njoku, 2014). Bandits have killed hundreds of people and dislodged an unspecified number of communities, forcing many schools to close and thousands of students to remain at home for months, thereby heightening the fears of an increased number of out-of-school children (Daily Trust reports, 2021)

Bandits and insurgents kidnap students and teachers, attack schools, and sometimes kill and rape female students. An unaccountable number of students have been kidnapped in the past five years (Vanguard, 2021), while a UNICEF report puts the number of kidnapped school children in Northern Nigeria at 1000 in 2018. Many schools are shut down or relocated, while bandits take over schools for their nefarious activities and use them as hideouts (Daily Trust, 2021). Such insecurities have hindered schooling, general teaching and learning, and teaching and learning of STM, particularly in affected schools. Many students, particularly in the rural schools in the North, have been forced to remain at home or relocate to internally displaced persons (IDP) camps, where they do not have access to schooling, thereby widening the educational gap between the rural and the urban environments and between the northern and the southern parts of Nigeria. Many parents in the affected areas have withdrawn their children, especially female students, resulting in an increase in the number of out-of-school children (UNESCO, 2014). Female students drop out of school and widen the gender difference in schooling.

The education sector in some Northern states (Kaduna, Kano, Katsina, Niger, and Zamfara) is affected by the attacks of Boko Haram and bandits. Two of the states (Kaduna and Zamfara) witnessed major incidents that negatively affected schooling. Attacks occurred in many schools in 2021, leading to unplanned closures of schools and loss of learning time. Kaduna and Zamfara are still witnessing attacks related to herdsmen and cattle rustlers in certain local government areas, which affects schools and schooling. In the 2019-20 academic year, repeated violent attacks led to school closures in the states including Niger state. Kaduna state schools lost the third term of the 2020-21 session due to the recurring kidnaping of students across the state. The 2021-22 academic year has resumed on 12th September, wherein the third term of 2019-20 was skipped to regularize the academic session. All these factors pose a threat to this project. However, some educational zones and urban and semi-urban towns are less prone to attacks and such places are identified for the safe implementation of this project.

Labour strikes

Other threats to Nigerian education include the occasional strikes by teachers due to irregular payment of salaries and allowances and poor services rendered to teachers. The 2018 report suggest that 12 Nigerian states could not pay teachers' salary and many states either pay partially or are unable to pay teachers' salary. Such a situation affects teachers' morale and commitment to duty. It is common knowledge that many teachers have taken to other businesses to meet their economic needs even during school hours at the expense of their primary teaching assignments. This has resulted in low school attendance of teachers and students' academic performance is consequently affected. The Federal Government's approval and proposed implementation of teachers' special salary and improved condition of service by January 2022 will stem the tide and better the teachers' performance in the delivery of the Nigerian education system.

Elections and political transitions

Elections in Nigeria and the subsequent transitions at the national and state levels have consequent effects on education. Policies and programs are truncated and any change in governments would not only lead to a change of political appointees in charge of education programs and interventions but also some of the technocrats/consultants of such programs. Programs get either suspended or abandoned, teaching and learning are implicated, and program objectives and outcomes get stalled, leading to the rescheduling of projects and implementation of work plans. Many projects have been affected in this context at both federal and state levels. Education sector program/intervention projects in Nigeria could also be affected by politically motivated holidays that are often declared by state governors in the run-up to elections. However, successive governments in many instances have had a positive effect on the evolution of national education policies, sustainability of policy implementation, and advancement of innovation in the Nigerian education space. This gives hope for the sustainability of the CL4STEM project under any government beyond the present one that may end in 2023.

Poverty

The socio-economic backgrounds of children belonging to poor families and those residing in rural areas of Nigeria affect their access and academic achievements (Azibukwe, Adegboye & Quadri, 2021). Nigeria has a high poverty level index, and the income of rural families is low, which affect access to education. The Federal Ministry of Education's Monitoring Learning Achievement (MLA) reports of 2004, 2010, and 2015 revealed that literacy and numeracy levels were lower for children from the lowest economic quintiles and those from rural areas. Studies reported that children from low socioeconomic backgrounds and rural areas are not likely to have textbooks, learning resources, access to ICT learning resources, and parental support for their education when compared with children from middle and higher economic quintiles (Obiako and Adediran, 2020; Azubuike, Adegboye and Quadri, 2021). It is reported that children in rural schools might be taught by unqualified or under-qualified teachers and subjected to other such disadvantages. All these could affect inclusiveness and equality to STEM education intended for the CL4STEM project. As a part of social support for addressing poverty and for facilitating school attendance, the government is providing home-grown nourishment to primary school children. This measure will provide relief to parents with low economic status, positively impact school attendance, and increase access to education.

2.1.3   Impact of the COVID-19 pandemic

COVID-19 pandemic has its impacts on schooling. According to UNESCO (2020), the closure of schools affected 39,440,016 primary and secondary school learners across Nigeria, including those in internally displaced camps. Students remained at home during the lock-down, teaching and learning were hindered, learning hours were lost, and the whole academic year was affected in most of the cases. In response to such an educational emergency, the federal and state governments and the non-state sector instituted measures to cushion the effect of school closures by implementing various learning interventions through technological platforms, internet-based tools, and traditional media (Adekanbi, 2021).

The suddenness of COVID-19 exposed most of the public schools that were the least prepared to adopt online teaching. Radio and television lesson broadcasts and several online platforms deployed by FMOE, and the state government could benefit only a limited number of students. Even some students residing in urban areas did not benefit due to limited internet coverage, lack of regular electricity, and lack of internet infrastructure. Students living in rural areas were the most disadvantaged, as they were not aware of such radio and television programs and online learning opportunities. The platforms did not address the specific needs of rural areas that lacked ICT infrastructure and parents were unable to support their children about online learning (Adekanbi, 2021).

In Nigeria, a majority of the population with internet access is from rich socioeconomic and urban households (Obiakor & Adeniran, 2020). Children from poorer socioeconomic backgrounds tend to have limited access to internet connectivity, computers, mobile phones, functional ICT skills, and active parental support. Studies have reported that a significant number of school-aged children might not have learnt during the COVID-19, due to limited socioeconomic means and exclusion from remote learning opportunities (TEP, 2020; Obiakor & Adeniran, 2020).

The impact of COVID-19 led to a review of the academic calendar, merger of academic sessions of 2020-2021 and 2021-2022, and adjustment of school term duration to less than the normal 12 weeks across the country. Such changes have affected the quality of teaching and learning adversely.

While the school closures were coupled with inherent issues and concerns, the pandemic opened opportunities for innovation and resilience in the Nigerian education space. Following schools' resumption, governments and educational institutions began to provide computers, ICT facilities, and infrastructure to schools at all levels. Opportunities were offered for blended learning experiences in some schools and accelerated digital skill acquisition programs were initiated for teachers and students by governmental and non-governmental organizations.

2.2 Education System

2.2.1 Education administration

The formal educational system of Nigeria evolved from the British educational system, and it has continued to develop over the years since its independence in 1960. The present 6-3-3-4 education system is based on the provisions of its educational laws and ordinances, and in particular, on the National Policy on Education (NPE), which was first published in 1977. The NPE of 1977 was revised during Nigeria's various developmental stages in 1981, 1988, 2004, and 2013. Education is mentioned as compulsory and as one of the rights of every Nigerian in the relevant provisions of the NPE and the Universal Basic Education (UBE) Act (2004).

By the Nigeria Constitution, Part II, paragraph 27-30, education is placed on the concurrent legislative list (FGN, 2013). This makes education a shared responsibility of the federal, state, and local governments in the management and funding of education through the Federal Ministry of Education (FME), States Ministry of Education (SME), FCT Education Secretariat, and the 774 Local Government Education Authorities (LGEAs).

Education is administered by the federal, state, and local governments. FME is responsible for overall policy formation, coordination of policy implementation, management of education at the federal level, and implementation of quality control of education in Nigeria through its relevant departments and agencies. School education is primarily the responsibility of the state (secondary) and local governments (basic primary). Individual states and their LGEAs assume the responsibility for implementing school policies in their respective jurisdictions. However, due to national exigencies, the federal government is involved in school education by establishing federal government colleges/technical colleges in the states, establishing secondary education units in the FMOE, and establishing the Universal Basic Education Commission for the management of basic education in Nigeria. A Director for STEM/TS (Technical and Science) education is responsible for STEM matters at both federal and state levels.

The activities of the Department/Directorate of Technical and Science Education (TSE) are centered on initiating and formulating TSE policies through the following:

- Setting standards and providing operational guidelines for establishing technical and science schools, ensuring teacher quality, providing school support services, and monitoring curriculum delivery
- Monitoring and evaluating the implementation of National Policy on Education
- Regulating the management of the federal science and technical colleges

Some specific functions of the department of TSE include:
- Specifying and reviewing the national guide of curricula for all types of vocational and science education programs below the tertiary level, in collaboration with relevant parastatal
- Sourcing intervention funds and seeking technological assistance from local and international organizations for the development of science, technical, and vocational education and training
- Developing instructional materials and facilities for TSE, in collaboration with the relevant stakeholders
- Ensuring effective global linkages for STEM education
- Providing leadership and advisory services for nationwide TSE development
- Liaising/collaborating with relevant NGOs and international organizations on TSE matters

The Nigerian constitution and the NPE encourage the private sector, local communities, and NGOs to establish schools by providing funds and by facilitating educational collaborations with the government.

2.2.2 Education policy and funding

The Nigeria educational policies (FRN, 2013) are in tune with the focus of the CL4STEM project. The educational policies are stated in the context of the NPE, and these include the following provisions:

- Education is compulsory and a right of every Nigerian, irrespective of gender, social status, religion, ethnic background, and any particular individual challenges
- Equal access to qualitative opportunities must be provided to all citizens at all levels of education

- All tiers of government should promote access, equity, and inclusiveness
- Unfettered access and equity to education must be ensured for the total development of an individual
- Delivery of quality education must be ensured at all levels
- Appropriate skills, mental, physical and social abilities, and competencies must be developed to empower individuals to contribute positively to the society
- Permanent literacy, numeracy, and the ability to communicate effectively must be inculcated at the basic education level
- A sound basis for scientific, critical, and reflective thinking must be laid
- ICT capability must be promoted at all levels
- Adequate infrastructure must be provided and capacity for effective utilization of IT must be developed to enhance the delivery of quality education
- Educational activities should be learner-centered
- Teaching should be practical, activity-based, experiential, and IT-supported
- The teacher-student ratio should be 1:35 and 1:40 for effective teaching and learning at the lower basic (primary) level and secondary school level, respectively
- Certification should be based on continuous assessment and national examination
- All teachers in the Nigeria education system should be professionally trained
- National Certificate in Education (NCE) shall be the minimum qualification for teaching at the basic education level and Bachelor's degree shall be the minimum qualification at the post-basic level
- All newly recruited teachers shall undergo a formal process of induction
- In-service training shall be an integral part of continuing teacher education
- Only professionally qualified and registered teachers shall be allowed to practice at all levels of education (National Policy on Education, 2013)

All these policies are reflected in the curriculum provisions, teaching and learning, and resource provisions for general education and STEM education in Nigeria. These provisions are consistently referred to and their implementation is analyzed in this situation analysis report.

Funding of education

All tiers of government in Nigeria are involved in the funding of education. Constitutionally, the local government authorities fund basic education; the states fund secondary education except for the Federal Unity Colleges, which are owned by the Federal Government, while tertiary education is funded by the Federal Government, except for the tertiary institutions established by states.

In principle, the Nigerian government upholds the UNESCO minimum standard recommendation of a minimum of 26% of the annual country budget being invested in education. The Nigerian government adopted this as a provision in its NPE (2013) stating that at least 26% of the federal, state and local government budgets shall be dedicated to the funding of education at all levels.

However, this provision is far from being implemented. The available records of federal spending on education are approximately less than 10% for the past few years and the estimated federal spending is 12% when it is included with state and local governments (FME, 2012). Funding of education in

Nigeria is described as grossly inadequate because only 7.9% of the 2021 budget of 11.70 trillion is allocated to education.

Table 2.1: Nigeria's budget and percentage committed to education from 2010-2018

S.No.	Year	Education Budgetary allocation	% For Education	National Budget
1	2010	N 234.8 billion	5.1	N 4.6 trillion
2	2011	N 306.3 billion	6.2	N 4.972 trillion
3	2012	N 400.15 billion	8.43	N 4.749 trillion
4	2013	N 426.53 billion	8.6	N 4.987 trillion
5	2014	N 493 billion	10.7	N 4. 69 trillion
6	2015	N 392.2 billion	8.91	N 4.4 trillion
7	2016	N 369.6 billion	6.01	N 6.1 trillion
8	2017	N 44.01 billion	6	N 7.3 trillion
9	2018	N 605.8 billion	7.04	N 8.3 trillion

Source: budgetoffice.gov.ng and nationalplanning.gov.ng

Funding of STEM education

STEM education is capital intensive, and its implementation requires more funding than other disciplines. It is acknowledged that education is generally underfunded and STM education, in particular, is the most affected because it requires enormous resources and teaching facilities. Consequently, inadequate funding for science education results in a deficiency of the supply of science equipment, teaching and ICT facilities, infrastructure, and employment of the required number of science teachers in all Nigerian schools (Taagahar & Orokpo, 2018).

2.2.3   Academic structure

Education is free and compulsory for children aged between 6 and 15 in Nigeria (grades one to nine). The mandatory school consists of primary and junior secondary basic education levels. The Nigerian education system is restructured based on the revised edition of NPE (2013) as follows:

- Early childhood care development and education (ECCDE): age 0-4 years
- Free and compulsory basic education: age 6-15 years
- Post basic education: age 16-18 years
- Tertiary education
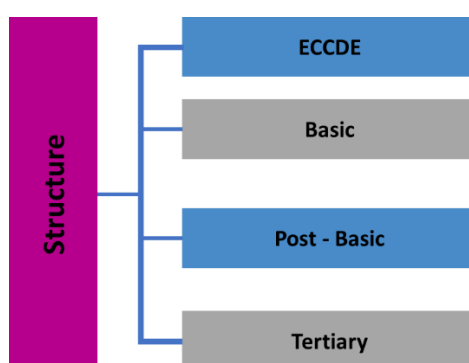
Figure 2.2: Nigerian schooling structure

According to Nigeria's National Policy on Education (2004; 2013), basic education (grades 1-9) covers nine years of formal schooling consisting of six years of primary education (grades 1-6) and three years of junior secondary (JSS) education (grades 7-9).

The NPE and the UBE act stipulate that basic education is compulsory for every Nigerian child and that all school-age children must enroll in schools. Progression to junior secondary education is automatic and compulsory. However, the enrollment rate to JSS is only 54.4%. This is far from the expected transition of 80% - 100%.

The curriculum at the JSS includes the same subjects as the elementary stage, but basic science and technology subjects are separated as distinct subjects at the JSS level.

Students are awarded the Basic Education Certificate (BEC), also known as Junior School Certificate, at the end of grade 9 (JSS). BEC is based on students' continuous assessment (40%) and performance in final examinations (60%), which are administered by the state governments of Nigeria.

Senior Secondary (SS) school is the post-basic phase of the school/technical education for children aged between 15 and 18 years (Grade 12) and its duration is 3 years.

Following the successful completion of senior secondary school, students appear for the Secondary School Certificate Examination (SSCE). Successful candidates are awarded the Senior Secondary Certificate (SSC). The SSC examinations are offered by two different examination boards, namely, the West African Examination Council (WAEC) and the National Examination Council (NECO).

Tertiary education is the third phase of the system, which consists of a university sector and a non-university sector. The latter is composed of polytechnics, monotechnic, and colleges of education. The tertiary sector offers opportunities for undergraduate and graduate students. The duration depends upon the study program and is generally 4 to 6 years.

The structure of the Nigerian education system was previously referred to as 6-3-3-4, but it is now referred to as the 9-3-4 education system.

2.2.4   Teacher education and service conditions

Teaching is considered a profession in Nigeria (FGN, 2013).

- The NPE specifies that only professionally trained teachers shall be allowed to teach in Nigerian schools and the minimum qualification for teaching is a National Certificate in Education (NCE) at the basic education level and a Bachelor degree (B.A., B.Sc., B.Ed.) at the secondary school level.

In Nigeria, teacher education is offered principally at the tertiary education level by colleges of education (COEs) for the award of NCE, and faculties of Nigerian Universities for the award of Bachelor, PGDE, Masters, and PhD degrees. Approximately 81 public COEs and 91 public university faculties of education are involved in teacher education in Nigeria.

The vision of teacher education, as stated in the NTEP (FME, 2009, 2014), is to attain:

- A national school system staffed by quality, highly-skilled, motivated, devoted, knowledgeable, and creative teachers, who are capable of raising a generation of Nigerian learners and who can compete globally based on explicit performance standards throughout the world
- Standard pre-service and in-service programs

The following are the objectives of the vision statement of Nigeria's teacher education:
- Production of highly motivated, conscientious, and efficient classroom teachers for all levels of the education system
- Provision of teachers with an intellectual and professional background, which is adequate for their assignments and enable them to adapt to any changing situations, not only in their country but in the world too
- Enhancement of teachers' commitment to the teaching profession (FRN: NPE 2004, 2013)

The curriculum content, standard, and quality assurance towards achieving the goals of teacher education in Nigeria are provided by the Federal Ministry of Education, The National Commission for Colleges of Education (NCCE) for Colleges of Education, and the National Universities Commission (NUC) for Universities' programs.

Teacher education encompasses the following stages:
- Initial teacher education (ITE): Pre-service teacher education is offered in Universities of Education, Colleges of Education, and Schools of Education.
- Induction into the teaching profession of newly qualified teachers (NQT) is carried out by the Teacher Registration Council of Nigeria (TRCN).
- The continuous professional development (CPD) for practicing teachers through in-service training that is an integral part of teacher education is principally conducted by NTI, TRCN, and professional associations

The curriculum structure and content reflect the following general standards for TE:

- Teaching subject: Content Knowledge (CK) or Subject Matter Knowledge (SMK)
- General Pedagogical Knowledge (PK) encompassing foundations of education, general principles of teaching and learning, curriculum and instruction, educational technology, and classroom management
- Pedagogical Content Knowledge (PCK) is an interactive construct of the knowledge domain of CK and PK
- Teaching practice

The following are the ratios of subject matter content knowledge (CK) of teaching subject to pedagogy and pedagogical contents knowledge (PCK):

NCE: 70:30 (2 teaching subjects) and credit load for graduation are 90:144 for a 3-year program. For Bachelor's degree programs, the ratio of subject matter CK to PCK was 60: 40, but it was reviewed

upwards (NUC, BMAS) for subject matter content to an approximate ratio of 70:30 and credit load for graduation is 120:192 for a 4-year program (Authors face validity, 2021).

The curriculum framework for teacher education is based on the national Benchmark Minimum Academic Standards (BMAS) developed by the relevant government agencies:
- NCE teacher education programs by the National Commission for Colleges of Education (NCCE)
- Undergraduate education programs by the National Universities Commission (NUC)

The BMAS ensures national standards in teacher education programs and training. However, the standard is flexible for peculiarity, knowledge advancement, and innovativeness.

The main aim of the pre-service teacher education undergraduate university program in Nigeria is to prepare teachers for the secondary school level, equip them with desirable knowledge, competencies, and commitment, and enable them to become effective teachers. Generally, the degree program is given the nomenclature of Bachelor of Science Education (BSc Ed) It is a four-year degree program in the respective science disciplines for prospective science teachers.

The following are the objectives of B.Sc. Ed. programs that are derived from the objectives of teacher education in the National Policy on Teacher Education (2009 & 2014) and the National Policy on Education (2013).
- Encourage the spirit of enquiry and creativity in students as prospective science teachers.
- Provide training through the study and education of science that will help produce science teachers, who will fit into the social life of the community and society and enhance their commitments to the national objectives.
- Provide intellectual and professional background adequate for the assignments of pre-service science teachers and make them adaptable to any changing situations.
- Build the pre-service science teachers' commitment to the teaching profession.

The following are the specific objectives of B.Sc. Ed. programs for the students.

- Sound knowledge of the subject matter of the respective science disciplines (Biology, Chemistry, Physics, Mathematics, etc.)
- Sound knowledge of the pedagogical content knowledge and competencies for effective instructional practices and quality learning outcomes
- Professional skills and abilities for performing different roles and functions of a science teacher in schools and the larger society and to adapt to the global environment
- Confidence and commitment in the science teaching and teaching profession
- Adequate background knowledge for postgraduate studies in various aspects of science education
- Knowledge, skills, and competencies in ICT and effective utilization of ICT to teaching science (Academic Prospectus, IBB University, Lapai, 2018)

The above objectives bear relevance to the statement of objectives of the curriculum of science teacher education, which is specified in the Nigeria University Commission (NUC) benchmark minimum academic standards and the selection of content of such curriculum. The objectives are in line with the global teacher education standards and cover:

- Intellectual development of the student-teacher
- Development of appropriate professional skills and competencies, and
- Development of attitudinal skills, professional attitudes, and professional commitment

The outline of the curriculum of the Nigerian undergraduate science teacher program includes the following:
- Courses in educational foundations
- Contents of the subject matter of Biology, Chemistry, Physics, Mathematics, etc.
- Studies in curriculum and instruction
- Courses in teaching methods and practices
- Courses in general studies

The aforementioned objectives and the curriculum outline embrace academic and professional studies. These aspects are in line with the consensus amongst science educators and educationists as to what should constitute the objectives and content of teacher education. Based on this, Mustapha (1998) contended that the curriculum of pre-service teacher education in Nigeria has some face validity.

However, the following challenges of teacher education in Nigeria were identified (NTEP, 2014).

- Low content knowledge in teaching subjects and poor pedagogical skills, especially in languages, science, mathematics, and technology, among newly qualified teachers (NQTs)
- Inadequate provision and inappropriateness of teaching and learning materials due to poor funding of education
- Low level of IT penetration and utilization in teacher education
- Inadequate teaching practice preparation in terms of duration and quality of supervision of student teachers
- Lack of strategic/systematic integration of initial teacher education (ITE) with in-service teacher education (ISTE) program
- Limited attempts to systematically link ISTE programs with the learning needs and workplace challenges of practicing teachers

Teacher continuing professional development

Initial teacher education and induction into the teaching profession of newly qualified teachers (NQT) provide the requisites for employment in the Nigerian teaching profession. It is found that teachers are not finished products. In-service education for teachers is required throughout their professional lives so that they remain effective in their teaching. The NPE states that teachers shall be exposed regularly to innovations in their profession through in-service programs (FGN, 2013). In recognition of this statement, the government established the National Teachers' Institute (NTI) and the Teacher Registration Council of Nigeria to provide continuous professional development and certification of

teachers. In addition, Federal and States MOE, Science Teachers' Association of Nigeria (STAN), and Mathematics Association of Nigeria (MAN) organize periodic training workshops, long vacation workshops, and annual conferences. STEM teachers are required to belong to STAN, MAN, and other related professional associations and they are expected to participate in the relevant activities, workshops, and conferences, which serve as one of the measures of their professional growth and might sometimes be required for promotion. It is found in the field data of the study that such expectations from teachers have not been met by them in many instances.

Table 2.2: Details of teachers' membership

S. No.	Item	Frequency	Percentage
1	Professional Membership	39	25.3
2	Awards	18	11.7
3	None	97	63
	Total	154	100

It can be observed from Table 2.2 that only 25.3% of the teachers were members of professional bodies. It can be implied that a good number of teachers may not be aware of the recent developments in the area of knowledge and pedagogies that are usually discussed during annual meetings and conferences.

Service condition of teachers

Teachers' salaries and other remuneration have generally been considered as poor. This has resulted in low morale and commitment to the teaching profession. Resultantly, many teachers consider teaching as a stepping-stone for other employment opportunities. Effective from the year 2022, teachers' special salaries and measures for the improvement of service conditions are to be implemented by the government at all levels (FGN, 2021; Presidential Independence broadcast). In addition, teachers are being sponsored through in-service provisions to acquire higher degrees and qualify to attain sponsorship for attending annual workshops and conferences.

2.2.5 Quantitative indicators of schooling

- In 2018, 7.2 million Nigerian children attended early education programs.
- The gross enrollment rate in Nigerian elementary schools was 68.3%.
- 22.4m Nigerian children enrolled into a public primary school.
- The school completion rate was 81% for males and 79% for females.
- 6.8 million Nigerian students enrolled in junior secondary schools.
- The gross enrollment rate in Nigerian junior secondary schools was 54.4%.
- The gross enrollment rate for Nigerian senior secondary schools was 68.6%.
- 80% males and 59% females completed Secondary School in Nigeria.
- The percentage-wise completion ratio of female to male was 1:1.2
- Although basic education is free and compulsory, 10.5 million Nigerian children are out of school.

2.2.6 National assessment of literacy, numeracy and STEM skills

Assessment is essential to monitor students' academic achievement and the overall quality of education of a nation. It is important that children attain minimum benchmarks in literacy, numeracy, science, and other life skills at the basic education level. In Nigeria, national assessments of learning achievement have been rare at the basic education level. The first nationwide assessment of learning at the basic level of education in Nigeria was done in 1996 by the Federal Ministry of Education (FME). The assessment was supported by UNESCO and UNICEF in three subject areas, namely, literacy, numeracy, and life-skills, for students of primary 4 only (Falayejo et al., 1996), followed by a few other assessments in 2015 and 2016. The results of different learning assessment surveys conducted at the basic level between 1996 and 2016 in literacy and numeracy are shown in the following table.

Table 2.3: National mean performance in the various assessed subjects by class

S. No	Subject	Primary 6%	JS 1%	JS 2%	JS 3%
1	English Language	48.8	40.45	39.75	42.26
2	Mathematics	42.87	37.68	34.42	33.61
3	Primary & Inter. Sci	40.78	22.38	21.05	27.83
4	Social Studies	49.77	25.15	23.15	27.07
5	Life Skills	NA	NA	NA	NA
6	Intro. Technology	-	45.08	50	23.4

Source: Federal Ministry of Education (2010)

The results of MLAs of literacy and numeracy by the Federal Ministry of Education (assessments from 2003 to 2011) were based on samples of primary six pupils in all 37 states and the FCT and the outcomes are summarized in Table 2.4. The mean percentage scores for the overall national and equity indicators are based on location, gender, and school type, and these are used as reference points for this study, as the national assessments are not conducted recently.

Table 2.4: FME primary six MLA (literacy and numeracy) percentage mean scores 2003-2011 indicators

Mean score	2003 MLA	2011 MLA	2003 MLA	2011 MLA
National mean score (%)	41.45	39.5	35.73	31.19
Girls (%)	42.22	40.49	35.25	NA
Boys (%)	41.71	39.9	35.56	NA
Urban (%)	44.61	40.64	37.19	34.53
Rural (%)	39.1	39.84	33.51	32.9
Public (%)	44.61	40.11	35.09	35.79
Private (%)	48.17	40.68	40.35	32.84
Attended Nursery (%)	47.37	43.51	40.05	33.19
Not attended nursery (%)	41	37.19	34.91	32.29

MLA assessments conducted by FME at the primary six levels revealed low achievements in literacy and numeracy over the study period of 2003-2011. The literacy and numeracy levels attained were influenced by location, gender, early school education, and school type.

The Nigeria Education Data Survey (NEDS) (2015) revealed a learning crisis within the Nigerian education system, as only 17% and 31% of pupils met the competencies of literacy and numeracy, respectively.

In a more recent study of students' learning achievement in literacy, numeracy and lifelong skills, Benjamin, Ephrain and Ambe (2018) revealed that students' learning achievement was above average in literacy, and it was better in numeracy.

In 2018, the general literacy rate in Nigeria was 62.02%, while the literacy rate in urban Nigeria was 86% for males and 74% for females.

Equity in STEM education

One of the national educational objectives is to provide equal opportunities to all Nigerians at all education levels, irrespective of socio-economic status or gender (NPE, 2004).

Studies on gender in STEM in Nigeria have consistently shown gender disparity in enrolment and performance in favour of the male students (Salman, Salami & Bala, 2018). Recent studies have however revealed that the gender gap is getting narrower, and, in some cases, female students outperformed male students in STEM. However, gender equity in science education remains an issue of concern.

The enrolment data and examination records of some of the schools visited during the field survey showed high participation and good performances of female students in STEM examinations when compared to male students. The reference cases are presented in the following tables.

School Type: A public male science college (Sample A)

Table 2.5: 2018 National Examination Council (NECO) results

Subject	No. Registered	No. with Credit	%
Mathematics	85	36	42
Physics	85	54	64
Chemistry	85	38	45
Biology	85	16	19

Table 2.6: 2018 West Africa Examination Council (WAEC) results

Subject	No. Registered	No. with Credit	%
Mathematics	124	7	6
Physics	124	42	34
Chemistry	124	19	15
Biology	124	0	0

Table 2.7: 2020 West Africa Examination Council (WAEC) results

Subject	No. Registered	No. with Credit	%
Mathematics	185	162	88
Physics	185	115	62
Chemistry	185	121	65
Biology	185	69	37

School Type: A public male college (Sample B)

Table 2.8: 2018 National Examination Council (NECO) results

Subject	No. Registered	No. with Credit	%
Mathematics	132	104	79
Physics	42	39	93
Chemistry	42	40	95
Biology	42	37	88

Table 2.9: 2018 West Africa Examination Council (WAEC) results

Subject	No. Registered	No. with Credit	%
Mathematics	128	59	46
Physics	100	59	59
Chemistry	100	53	53
Biology	100	58	58

Table 2.10: 2019 National Examination Council (NECO) results

Subject	No. Registered	No. with Credit	%
Mathematics	71	53	75
Physics	71	62	87
Chemistry	71	47	66
Biology	71	32	45

Table 2.11: 2019 West Africa Examination Council (WAEC) results

Subject	No. Registered	No. with Credit	%
Mathematics	125	93	74
Physics	82	52	63
Chemistry	82	51	62
Biology	82	43	52

School Type: A Public Girls Science College

Table 2.12: 2018 West Africa Examination Council (WAEC) results

Subject	No. Registered	No. with Credit	%
Mathematics	376	325	86.44
Physics	376	165	43.88
Chemistry	376	126	33.51
Biology	376	186	49.47

Table 2.13: 2019 West Africa Examination Council (WAEC) results

Subject	No. Registered	No. with Credit	%
Mathematics	450	338	75.11
Physics	450	165	36.67
Chemistry	450	130	28.89
Biology	450	216	48

It is evident from the collected field data that female enrolment matched well with male enrolment. However, male students performed better than female students in the external examinations.

Senior secondary schools' examination

On successful completion of senior secondary education, students are required to appear for an external examination of certification. The Senior School Certificate examinations are offered by two different examination boards, namely, the West African Examination Council (WAEC) and the National Examination Council (NECO). The following table reflects the students' performances in science subjects in one of such examinations during a period of ten years.

Table 2.14: Enrolment and performance of biology, chemistry, and physics students in WASSCE for ten years (2007- 2016)

Year	Biology			Chemistry			Physics		
	Total sat	Credit passed (A1-c6)	% Pass	Total sat	Credit passed (A1-c6)	% Pass	Total sat	Credit passed (A1-c6)	% Pass
2007	1238163	413211	33.37	424747	196063	46.16	409449	180797	44.16
2008	1259964	427644	33.94	456980	202762	44.37	408237	200345	49.08
2009	1259964	453928	33.87	456980	203365	43.49	444236	222722	50.14
2010	1300418	427644	32.88	465643	263059	50.70	463755	237756	51.27
2011	1505199	579432	38.50	565692	280250	49.54	563161	360096	63.94
2012	1646150	587044	35.66	627302	270570	43.13	624658	429415	68.74
2013	1648363	852717	51.73	639296	462517	72.34	637023	297988	46.77
2014	1365384	766971	56.17	636268	397649	62.49	635729	386270	60.76
2015	1390234	798246	57.42	680357	412323	60.6	684124	410543	60.01
2016	1200367	740345	61.68	706873	408122	57.74	705125	415655	58.95

Source: Statistics Section of the WAEC Office Yaba, Lagos (2017)

The performances were fair with a credit pass ranging from about 33% to 62% for biology, about 43% to 72% for chemistry, and 44% to 68% for physics during a ten-year period (2007-2016).

The examination results in the surveyed schools and interviews with principals revealed a similar trend in the students' performances at the external WAEC and NECO examinations. The schools considered students' performances as good with a high percentage credit pass in science and mathematics. The WAEC and NECO results of students were combined to account for a 5-credit pass success level.

The following table depicts a sample summary of STEM examination results of the few surveyed schools.

Table 2.15: 2018 West Africa Examination Council (WAEC) Results

Subject	No. Registered	No. with Credit	%
Mathematics	128	59	46
Physics	100	59	59
Chemistry	100	53	53
Biology	100	58	58

Table 2.16: 2019 National Examination Council (NECO) Results

Subject	No. Registered	No. with Credit	%
Mathematics	71	53	75
Physics	71	62	87
Chemistry	71	47	66
Biology	71	32	45

Table 2.17: 2018 West Africa Examination Council (WAEC) Results

Subject	No. Registered	No. with Credit	%
Mathematics	376	325	86.44
Physics	376	165	43.88
Chemistry	376	126	33.51
Biology	376	186	49.47

Table 2.18: 2019 West Africa Examination Council (WAEC) Results

Subject	No Registered	No with Credit	%
Mathematics	450	338	75.11
Physics	450	165	36.67
Chemistry	450	130	28.89
Biology	450	216	48

2.3   ICT In Education

Policy: Advancement in the field of ICT and its application in education are revolutionizing the concept of teaching and learning. A paradigm shift is expected in the role of STEM teachers and students' learning. The development of basic skills and competencies of ICT has become a core component of education in Nigeria. The National Policy on Education (2004) portrays the significant role of ICT in education. The policy demands that Nigeria education should bring about the development of a computer-literate society. One of the national policies and objectives on ICT in education (2019) is to integrate ICT into the mainstream of education and training. In this context, e-learning is being introduced at all levels of education to facilitate teaching and learning in Nigeria.

The following aspects reflect the general status of integrating ICT in education in Nigeria.
- Revised edition of National Policy on ICT in Education (2004) published in 2019 is used
- Some schools under the purview of the federal and state governments, and private schools have the requisite ICT infrastructure including access to the internet
- ICT capacity-building for teachers and educational administrators is organized at all educational levels
- Computer education is made compulsory, and it has become a component of the school curriculum at all levels of education
- The government provides funds and budgetary provisions to ensure the supply of ICT systems at all educational levels, although it is considered inadequate
- ICT laboratories are established in tertiary schools, centers of excellence, and institutions by the government
- Computer-based tests and electronic computation of results are used in some schools at all levels of education
- STEM centers are established with state-of-the-art ICT facilities

2.3.1   ICT in the secondary education system

The Nigerian government is making provisions for ICT and the related infrastructure at the secondary school level, although they are considered inadequate. Governments, especially at the state level, are not committed towards the implementation of the National Policy on ICT at the secondary school level. Most schools at the state levels do not have the requisite facilities for building ICT for teaching. Facilities are found to be inadequate in schools that have the basic ICT infrastructure. However, some private organizations, non-governmental agencies, and telecommunication outfits have supported by providing equipment for ICT operations in schools to meet their learning needs. SchoolNet initiative, Zinox computers initiative, telecommunication companies' interventions, and oil companies' interventions are examples of ICT interventions at secondary and other levels of education. Such supports and provisions include computer laboratory facilities, hybrid libraries (e-libraries and physical libraries), website hosting, alternative power source, and procurement of electronic devices for instructional purposes.

The Federal Government of Nigeria (FGN) inaugurated the STEM centre of the Northwestern geographical zone in Kano state and an e-Library at the FG College, Kano in September 2021. The STEM centre provides e-learning facilities, state-of-the-art ICT infrastructure, and modern teaching content

to the students at public secondary schools and facilitates them to have access to digital and updated learning materials while developing their ICT skills and building teachers' capacities to enhance their usage of ICT for teaching. The STEM centre is available for implementing the CL4STEM project in the state. The project is also to be implemented in all regions of the country. It is expected that the CL4STEM project would enhance schools' readiness in implementing the ICT policy in education across the country.

The following are some of the challenges that threaten the full implementation of ICT in Nigerian schools, as found in literature and as observed in the school visits.

- Teachers are grossly and inadequately qualified to teach ICT in schools
- Many teachers do not have clarity about the manner in which ICT can be beneficial in facilitating and enhancing learning
- School management does not provide internet subscription
- School management find the cost of bandwidth to be high
- The ICT support staff is inadequate
- Computer sets and other devices are short in supply
- The electricity supply is inconsistent and power outage is erratic
- Cost intensive computer sets affect access and equity among urban and rural school students in Nigeria, especially those with a low socio-economic background
- ICT infrastructure, facilities and equipment are ill-maintained
- Telecommunication infrastructure is grossly inadequate in the country
- Internet connectivity is slow or poor
- Phone credit and internet data are not affordable, and teachers and students have low access to ICT devices in schools

Source: Field survey (2021); Federal Republic of Nigeria (FRN). (2012)
National Information and Communication Technology (ICT) Policy; Abuja: Ministry of Communication

Advancement in the field of ICT and its application in the field of education is revolutionizing the concept of teaching and learning. ICT has caused a paradigm shift in the role of STM teachers and STM students. Therefore, STM teachers and students have to acquire specific skills to use ICT in teaching and learning, respectively. Science teachers require ICT skills to enhance their learning requirements, cope with the demand for a knowledge economy, personal survival, and be global citizens. In addition, their proficiency in ICT is fundamental to the successful implementation of ICT policy in education and for the effective integration of ICT in classrooms. Studies have revealed that although STM teachers have a positive attitude towards using ICT in education, they refrain from using computers due to low self-efficacy. They consider themselves to lack in skills, knowledge, and competencies required for using computers in teaching and as a tool for learning (Mustapha, 2009; FMOE, 2013; Tayo, 2015; Shittu, Kareem & Tukura, 2019). The field information revealed that teachers understand the role of ICT as a necessary facility for teaching and learning; however, they do not integrate ICT in their teaching.

2.3.2 Teacher proficiency in ICT in education

In the context of the National Teacher Education Policy (2009), pre-service teachers must be trained to master subject matter knowledge, acquire professional skills and competencies, be computer literate, and apply ICT and other media in teaching and learning (FMOE, 2009).

Further, teacher education programs at college and university levels must include ICT courses in the curriculum. ICT courses must be designed to expose pre-service teachers to apply the principles of ICT in education (NTEP, 2019). However, it has been observed that the crucial components of ICT competencies and functional skills are missing from the curriculum and that the technological pedagogic and content knowledge (TPACK) framework required for the successful integration of ICT into classroom practices is missing (Bello, 2018). In addition, the level of integration of ICT into teaching and learning in Nigerian schools has summarily been described as low, as teachers and teacher educators are yet to deploy ICT fully and effectively in their teaching (Tayo, 2015; Shittu, Kareem & Tukura, 2019). STEM teachers are not professionally and psychologically ready to conduct ICT-mediated teaching reforms. The field study report in Table 2.19 attests to the low ICT capacities of STEM teachers in Nigeria and may therefore be incapable of adopting computer technologies for teaching and learning effectively.

Reform is urgently required in pre-service and in-service teacher education in order to produce teachers who are ICT compliant, capable of using various ICT devices, and capable of deploying ICT into teaching and learning in Nigeria.

2.3.3 ICT in education infrastructure and resources

The use of ICT in teaching and learning processes involves the usage of eBooks, eLearning resources, and computers for finding information via the internet and for teaching. The schools visited for this study had ICT laboratory/hybrid libraries with available physical facilities and e-resources, but at different levels of functionality, usage, and adequacy. Although the ICT facilities were generally available, they were reportedly being used by both teachers and students for acquiring ICT skills and were rarely used for instructional purposes (Field report, 2021). The following table provides the quantitative data of digital applications in the schools.

Table 2.19: Digital Applications Being Used by Teachers In Classroom Teaching, Online Classes, Or Professional Development

S. No.	Item	Frequency	Percentage
1	Videos	55	35.7
2	Simulations	13	8.4
3	Google docs	12	7.7
4	Google drive	11	7.2
5	Google forms	2	1.2
6	Microsoft Word	28	18.1
7	Microsoft Excel	8	5.1
8	Microsoft PowerPoint	25	16.2
9	GeoGebra	0	0
10	PhET	0	0
11	Google classroom	0	0
12	Moodle	0	0
13	Others (Specify)	0	0
	Total	154	100

Field survey, 2021

It can be inferred from the table that a majority of teachers used videos and Microsoft PowerPoint digital applications and none of the teachers used other applications, such as GeoGebra, PhET, Google classroom, and Moodle. This may be partly due to their lack of awareness or knowledge of such applications. Thus, teachers need to be sensitized to use the wide range of available applications.

Providing equitable and inclusive access to digital learning resources

Computer science is taught at the basic education level in Nigeria, and it is offered as a general or as an elective subject at the post-basic level. The objective of teaching computer science in schools is to enable students to acquire basic ICT skills. Studies have revealed low access to ICT, with no significant difference between male and female students (Aladejana & Sowunmi, 2012) and low ICT skills and competencies among students (Obiakor & Adeniran, 2020). Studies in the Nigerian context have revealed a digital divide in Nigerian educational settings, as not all students have the same access to information and communication technologies (ICTs) due to their socio-economic background, school type, and school location. Azubuike, Adegboye and Quadri (2021) reported a relationship between socio-economic status and the digital divide in access to remote learning. They reported significant differences between government and private school students in their access to remote learning opportunities and digital tools. A statistically significant association was found between parental education level and their ability to support their children regarding online learning, due to their limited or lack of ICT knowledge (Obiakor & Adeniran, 2020; Azubuike, Adegboye & Quadri, 2021). All these factors indicate the inequitable and lack of inclusive assessment in digital learning resources in the context of quality education in Nigeria. Therefore, a pragmatic way of addressing the differences in digital access becomes necessary.

2.3.4   ICT in education initiatives

The following are the government and NGO interventions and projects that have affected teaching and learning in schools.

- The Nigerian Communications Commission (NCC) supplies computers and other ICT devices and equipment, including scanners, VSAT, dish subscription and bandwidth subscription for internet access, to 229 secondary schools across six geopolitical zones of Nigeria. NCC organizes digital awareness programs to encourage schools and colleges to use and implement ICT in teaching and learning (https://www.ncc.gov.ng/stakeholders/corporate-matters/page)
- The massive expansion of transmission infrastructure of Mobile Telephone Network (MTN) provides internet access to approximately 60% of Nigerians including students and teachers.
- Internet access is provided to urban and remote rural areas. E-learning and educational lessons are broadcast through radio and television by the federal and state governments.
- Similarly, the Nigeria Information Technology Development Agency (NITDA) provides ICT infrastructure support to 271 Nigerian schools (https://technologytimes.ng>nitda-te).
- SchoolNet has collaborated with MTN and established ICT laboratories/cyber cafes in 12 of the 36 states as a pilot (https://www.infodev.org>Inf).
- Further, SchoolNet creates learning communities of educators and learners to use ICTs and enhance education by providing and supporting low-cost and scalable technology solutions and internet for schools, and by providing support mechanisms for technical infrastructure and connectivity in schools.
- Regional STEM centres provide e-learning facilities, state-of-the-art ICT infrastructure, and modern content to students in public secondary schools. STEM centres enhance learners' access to digital and updated learning materials and develop their ICT skills. STEM centres build teachers' capacities to enhance their ICT usage in teaching (https://thenationlineng.net/kano).

The aforementioned STEM centres and other institutions will be readily available for implementing the CL4STEM project in Nigerian states.

2.4   Equity And Inclusion In Education

2.4.1   Inclusive education

Inclusive education is about the child's right to participate in school duty, programs, and learning, regardless of the child's disabilities. All students, including those with significant disabilities, must be provided equitable opportunities to receive effective educational services, along with the supplementary aids and support services, in age-appropriate classrooms. Consequently, students would be prepared to live productively and as full members of society (FGN, 2013; National Centre on Educational Restructuring and Inclusion, 1995).

One of the philosophies of Nigeria education is to attain a just and egalitarian society. Nigeria's National Policy on Education (2013; pp. 65), Section 7 specifies in the context of inclusive education that persons with special needs shall be provided with inclusive services, which are attended by

normal persons, in age-appropriate general education classes that are directly supervised by general teachers.

By the provision of the policy, the education of children with special needs shall be free at all levels. The government shall provide all necessary facilities that would ensure easy access to education, and these include:

- Inclusive education or integration of special classes and units into ordinary/public schools under the Universal Basic Education (UBE) scheme
- Special education equipment and materials like Perkins brailler, white/mobility care, brailed textbooks, abacus, talking watch, audiometers, speech trainers, hearing aids, ear molding machines, educational toys, calipers, crutches, wheelchairs, artificial limbs, audio-visual equipment, and internet facilities, shall be provided
- Special education training on braille reading and writing, typewriter use, speech signs, and daily living skills
- Special training and re-training of personnel on capacity building to keep them abreast of the latest teaching techniques on various categories of disabilities, the gifted, and the talented
- A teacher-pupil ratio of 1:10 in special schools (National Policy on Education (2013), pp. 60-80).
- Promotion of access, equity, and inclusiveness in education by all tiers of government

Statistics for inclusive education

- The population of special needs children in Nigeria is estimated to be 19 million
- Percentage of children receiving special education: 14-20%
- Number of special needs schools: 1,777
- Number of UBE schools with the inclusive setting: data not readily available
- The number of special needs students in the inclusive school setting is 0-4% at the university level, but it could be more at the lower levels
- Number -of-school children: 10.5 million, among which 5-7 million are special needs children
- Number of institutions for the training of special teachers: one (Federal Government College of Education, Oyo)

Challenges observed in the implementation of inclusive education in Nigeria

- Conventional regular public schools do not have the necessary provisions for students with special needs, even after their enrolment
- Children with disabilities are mostly admitted in special schools and not in regular schools, thereby promoting segregation rather than inclusion
- Designated schools for special education are labelled as derogatory, school of handicapped, the school for the blind; school of the deaf, etc., which is contrary to the conception, psychology, and setting of inclusive education
- Gifted children are educated under an exclusive learning environment labelled as 'gifted schools'.
- The curriculum of the regular school is not modified to reflect inclusive practice
- Integration of special classes into UBE schools is not implemented

- Classes are overcrowded in conventional public school classes, as the average teacher-student ratio is above the stipulated 1:10 for the inclusive classroom
- The availability of specially trained teachers is inadequate for teaching in an inclusive class setting
- Lack of physical, pre-vocational, teaching and learning, and recreational facilities deter the needs of special needs students from being met in regular schools

Thus, policy provisions for inclusive education in Nigeria can be described as good, but the facilities and provisions that result in effective schooling for special needs students in regular schools are far from being available, despite the statistically low enrolment of special needs students in regular schools.

2.4.2 Girls education marginalization in Nigeria

The 1999 constitution of the Federal Republic of Nigeria deals with the fundamental principles of the state policy and reflects Nigeria's commitment to equality of all people, irrespective of race, sex, or gender. The principle of gender equity provides equality and eliminates all forms of discrimination against women, and it is well reflected in the constitution. The National Policy of Education (2004) stipulates that every Nigerian child should have a right to equal educational opportunities and the national gender policy (2006; 2021) emphasizes the goal to build a just society devoid of any form of discrimination. Several government policies, programs, and interventions promote gender equity in the accessibility to education in Nigeria.

However, literature has pointed out high gender inequality in terms of accessibility to education in favour of boys across all levels of education. In many states of Nigeria, the literacy rate was 47% for females and 53% for males. Female children make up 20% of out-of-school children and 60% of children who are not in school (Olibie, Eziuzo & Enueme, 2013; Brutai, & Abdullahi, 2020; Ishaku, 2021; Odoyi, 2021).

Several government mechanisms, programs, and interventions, the introduction of the UBE, education of the girl child, international support programs of UNICEF and UNESCO, etc., have begun to impact girls' enrolment in public primary schools over the years. For instance, girls' enrolment in public primary schools increased from 37.8% in 2005-06 to 40.6% in 2009-10 to 69.6% in 2018. Girls' enrolment in Junior Secondary Schools increased from 33.9% to 35.3%. More than two million students enrolled in Nigerian secondary schools in 2019, out of which 47% were girls and 53% were boys. It was revealed that thirteen states, namely, Abia, AkwaIbom, Anambra, Cross Rivers, Delta, Edo, Enugu, Imo, Lagos, Ogun, Ondo, Oyo, and Rivers, had achieved gender parity in secondary school enrolment. However, 23 other states and the Federal Capital Territory (FCT) of Abuja are yet to attain gender parity. The worst affected states include Adamawa Bauchi, Benue, Borno Gombe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Nassarawa, Niger, Sokoto, Taraba, Yobe, and Zamfara among others.

Several factors, such as discriminating social norms, cultural and economic values, religious practices, parents' level of education, poverty, and insecurity, have been identified to be militating female access to education and educational opportunities in Nigeria, especially the northern part. The government's laudable policy of providing equal educational opportunities to all Nigerian children has not been implemented substantially in the educational areas of science, technology, and mathematics. Females are grossly underrepresented in terms of enrollment, participation, and achievement in science, technology, and mathematics at all levels of education in Nigeria (Abdullahi, Abubakar, Abubakar, & Aliyu, 2019). Causes of low enrollment of girls in science,

technology, and mathematics subjects at all levels of education have been established by researchers over the years. Some of the causes are sex-role stereotyping in science curriculum, masculine image of science education, cultural practices, and scientific illiteracy of women (Eyiuche, 2019).

Many children are educationally marginalized in Nigeria. The Federal Ministry of Education Roadmap (2009, 2014) has indicated that children of nomadic tribes and immigrant fishermen, children with special needs, and children residing in regions of conflict/insecurity are educationally disadvantaged. Several strategies and policies towards inclusive education are in place to cater for the educational needs of such disadvantaged children. However, the implementation of such educational programs is found to be ineffective (Ajayi & Bello, 2011; Uwisike, 2020).

2.5 Science And Maths Teaching & Learning In Secondary Schools

2.5.1 Science and maths education practice

Language

As stipulated by the NPE, the English language is the medium of instruction in Nigeria, starting from basic 4 to post-basic and tertiary education. However, the national language policy stipulates the use of mother tongue or the language of the immediate environment at the lower basic 1-3.

Curriculum

The NPE has made provisions for formal learning of STEM at the basic and secondary school levels with an appropriate curriculum developed for each of the levels. Children are recommended to acquire core knowledge, skills, competencies, and values to enable them to live and function well in society. Each subject of the national core curriculum is published by the National Education Research and Development Council (NERDC, 2007; 2014). All schools are required to use the curriculum officially and mandatorily.

The curriculum provides the minimum academic standard and content to be implemented in all schools nationwide. Each curriculum specifies the philosophy and objectives and prescribes the content, recommended instructional strategies, teaching and learning materials, learning activities and the evaluation modes that guide the implementation of the curriculum. The curriculum is spirally structured, and its content is organized under themes, which recur at all class levels. The themes subsume concepts and provide links to enable the understanding of knowledge structure and the relationship among concepts.

The UBE guideline is implemented in 2014 at the basic education level, which is the 9-year basic education. The curriculum feature is made up of core subjects, namely, English, Mathematics, Basic Science, Basic Technology, Information Technology, and Physical and Health Education, offered to every student at the basic education level. The subjects and their contents flow systematically from primary 1 to JSS 3 and serve as the foundation for the subsequent study of basic science, biology, chemistry, physics, and mathematics at the secondary school level. The themes with respect to STEM are outlined below.

Basic Science and Technology (1-6):
- Theme 1: You and Environment
- Theme 2: Living and non-living things
- Theme 3: Science and Technology and Development
- Theme 4: You and energy

Basic Mathematics (1-6):
- Theme 1: Number and Numeration
- Theme 2: Mensuration and Geometry
- Theme 3: Everyday Statistics
- Theme 4: Algebraic Processes

Basic Science (JSS 1-3):
- Theme 1: You and Environment
- Theme 2: Living and non-living things
- Theme 3: Science and Technology and Development
- Theme 4: You and Energy

English and Mathematics are compulsory subjects at the post-basic level and STEM students can choose subjects from Basic Science, Biology, Chemistry, Physics, and Mathematics. The curriculum of each subject is structured on the following themes.

Biology themes:
- Theme 1: Organization of Life
- Theme 2: Organisms at Work
- Theme 3: Organisms and their Environment
- Theme 4: Continuity of Life

Chemistry themes:
- Theme 1: The Chemical World
- Theme 2: Chemistry and Environment
- Theme 3: Chemistry and Industry
- Theme 4: Chemistry of Life

Physics themes:
- Theme 1: Interaction of Matter, Space, and Time
- Theme 2: Waves: Motion without Material Transfer
- Theme 3: Fields at Rest and Fields in Motion
- Theme 4: Energy Quantization and Duality of Matter
- Theme 5: Physics in Technology

Mathematics themes:
- Theme 1: Number and Numeration
- Theme 2: Algebraic Processes
- Theme 3: Mensuration and Geometry
- Theme 4: Introductory Calculus

Under these themes, each of the curriculums is organized into six sections, namely, Topic, Performance Objectives, Content, Activities-Teacher and Students, Teaching and Learning Materials, and Evaluation Guide.

This organization provides a maximum guide to teachers and the curriculum thus acts as a guide to teachers.

The STEM curriculum reflects the depth and interrelatedness of the curricular content through the flow of themes and the curriculum's spiral structure from the basic education level to the post-basic level. This ensures continuity and recurrence of learning experiences but in detail and complexity. The curriculum organization model makes a basic science curriculum to serve as a foundation for the subsequent study of biology, chemistry, physics, and mathematics at the post-basic level.

In line with the content of the curriculum, relevant books of high content and validity have been published by the Science Teachers' Association of Nigeria (STAN), Mathematics Association of Nigeria (MAN), and other reputable authors for the basic and post-basic STEM levels. STAN (Biology, Chemistry, Physics) books and MAN (Mathematics) books are readily available in most of the Nigerian schools and are recommended to schools by the Nigerian government and school management. Other quality published STEM books are found in schools. School managements generally assume responsibility for the selection of in-use books. Thus, different but recommended books are found in use across the schools in Nigeria.

Pedagogy

The NPE (FGN, 2013) and the STEM curriculums (NERDC, 2009) prescribed that educational activity should be learner-centered and teaching of science should be practice-oriented, activity-based, experiential, and ICT-supported. Activities are built in the curriculum around the content, concepts, and principles, thus promoting activity-based teaching and learning. The major recommendation is that teaching and learning of science should be by inquiry and guided discovery, with emphasis on experimentation, questioning, discussion, and problem-solving. While the STEM curriculum requires the use of inquiry-based teaching methods, researchers have revealed that most of the STEM teachers in schools are not familiar with effective teaching strategies and they do not have the knowledge and competencies to use such methods. The teaching of STEM is predominantly by lecture method, notes dictation, and textbook-oriented (Mustaha, 2013; Olawuwo, 2015) and ICT is not adequately deployed for the teaching of STEM (Tayo, 2015). In order to facilitate effective learning and to enable students to have participatory, exploratory, and experimental learning experiences through practical activities, the teacher to student ratio is officially recommended as 1:40 and 1:35 for basic and post-basic education, respectively (FGN, 2013).

Assessment

Assessments are generally school-based, and teachers enjoy autonomy in assessing their students based on the prescribed standards. The assessment features continuous assessment with a weightage of 40% and a 60% weightage at the end of term/session examinations (NPE, 2013).

On successful completion of junior secondary and senior secondary school, students appear for government's region-based examinations (National and West Africa) for the award of Junior School Certificate and Secondary School Certificate. These certificates are based on the students' performance in the final examinations and continuous assessment records.

Academic calendar and timetable

The academic calendar of Nigerian schools is divided into three terms per session and each term is made of 12-week duration. The academic session begins in September/October and ends in June/July of the following year. Three vacations per session are scheduled at the end of each term.

STEM subjects are officially allocated 3-4 lesson periods of 40-45 minutes per week, which is approximately required to cover the subject's curriculum. The average lesson hours for STEM subjects per annum are about 108 hours.

The average number of lesson periods (4), the 40 minutes duration per lesson period, and the total available hours per annum for STEM subjects were found to be inadequate by Principals and HODs. Teachers sought additional hours of teaching during weekends to cover the STEM subjects' curriculum and the examination syllabi. The syllabi of STEM subjects have been severally criticized as overloaded.

2.5.2   Teacher proficiency in science and math education

It is a popular saying that no educational system can rise above the quality of its teachers. Quality teaching and quality learning achievement and outcomes demand that teachers are qualified, have relevant subject matter knowledge, have pre-requisite skills and competencies, and possess the attitude and capabilities to induce quality learning (Mustapha, 2009). Therefore, staffing schools with qualified specialists and STEM teachers is a crucial determinant in the delivery of quality education services to learners and the society at large (Ndabawa, 2003). However, the adequacy of science teachers has remained an issue of concern, as a shortage of qualified STEM teachers is evident in Nigerian schools (Olawuwo, 2015).

Interviews with Principals of all schools during the field survey attested that their schools had qualified teachers for all STEM subjects, but they were inadequate in number. The gap was addressed by engaging part-time teachers and the National Youth Corps with the financial support of the Parent-Teacher Association (PTA).

STEM teachers' profile survey and field data (2021) are presented in the following tables.

Table 2.20: Qualification of STEM teachers

S. No.	Item	Frequency	Percentage
1	Bachelor's Degree	80	52
2	M.ED/MSC	15	9.7
3	M.Phil.	0	0
4	PGDE	38	24.7
5	PhD	1	0.64
6	Others	20	13.9
	Total	154	100

It can be observed from Table 2.20 that more than 85% of teachers were qualified to teach STEM subjects academically and professionally. Further, 52% had Bachelor's degrees, about 10% had

postgraduate degrees, and 24% had a postgraduate diploma in education. Only 13.9% had no degree and these may include OND, NCE, and HND.

Table 2.21: Years in the teaching profession of STEM teachers

S. No.	Item	Frequency	Percentage
1	Less than 5 years	11	7.1
2	5-10 years	28	18.2
3	10 years and above	115	74.7
	Total	154	100

Table 2.21 reveals that 92.9% of teachers had more than 5 years of teaching experience while only 7% had less than 5 years of experience and they fall in the category of NQTs. This has an implication to target teachers for the CL4STEM project. However, a majority of teachers in the surveyed schools were experienced but required professional development training, especially with the usage of ICT in teaching.

Specialization and subjects taught

Table 2.22: Specialization of STEM teachers

S. No.	Item	Frequency	Percentage
1	Mathematics	41	26.6
2	Physics	34	22.1
3	Chemistry	26	6.7
4	Biology	31	20.1
5	Computer Science	22	14.2
	Total	154	100

Table 2.22 reveals that 26.6% of the schoolteachers specialized in Mathematics, 22.1% in Physics, and 20.1% in Biology. The greater proportion of mathematics teachers may be connected to the fact that mathematics is a compulsory subject for all students at the secondary school level and it would require more teachers. Chemistry teachers were less with 6.7% and this may be connected to the fact that chemistry is an optional subject for many students, except core science students.

Table 2.23: Subject taught by STEM teachers

S. No	Item	Frequency	Percentage
1	Mathematics	41	26.6
2	Physics	34	22.1
3	Chemistry	26	6.7
4	Biology	31	20.1
5	Computer Science	22	14.2
	Total	154	100

Table 2.23 shows the number of teachers involved in the teaching of STEM in the surveyed schools. It is revealed from the preceding table that all teachers teach their subject of specialization. This is good for anticipated quality teaching. However, it was found that teachers teach outside their field of specialization in two cases.

As raised by most Principals and HODs, it is inferred that the number of STEM teachers is inadequate in schools. This is challenging and part-time teachers have to be engaged to fill the gap, as revealed during the interviews.

Field data on STEM teachers' access and use of ICT are presented in the following tables.

Table 2.24: Teachers' digital access in participating schools

States	Name of Schools	School Status	School Location	No. of teachers who own smartphone
Niger	FGC, Minna	Public	Urban	5
	GGSS, kontagora	Public	Urban	5
	GSC, Kutigi	Public	Semi-Urban	5
	MBGC, Minna	Public	Urban	5
	MKSS, Lapai	Public	Semi-Urban	5
	Govt Sc. College, IZOM	Public	Semi-Urban	5
	GGSS, Bida	Public	Urban	5
	Girls Science Sec, Sch, PAIKO	Public	Semi-Urban	5
	Govt. Science College, Kagara	Public	Semi-urban	5
	Government Science College, Wushishi	Public	Semi-urban	5
Kaduna	Capital School, Kaduna	Public	Urban	5
	Queen Amina College, Kaduna	Public	Urban	5
	GSS, Kaduna	Public	Urban	5
	GC, Kaduna	Public	Urban	5
	GSSS, Rigachikun	Public	Semi-Urban	5
Kano	GSS, R/Zaki	Public	Urban	
	Govt. College, Kano	Public	Urban	5
	FLC, Mariri	Public	Urban	5
	FGC, Kano	Public	Urban	5
	GGSS, Gezawa	Public	Semi-Urban	5

It should be noted that less than 10% of teachers in the participating schools had 0-5 years of teaching experience. Thus, the focus for developing the CL4STEM capacity in the Nigerian context would be to consider the teachers and NQTs available in schools, as proposed for the project.

Table 2.25: ICT devices owned by STEM teachers

S. No.	Item	Frequency	Percentage
1	Laptop	53	34.4
2	Desktop	20	13
3	Smart phone	62	40.3
4	iPad/tablet	19	12.3
	Total	154	100

Table 2.25 reveals that all teachers used one form of ICT or the other. A good number of teachers used either laptops or smartphones, with the latter being owned by most of the teachers. This may be due to the easy accessibility and versatility of smartphones for social communication.

Table 2.26: Communication media frequently used by STEM teachers

S. No.	Item	Frequency	Percentage
1	Email	57	37.1
2	Forums/ message boards	4	2.6
3	Facebook	33	21.4
4	WhatsApp	45	29.2
5	Messenger	8	5.2
6	Instagram	3	1.9
7	WeChat	1	0.64
8	Telegram	3	1.9
	Total	154	100

Table 2.26 reveals that a good number of teachers used email, Facebook, and WhatsApp as their most frequent media of communication. Instagram, WeChat, and Telegram are less popular in Nigeria and therefore were rarely used by STEM teachers.

Table 2.27: Internet and social media often use by STEM teachers

S. No	Item	Frequency	Percentage
1	Get news updates	97	63
2	Stay connected with friends	12	7.8
3	Shop online	14	9.1
4	Watch news, movies, etc.	6	3.9
5	Share information with teachers / parents	18	11.6
6	Professional networking	7	4.5
7	Others (specify)	0	0
	Total	154	100

Table 2.27 reveals that a majority of teachers used the internet and social media to get news updates and share information with colleagues, teachers, and parents. However, professional networking was found to be very low, and this may be connected to the fact that teachers in Nigerian secondary schools do not possess knowledge of online sharing for professional practice, for the community of practice, and collaboration.

Table 2.28: Digital applications often used by STEM teachers in classroom teaching, online classes, or professional development

S. No.	Item	Frequency	Percentage
1	Videos	55	35.7
2	Simulations	13	8.4
3	Google docs	12	7.7
4	Google drive	11	7.2
5	Google forms	2	1.2
6	Microsoft Word	28	18.1
7	Microsoft Excel	8	5.1
8	Microsoft PowerPoint	25	16.2
9	Geo-Gebra	0	0
10	PhET	0	0
11	Google classroom	0	0
12	Moodle	0	0
13	Others (Specify)	0	0
	Total	154	100

It can be observed from Table 2.28 that about 35.7%, 18.1%, and 16.2% used videos, Microsoft Word, and Microsoft PowerPoint, respectively, in classrooms, and this may be due to their ease and common usage. While none of the teachers used applications, such as GeoGebra, PhET, google classroom, and Moodle, this may be due to their lack of knowledge of such applications.

Table 2.29: Activities engaged by STEM teachers in the past three years

S. No.	Item	Frequency	Percentage
1	Taught online	25	16.2
2	Taken an online course	43	27.9
3	Participated in online forums/ message boards	86	55.8
	Total	154	100

Table 2.29 reveals that most of the teachers were engaged or participated in online discussions in the form of message boards or texting and this may be due to the simplicity. While only a few of the teachers (16.2%) were involved in online teaching, this may be connected to their lack of knowledge or technique involved.

Table 2.30: Gender distribution of STEM teachers

S. No.	Item	Frequency	Percentage
1	Male	114	74
2	Female	40	26
	Total	154	100

Table 2.30 reveals that a majority of STEM teachers were male with 74% of the whole population. This was another challenge on the part of gender differences in STEM that is often found in the literature.

2.5.3 Science and maths education learning infrastructure and resources

Analysis of interview data from the Principals and HODs focusing on the state of science education and STEM teaching and learning resources revealed the following:

- STEM education was prominent in the school curriculum and the government lent priority to the study of science by providing necessary resources, employing qualified teachers, providing laboratories and equipment, supplying books, and funding science teaching and learning.
- Admission into science classes was based on qualifying examinations conducted by central and state governments to ensure the quality of students' intake for STEM education.
- The government gave admission access to all categories of students through a selection process that allows the opportunity for equity and inclusiveness and considers the socio-economic, location, and gender factors. Therefore, the students' population in all schools was cut across different socio-economic strata, but a majority of students were from the middle class and lower economic strata.
- The state governments offered education free. This gave wider admission access to students from low socio-economic backgrounds to study STEM subjects.
- A greater number of schools had one laboratory each for Physics, Chemistry, and Biology, and a Computer laboratory/hybrid library. Few of the schools had 2-3 laboratories for each of the science subjects. A few of the schools had multipurpose science laboratories, which were grossly inadequate in resources and facilities for teaching STEM subjects. Mathematics laboratory was lacking in all schools.
- Several STEM teachers were qualified to teach their subject of specialization academically and professionally. Male STEM teachers outnumbered female STEM teachers in most of the cases. In a few cases, male student enrolment outnumbered female student enrolment in science classes.
- Few NQTs were recruited in the last three years and therefore teachers with less than five years of teaching experience were rarely found in schools.
- Teachers reported a lack of opportunity for professional development/training and thus, most of the STEM teachers in the field had not attended any ICT and STEM workshop in the last three years.
- The teachers generally had a high workload. The teacher-student ratio ranged from 1:60 to as high as 1:100. However, the teacher-student ratio was found to be less than 1:35 in one or two cases, which was lower than the national average of 1:51 and the ideal government-approved ratio of 1:35 in secondary school classes.
- Few of the Principals remarked that qualified teachers and teaching facilities were adequate, but the teachers required continuous professional training for which funds were not readily available. Most of the school Principals remarked having teachers for all STEM subjects but considered them as inadequate in number.
- The schools used the national core STEM curriculum published by NERDC and had relevant STEM textbooks. The schools used STEM textbooks, published by the Mathematical Association of Nigeria (MAN) and Science Teachers' Association of Nigeria (STAN).

- Most of the schools had at least one ICT laboratory and internet facilities. However, some computers were not functioning due to a lack of maintenance and power supply in a few cases. Few schools had more than one well-equipped science and ICT laboratories and the facilities were used for teaching.
- Some of the teachers were competent in the use of ICT, but generally needed training in the use of ICT in teaching.
- All schools received computers/ICT lab/hybrid library through School Net, National Communication Commission Federal and State governments, Telecommunication companies, Oil companies, Parent-Teacher Associations, Old Students' Associations, or from NGOs.

The following challenges mitigated the use of ICT in schools:
- Shortage of manpower, unstable power supply, lack of system maintenance, poor Internet connectivity, poor funding, etc.
- Due to the impact of COVID, the Principals revealed that academic activities were not conducted during the COVID lockdown. However, radio and television programs featuring lessons on STEM subjects and English helped students (especially final year students) to prepare for the examinations.
- COVID-19 caused a lot of learning hour loss, disruption and shortening of the academic calendar, and cancellation of the third term. However, e-learning/online teaching was promoted to complement face-to-face teaching during and after the COVID lockdown.
- Many female students studied STEM subjects in the surveyed schools and performed as per expectations.
- All Principals welcomed the CL4STEM project, applauded the objective, and considered it relevant for the requirements of schools and teachers in particular.

2.6 Stakeholders

Table 2.31: Stakeholders

SNo	Name of Stakeholders
1	Federal Ministry of Education, (FME) Abuja.
2	FME, Department of Technical and Science education
3	Niger State Ministry of Education, Science and Technology
4	Niger State Science and Technical Schools' Board
5	Kano State Ministry of Education, Science and Technology
6	Kano State Science and Technical schools 'Board
7	Kaduna State Ministry of Education
8	National Universities Commission, Abuja
9	National Commission for Colleges of Education, Abuja
10	Teachers Registration Council of Nigeria, Abuja
11	National Teachers' Institute, Kaduna
12	Nigerian Educational Research and Development Council (NERDC), Sheda, Abuja
13	Science Teacher Association of Nigeria (STAN), Kwali, Abujs
14	Mathematical Association of Nigeria (MAN), Abuja

3. About Ibrahim Badamasi Babangida University, Lapai

Figure 3.1: IBBUL

IBBUL - CL4STEM synergies

Ibrahim Badamasi Babangida (IBB) University is owned by the Niger state government. It was established with the mandate and commitment to its mission to the production of world-class graduates for the pursuit of all-around excellence through quality research, teaching, community service, and innovation.

It is guided by its core values and passion for the attainment of excellence in teaching, research, and community services, offering equal opportunities and respect for all, respecting the dignity and rights of all persons, and rendering sensitivity and responsiveness to contemporary development challenges through relevant and innovative programs, and ensuring a global outlook in all academic activities to make IBB University internationally recognized and globally focused. These core values are reflected in the university services and educational delivery and shall bear in the implementation of the CL4STEM project.

Towards the pursuit of its mandate, IBBUL has established relevant academic programs including Science Education. The Science Education program is established to give an adequate knowledge base to students in both subject matter and pedagogical skills to meet the current global practices and with the mission to produce a new crop of professional science teachers with relevant pedagogical skills that include ICT skills, competence for knowledge management, life-long learning, and professional practice.

In the context of the above factors, the Department of Science Education, IBB University offers the following degree programs:

- B. Sc Ed Biology
- B. Sc Ed Chemistry
- B. Sc Ed Physics
- B. Sc Ed Geography
- B. Sc Ed Mathematics
- B. Sc Ed Computer Science

The implementation of the programs is carried out through two faculties, namely, the Faculty of Natural Science, and the Faculty of Education and Arts. The objective of these programs is to provide strong subject matter knowledge and pedagogical content knowledge through relevant faculty experts in the respective fields of study. Therefore, adequate and quality human resources are available for teaching, research, and adopting innovative practices and programs of the CL4STEM project in the university.

Engagement with ICT and pedagogical practice for pre-service teachers

The Department of Science Education has a functional educational and technological laboratory, an ICT laboratory, a science education methodology laboratory, and a mathematics laboratory, which are being deployed effectively for teaching and research, and students' micro-teaching practice and research. The curriculum of the pre-service teachers includes a course in general studies, GST 104 Use of Library, Study Skills and ICT, and department-based courses; EDU 320: Educational Technology and SED 308: ICT in Science Education. The science education program is sufficient to equip pre-service students with the prerequisites for the CL4STEM project and the available resources in the department and faculty can meet the demands for the CL4STEM project. This is to align with the project activity of diffusing knowledge and to achieve the project objective with respect to pre-service teacher education.

Engagement with ICT and pedagogical practice and training of faculties

Generally, the faculties are exposed to several workshop training in the usage of ICT for various education processes including deployment of ICT in teaching. In the recent past, the faculties were trained in the usage of the smart board for teaching, usage of teaching Moodle for educational processes, and usage of ADAPTI for computer administrative skills. Microsoft, word processing, Excel and statistical packages, and University-based ICT training of faculties was used for teaching and developing OERs in the university. These practices have enhanced the capabilities of all faculties and core science educators to curate and implement OERs that could be used for training NQTs.

Profiles of key teacher educators engaged in the CL4STEM project

Table 3.1: Profiles of key teacher educators engaged in the CL4STEM project

Full Name	Institution	Subject
Prof. Garba Shuaibu	BUK	Mathematics
Mutawakkilu Muhammad	BUK	Science (Chemistry)
Mufida Bello Hussain	BUK	Science (Biology)
Idris Hamza Kawo	BUK	Science (Physics)
Naomi John Dadi-Mamud	IBBUL	Science (Biology)
Aliyu Alhaji Zakariyya	IBBUL	Mathematics
Murtala Haruna Harbau	BUK	Mathematics
Yusuf Abdullahi	IBBUL	Science (Physics)
Dr Jibrin Alhaji Yabagi	IBBUL	Science (Physics)
Dr Fatima Shehu Kabir	KADSU	Mathematics
Aliyu Umar Abubakar	KADSU	Mathematics
Haliru Ibrahim	KADSU	Science (Physics)
Samira Dahiru Hunkuyi	KADSU	Science (Biology)
Prof Salihu Abdulwaheed Adelabu	IBBUL	Mathematics
Dr Sarah Victor USMAN	KADSU	Science (Chemistry)
Prof James Omonu	IBBUL	Science (Biology)
Ibrahim Abdullahi	IBBUL	Mathematics

Table 3.2: Profiles of other team members

Consortium	Researcher Name	Subject / Expertise
Research Team		
Team Leader	Prof Muhammad Mustapha	Science Education
Advisor	Prof Steve Nwokoecha	Education
Member	Dr Aminu Wushishi	Science Education
Member	Aliyu Zakariyya	Science Education
Member	Prof J. Boyi Omonu	Health Education
Adaptation Team		
Team Leader	Prof Salihu Adelabu	Education
Member	Dr Abdullahi Ibrahim	Computer Science / ICT
Member	Dr Naomi DadiMamud	Biology
Dissemination Team		
Team Leader	Prof M. Aliyu Paiko	Chemistry
Member	Prof Dickson Musa	Chemistry
Member	Dr Hussaini Majiya	Biology

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