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EVALUATION

**INTEGRATING INQUIRY-BASED LEARNING AND  
TECHNOLOGY IN STEM EDUCATION:  
STRATEGIES TO FOSTER LEARNERS INTEREST  
IN SOME PRIMARY SCHOOLS IN YAOUNDE 6**

*A Dissertation Presented and defended on the 28<sup>th</sup> July 2025*

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## **DEDICATION**

**To my daughter  
Lontti Sharon Lombe**

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## CERTIFICATION

We hereby certify that this dissertation title: **Integrating inquiry based learning and technology in STEM education: boosting learner's interest in some primary schools in Yaoundé VI subdivision** submitted to the Department of Curriculum and Evaluation, Faculty of Education in the University of Yaoundé 1 was carried out by Elemwa Ntube Mirabel registration number 22V3888 of University of Yaoundé I, Faculty of Education, department of Curriculum and Evaluation. The work has been properly referenced and acknowledged.

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## ABBREVIATIONS

AU-STISA	Africa Union's Science, Technology and Innovation Strategies for Africa
CAB	Competency Based Approach
CBC	Competence Based Approach
CESA	Continental Educational Strategies for Africa
ELT	Experimental Learning Theory
GPE	Global Partnership for Education
IBL	Inquiry Base Learning
ICT	United Nation Education Technology
MINESEC	Ministry of Secondary Education
NDS	National Development Strategies
NGO	Non-Governmental Organisation
OER	Over Educational Resources
PBL	Problem Based Learning
SDG	Sustainable Development Goals
SPSS	Statistical Package for Social Science
STEM	Science Technology Engineering and Mathematics
TPACK	Technological Pedagogical Content Knowledge
TPD	Teacher Professional Development
ZPD	Zone of Proximal Development
TPACK	Technological pedagogical Content Knowledge
MASLEPT	Mastery of Active shared Learning Processes of Techno-Pedagogy

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## ABSTRACT

This study investigates the integration of Inquiry-Based Learning (IBL) and technology in STEM education as a strategy to enhance learner interest in primary schools within Yaoundé VI Subdivision, Cameroon. Grounded in constructivist, experiential, and problem-based learning theories, the research employs a mixed-methods approach combining surveys, interviews, classroom observations, and document analysis. Quantitative data from 300 pupils, 10 head teachers and 50 teachers revealed significant correlations between IBL practices, digital integration, and learner motivation in STEM. Regression analysis confirmed IBL and technology as strong predictors of learner interest, with IBL having a more substantial impact. Qualitative findings highlighted systemic barriers such as lack of digital infrastructure, limited teacher training, and overcrowded classrooms. Teachers expressed willingness to implement IBL and digital tools but emphasized the need for support in materials, training, and time allocation. The study concludes that effective STEM pedagogy requires not only innovative teaching strategies but also structural reforms aligned with Cameroon’s Education and Training Sector Strategy Plan (2023–2030), the National Development Strategy 2030 (NDS30), and Sustainable Development Goal 4. Recommendations include targeted professional development, resource provision, and school-based support systems to sustain innovation in STEM teaching and learning.

**Keywords:** *Inquiry-Based Learning, STEM Education, Technology Integration, Learner Interest, Primary Education, Cameroon*

## RÉSUMÉ

Cette étude examine l'intégration de l'apprentissage par investigation (IBL) et de la technologie dans l'enseignement des STEM comme stratégie visant à accroître l'intérêt des apprenants dans certaines écoles primaires de l'arrondissement de Yaoundé VI, Cameroun. Fondée sur les théories de l'apprentissage constructiviste, expérientiel et basé sur les problèmes, la recherche adopte une approche méthodologique mixte incluant des questionnaires, des entretiens, des observations de classe et l'analyse documentaire. Les données quantitatives recueillies auprès de 300 élèves et 50 enseignants ont révélé des corrélations significatives entre les pratiques IBL, l'intégration du numérique et la motivation des élèves en STEM. L'analyse par régression a confirmé que l'IBL et la technologie sont de puissants prédicteurs de l'intérêt des élèves, l'IBL ayant l'impact le plus élevé. Les résultats qualitatifs ont mis en évidence des obstacles systémiques tels que le manque d'infrastructure numérique, la formation insuffisante des enseignants et la surcharge des effectifs. Les enseignants ont exprimé leur volonté d'adopter ces approches innovantes, mais ont souligné le besoin de soutien en termes de matériel, de formation continue et de temps dédié. L'étude conclut que pour une mise en œuvre efficace de la pédagogie STEM, il est nécessaire de combiner stratégies pédagogiques innovantes et réformes structurelles en cohérence avec le Plan Stratégique du Secteur de l'Éducation 2023–2030, la Stratégie Nationale de Développement 2030 (SND30), et l'Objectif de Développement Durable n°4. Des recommandations sont faites pour renforcer la formation professionnelle ciblée, fournir des ressources adaptées et mettre en place des mécanismes de soutien à l'échelle des établissements scolaires.

*Mots-clés : Apprentissage par investigation, Éducation STEM, Intégration technologique, Intérêt des apprenants, Éducation primaire, Cameroun*

# CHAPTER ONE

## INTRODUCTION

This chapter entails this research work introduction, background of the study, statement of the problem, objectives of the study, research questions, research hypotheses, significance of the study, justification of the study, scope and delimitation of the study and operational definition of terms. The integration of inquiry-based learning (IBL) and technology in Science, Technology, Engineering, and Mathematics (STEM) education has gained prominence globally as an effective approach to fostering learner engagement, problem-solving skills, and critical thinking. As nations strive to develop 21st-century competencies in their youth, particularly in the Global South, there is growing recognition that traditional didactic teaching methods fall short in preparing learners for complex, real-world challenges. Cameroon, through its education policy frameworks including the 1998 Orientation Law of Education, the Education and Training Sector Strategy Plan (2023–2030), and the National Development Strategy (NDS) 2030—has embraced competency-based education and digital transformation as central pillars for educational reform.

Primary education serves as the foundation for lifelong learning and is a critical stage for cultivating interest in STEM subjects. Yet, in many Cameroonian primary schools, STEM instruction is often theoretical, teacher-centred, and disengaging for pupils. Research has shown that early exposure to hands-on, inquiry-driven learning experiences not only enhances understanding of scientific concepts but also stimulates curiosity and a lifelong passion for STEM fields. Technology, when appropriately integrated, can support interactive learning environments, offer access to simulations and digital content, and promote collaboration and differentiated instruction. Despite these potentials, many schools in Cameroon face challenges including limited resources, inadequate teacher training, and lack of structured frameworks for implementing IBL and digital pedagogy.

The 1998 Orientation Law of Education emphasizes the development of intellectual, physical, civic, and moral capacities through learner-centred pedagogies. It calls for a system that nurtures autonomy, creativity, and the capacity for lifelong learning. These goals are further reinforced by the Education and Training Sector Strategy Plan (ETSSP) 2023–2030, which prioritizes the integration of information and communication technologies (ICTs) and the promotion of innovative teaching methods. Additionally, Cameroon’s NDS30 highlights education and human capital development as strategic pillars for achieving inclusive growth,

poverty reduction, and sustainable development. These policies are also aligned with Sustainable Development Goal 4, which seeks to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

### **Background of the Study**

The twenty-first century has ushered in an era of complex global challenges that demand innovative, scientific, and technologically competent citizens. Science, Technology, Engineering, and Mathematics (STEM) education has emerged as a strategic priority for nations seeking to foster sustainable development, address unemployment, and enhance competitiveness in a knowledge-driven global economy (; UNESCO, 2020 World Bank, 2021). STEM subjects enable learners to develop the core competencies required to thrive in the global economy skills such as critical thinking, creativity, collaboration, and digital literacy. In this context, primary education plays a critical role in laying the foundational competencies necessary for learners to develop scientific inquiry, technological fluency, and problem-solving abilities that are essential for lifelong learning and socio-economic transformation (Talasza, 2022; Yelland, 2019).

Historically, STEM education has evolved from fragmented subject-specific instruction into an integrated model that emphasizes interdisciplinary learning and real-world application. STEM learning teaches students to ask questions, look at a problem through multiple lenses, work collaboratively with others, plan carefully, become flexible, embrace change, improve upon their idea, persevere through challenges, and open themselves up to discussing new ideas and differing points of view. STEM education requires deep thought, intensive planning, adaptability, and reflection for successful implementation.

This approach focuses on teaching these four subject areas in a “cohesive learning paradigm based on real-world applications” (Hom, 2014). STEM curricula incorporates hands on learning, collaboration, and creativity in the classroom. It allows students to look at real world problems and come together to solve them in creative ways. This type of learning presents students with the opportunity to think outside of the box, let their imagination run wild, and build the skills to become 21<sup>st</sup> century learners.

Initially, science, technology, engineering, and mathematics were taught as isolated disciplines with limited focus on cross-curricular integration. This siloed approach often hindered students' ability to make meaningful connections between concepts and to apply their knowledge in

practical, innovative ways. However, as global economies shifted toward knowledge-based industries in the mid-20th century, the need for a scientifically literate and technologically proficient population became more urgent.

In the global North particularly in the United States, United Kingdom, and parts of Europe educational reforms emerged in response to the post-industrial economy's demand for innovation and problem-solving skills. The 1957 launch of the Soviet Sputnik satellite sparked widespread concern in the United States over its scientific competitiveness, leading to federal investments in science education under initiatives like the National Defence Education Act (1958). These efforts prioritized inquiry, experimentation, and analytical reasoning in school curricula, moving away from rote memorization and passive learning.

Concurrently, developments in educational psychology provided the theoretical foundation for STEM pedagogical reform. The constructivist revolution, led by theorists such as Jean Piaget, Lev Vygotsky, and Jerome Bruner, reshaped how educators understood learning processes. Piaget emphasized that children construct knowledge through active engagement with their environment, progressing through developmental stages that influence how they comprehend abstract concepts (Piaget, 1950). Vygotsky introduced the idea of the Zone of Proximal Development, advocating for guided learning through social interaction and scaffolding (Vygotsky, 1978). Bruner advanced the concept of discovery learning, suggesting that students learn best when they are encouraged to explore and infer principles on their own rather than receive direct instruction (Bruner, 1961).

These constructivist ideas prompted a pedagogical shift from teacher-centered to learner-centered instruction. Rather than treating learners as passive recipients of knowledge, educators began designing activities that encouraged exploration, hypothesis testing, and collaborative problem-solving. This philosophical shift aligned closely with emerging STEM educational models that sought to engage learners in processes resembling those used by scientists and engineers. The resulting teaching approaches such as inquiry-based learning (IBL), project-based learning (PBL), problem-based learning, and experiential learning emerged as powerful strategies for building deep conceptual understanding and real-world problem-solving abilities.

By the 1980s and 1990s, integrated STEM education gained further traction as educational systems in the global North began to emphasize interdisciplinary curricula that merged scientific content with technological application and engineering design. The National Science

Education Standards in the United States, for instance, encouraged the development of scientific literacy through hands-on inquiry and cross-cutting concepts (NRC, 1996). In the UK, similar reforms promoted curriculum models that enabled students to apply mathematics and technology in scientific contexts, enhancing their ability to innovate and solve complex problems.

The late 20th century also witnessed the rapid proliferation of information and communication technologies (ICTs), which catalyzed new forms of digital learning. The integration of technology in STEM instruction allowed for interactive simulations, data analysis tools, collaborative platforms, and virtual laboratories that transcended the limitations of traditional classrooms. These digital tools empowered learners to visualize abstract concepts, manipulate variables, and engage in authentic scientific inquiry regardless of geographic or material constraints (Kopcha et al., 2017).

Moreover, global benchmarking studies such as the Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) began to emphasize problem-solving, reasoning, and application skills in evaluating educational systems. As a result, education ministries and school boards in the global North adopted competency-based curricula and national STEM strategies aimed at nurturing learners who are prepared for dynamic, technology-driven economies.

Thus, the evolution of STEM education from isolated content instruction to integrated, inquiry-driven, and technology-supported learning is both historical and dynamic. It reflects broader societal shifts toward innovation, collaboration, and lifelong learning. Today, STEM education continues to evolve, influenced by advances in artificial intelligence, robotics, and data science, reinforcing the need for foundational approaches that begin in early childhood and primary education.

Conceptually, IBL is defined as a pedagogical strategy that encourages learners to explore, question, experiment, and construct new knowledge through active participation (Harlen, 2010). Modeled on the scientific method, the particular process of inquiry Dewey (1910) advocated involved “sensing perplexing situations, clarifying the problem, formulating a tentative hypothesis, testing the hypothesis, revising with rigorous tests, and acting on the solution” (Barrow, 2006, p. 266) Unlike traditional teacher-centered methods, IBL fosters curiosity, autonomy, and engagement by emphasizing the process of learning rather than the

mere acquisition of facts. Learners are guided to investigate real-world problems, formulate hypotheses, test solutions, and reflect on their findings. This method aligns closely with the experiential learning theory proposed by Kolb (1984), which posits that knowledge is created through the transformation of experience. The experiential learning theory works in four stages: concrete learning, reflective observation, abstract conceptualization, and active experimentation. The first two stages of the cycle involve grasping an experience, the second two focus on transforming an experience. Kolb argues that effective learning is seen as the learner goes through the cycle, and that they can enter into the cycle at any time.

Technology integration, on the other hand, refers to the purposeful use of digital tools and platforms to enhance teaching and learning. From educational software and simulations to interactive whiteboards and online collaboration tools, technology facilitates personalized learning pathways, real-time feedback, and access to a wide range of content (Mishra & Koehler, 2006; Akram & Li, 2024). Especially in the early days of the introduction of digital technologies in schools, there was a tendency to focus on digital tools and skills; more recently, the focus shifted toward the pedagogical use of technology to achieve specific learning goals (Davies & West, 2014; Duran, 2022). When combined with IBL, digital tools amplify the effectiveness of inquiry by enabling learners to visualize concepts, simulate experiments, and collaborate beyond classroom walls (Kopcha et al., 2017).

Globally, numerous studies and policy frameworks recognize the synergy between IBL and technology in improving STEM education. For example, the OECD (2021) highlights that countries implementing innovative pedagogies supported by digital tools tend to outperform those relying solely on traditional methods. Research in Indonesia, the United States, and Finland has demonstrated that learners exposed to inquiry and technology-based STEM instruction exhibit higher levels of motivation, achievement, and conceptual understanding (Sarnoko et al., 2024).

In Sub-Saharan Africa, the call for STEM education reform is growing stronger. The African Union's Science, Technology and Innovation Strategy for Africa (AU-STISA 2024) emphasizes the need for member states to integrate STEM at all levels of education to drive innovation and youth employability. Countries such as Rwanda, Ghana, and Kenya have launched national STEM strategies and digital learning platforms to expand access and equity. In Rwanda, for example, the Smart Classrooms initiative leverages ICTs to support inquiry-

driven STEM lessons, with measurable gains in learner engagement and achievement (UNESCO, 2023).

In Cameroon, STEM education is gaining prominence within national policy discourse. The 1998 Orientation Law of Education, particularly in Section 4 and Section 25, underscores the role of education in fostering scientific and technological advancement. The Education and Training Sector Strategy Plan (ETSSP) 2023–2030 echoes this mandate by prioritizing ICT integration, teacher professional development, and competency-based curricula. The National Development Strategy 2030 (NDS30) further highlights STEM education as a catalyst for economic transformation and inclusive growth (MINESEC, 2023). These frameworks are harmonized with global commitments, especially Sustainable Development Goal 4, which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Nonetheless, the gap between policy intent and implementation remains wide. Many Cameroonian primary schools continue to rely on traditional, teacher-dominated methods that suppress learner agency and curiosity. Classrooms are often overcrowded, under-resourced, and lacking in digital infrastructure. Teachers, though committed, frequently lack training in inquiry pedagogy and digital competency. According to Tchombe et al. (2020), these challenges have led to learner disengagement, poor STEM performance, and limited interest in science and technology careers.

The Yaoundé VI Subdivision represents a microcosm of these challenges and opportunities. It encompasses a blend of public and private schools with varied access to teaching and learning resources. While some schools have experimented with digital learning and student-centered approaches, many continue to operate under rigid curricula and outdated instructional methods. Parents and community stakeholders express concerns about learners' declining interest in science and the lack of practical exposure to real-life applications of STEM concepts.

In this context, it becomes imperative to investigate how innovative pedagogies specifically IBL and technology-enhanced instruction can be systematically integrated into STEM education in Yaoundé VI. By doing so, this study aims to generate evidence on how these strategies influence learners' motivation, participation, and academic success in STEM subjects. The research aligns with Cameroon's broader educational reforms and developmental goals, including the Vision 2035 Framework and the SDGs.

Moreover, building learners' STEM capacities at the primary level has broader implications for national development. A digitally literate and scientifically curious population is better equipped to innovate, solve local problems, and contribute to knowledge economies. As such, this study is not only relevant for education policy but also critical for labour market readiness, social inclusion, and sustainable development.

In general, this research is situated at the intersection of global trends, national policies, and local realities. It contributes to the scholarly discourse on STEM education by exploring how IBL and digital tools can transform classroom practices and reignite learner interest. By focusing on the foundational level of primary schooling, it offers a strategic entry point for long-term educational transformation in Cameroon.

The integration of inquiry-based learning (IBL) and technology in Science, Technology, Engineering, and Mathematics (STEM) education has gained prominence globally as an effective approach to fostering learner engagement, problem-solving skills, and critical thinking. As nations strive to develop 21st-century competencies in their youth, particularly in the Global South, there is growing recognition that traditional didactic teaching methods fall short in preparing learners for complex, real-world challenges. Cameroon, through its education policy frameworks including the 1998 Orientation Law of Education, the Education and Training Sector Strategy Plan (2023 to 2030), and the National Development Strategy (NDS) 2030 has embraced competency-based education and digital transformation as central pillars for educational reform.

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STEM education emphasizes three fundamental elements (problem solving, innovation, and design) that have a significant place on every countries’ agenda (Hernandez et al., 2014). STEM education is a learning and teaching approach that integrates science, technology, engineering and mathematics knowledge and skills (Maryland, 2012). STEM education is aimed at the development of students’ research-questioning, logical reasoning, and working behaviours in a collaboration. In this respect, the aim of STEM education is to train qualified individuals to meet the 21st century workforce needs (Moore, 2009).

Thus, in order to prepare young people with the skills needed to compete in the job market and economic development, STEM education (Science, Technology, Engineering & Mathematics) a new educational innovation was introduced in the Cameroonian Education Development Plan (GESP) 2009 blueprint. Thus, the role of teacher as an implementer of innovation should be taken seriously in promoting STEM education. These policies are also aligned with Sustainable Development Goal 4, which seeks to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Yaoundé VI Subdivision, located in the Centre Region of Cameroon, comprises a mix of public and private primary schools serving diverse populations. While some schools have made efforts to modernize their teaching practices, others continue to grapple with structural and pedagogical limitations. Teachers often lack the training, resources, and institutional support needed to implement inquiry-based STEM teaching or integrate digital tools effectively. Moreover, learners’ interest in STEM subjects appears to wane due to rote learning, abstract instruction, and limited practical engagement.

Given this context, it becomes essential to explore how IBL and technology are currently utilized in STEM education at the primary level, what challenges exist, and what strategies may be adopted to enhance learner motivation and interest. This research, therefore, aims to investigate the extent to which IBL and technological tools are integrated into STEM

instruction in selected primary schools within Yaoundé VI Subdivision, and how these practices influence learners' engagement and interest in STEM subjects.

The study adopts a mixed-methods approach, combining quantitative data from surveys and assessments with qualitative insights from interviews and classroom observations. It seeks to provide a nuanced understanding of pedagogical practices in STEM education, assess the alignment between policy and practice, and offer evidence-based recommendations for stakeholders at the national and local levels.

By investigating these dynamics, the study contributes to educational research and policymaking in Cameroon, offering practical insights that can support school-level interventions and national strategies aimed at transforming primary education. The findings are expected to inform teacher professional development programs, resource allocation, curriculum design, and school leadership strategies in fostering a more interactive, inclusive, and engaging STEM education environment for young learners (Harlen, 2010; Fullan, 2020; UNESCO, 2023).

Additionally, students benefit most from an interdisciplinary approach to learning and coursework. A review by the National Research Council (2012) revealed that effective instructional strategies in STEM disciplines involve incorporating interactive lectures, group work, opportunities for formative feedback, and authentic problems and activities. In general, the report suggests that moving away from recipe-driven instructional approaches when teaching in STEM-related subjects, and toward more open-ended and student-driven experiences can motivate students to take an interest in math and science discipline.

Empirical studies affirm that inquiry-driven instruction significantly enhances conceptual understanding and retention in science education (Duschl & Bybee, 2014; Van Horne et al., 2018). Similarly, digital tools have been shown to improve differentiated instruction and collaborative learning, especially in large and diverse classrooms (Mishra & Koehler, 2022; OECD, 2021). These global findings mirror challenges and opportunities observed in Cameroonian schools (Tchombe et al., 2020). According to Saage (2021), contextual constraints such as teacher training gaps and infrastructural limitations remain barriers to effective implementation of educational innovations in Sub-Saharan Africa.

Nationally, Cameroon's Orientation Law of 1998 emphasizes the use of learner-centered approaches and the moral, intellectual, and civic development of the child. The Education and Training Sector Strategy Plan (2023–2030) builds on this foundation by focusing on inclusive, equitable, and digitally-enabled education systems. Moreover, the National Development Strategy 2030 prioritizes education and human resource development as enablers of sustainable economic growth. These commitments align with SDG 4, which calls for inclusive and equitable quality education and the promotion of lifelong learning opportunities for all (UNESCO, 2023).

Thus, this study is not only timely but necessary. It responds to both national policy mandates and global calls for innovation in basic education, particularly in STEM fields. The study's outcomes are expected to serve as a roadmap for more effective integration of IBL and digital pedagogy in Cameroon's primary schools, contributing to both educational quality and equity and policymaking in Cameroon, offering practical insights that can support school-level interventions and national strategies aimed at transforming primary education. The findings are expected to inform teacher professional development programs, resource allocation, curriculum design, and school leadership strategies in fostering a more interactive, inclusive, and engaging STEM education environment for young learners.

### **Statement of the Problem**

In recent years, Cameroon has witnessed a growing national and international interest in Science, Technology, Engineering, and Mathematics (STEM) education as a vehicle for socioeconomic transformation. This interest is reflected in national policy documents such as the 1998 Orientation Law of Education, the Education and Training Sector Strategy Plan (ETSSP) 2023–2030, and the National Development Strategy 2020–2030 (NDS30), all of which emphasize the urgent need to develop 21st-century competencies through learner-centered, inquiry-based, and digitally integrated instruction. These documents recognize that an economy driven by innovation, entrepreneurship, and global competitiveness requires foundational STEM competencies acquired from early stages of education (Republic of Cameroon, 2020; MINESEC, 2023).

Despite this policy momentum, there remains a significant gap between official intentions and the actual teaching and learning practices observed in many primary schools across Cameroon, particularly in urban and peri-urban areas such as Yaoundé VI Subdivision. While the curriculum has been revised to encourage active learning, practical STEM applications, and

digital tool integration, classroom realities often paint a different picture. Primary school teachers continue to rely on conventional didactic approaches that emphasize rote memorization, teacher authority, and abstract instruction. These methods neither engage learners nor develop their curiosity, problem-solving abilities, or capacity to explore real-world applications of STEM concepts (Tambo, 2003; Essono & Fouda, 2018).

Moreover, the lack of adequate pedagogical training in innovative STEM methods further widens the implementation gap. Many teachers have received little to no professional development in integrating inquiry-based learning (IBL) or educational technology in meaningful ways. As a result, they often lack the confidence, competencies, and classroom management strategies required to guide learners through open-ended scientific investigations or facilitate technology-mediated learning environments (UNESCO, 2023; Tchombe et al., 2020).

Infrastructural and resource constraints compound the problem. Classrooms in Yaoundé VI frequently lack access to even the most basic science and digital tools, such as microscopes, computers, internet connectivity, or audio-visual materials. Where available, these tools are often underutilized due to insufficient training or poor maintenance. Furthermore, overcrowded classrooms, rigid assessment practices, and limited institutional support leave little room for pedagogical experimentation or differentiated instruction. Consequently, learners are exposed to STEM content in ways that feel abstract, disconnected from their daily lives, and uninspiring.

This disconnect has serious consequences for learner outcomes and broader national goals. Studies reveal that students who are not engaged through active and meaningful learning experiences in STEM subjects are less likely to develop long-term interest in STEM careers (Eslit, 2023). They also tend to perform poorly on problem-solving tasks, exhibit low self-efficacy in science and math, and fail to acquire the critical thinking and digital literacy skills essential for the modern workforce (Adeoye & Jimoh, 2023; Van Horne et al., 2018). In a knowledge-based global economy, this has far-reaching implications for Cameroon's ability to produce competitive human capital and achieve inclusive development targets outlined in the NDS30 and the Sustainable Development Goals (SDGs), particularly Goal 4 and Goal 9.

The issue is even more pressing at the primary school level, which serves as the foundation of all subsequent learning. Learners in their formative years are naturally curious and responsive to interactive and exploratory modes of instruction. If primary STEM education fails to

leverage this developmental window, it misses the opportunity to instill foundational scientific reasoning and technological fluency. Moreover, early experiences with inquiry-based and technology-supported STEM learning have been shown to predict later achievement and interest in STEM fields (Yelland, 2019; Akram & Li, 2024). Therefore, strengthening STEM teaching methods at the primary level is a strategic investment in Cameroon's long-term educational and economic success.

In Yaoundé VI Subdivision, which contains a diverse range of public and private institutions, the diversity of learner backgrounds, school capacities, and parental support structures presents both a challenge and an opportunity. While some schools have piloted digital initiatives or experiential learning models, many others operate in low-resource environments with limited exposure to modern pedagogical tools and methodologies. The variability in teacher preparedness, classroom infrastructure, and school leadership further contributes to inconsistent STEM delivery across the subdivision. These disparities threaten to exacerbate educational inequalities and hinder national efforts toward equitable and inclusive education as articulated in the ETSSP 2023–2030 (MINEDUB, 2023).

The root of the problem lies not only in the lack of resources or training but also in the absence of systemic integration of inquiry-based learning and digital tools into school culture, curriculum design, and instructional supervision. Efforts to address this disconnect must, therefore, go beyond material provision to include pedagogical transformation, professional development, community engagement, and institutional support mechanisms.

Thus, the central problem this study seeks to address is: *How can strategic teaching approaches such as experiential learning, problem-based learning, and real-world contextualization support the integration of inquiry-based learning and technology in primary STEM education to foster learner interest and engagement?* This research investigates the extent to which such strategies are currently applied in selected primary schools in Yaoundé VI and the extent to which they influence learners' curiosity, participation, and overall motivation toward STEM subjects.

## **Objectives of the Study**

### **General Objective**

The general objective is to investigate the influence of teaching strategies on integrating inquiry-based learning and technology in STEM education in selected primary schools in Yaoundé VI Subdivision.

### **Specific Objectives**

To assess the influence of experiential learning on the integration of inquiry-based learning and technology in STEM education.

To evaluate how problem-based learning supports the integration of inquiry-based learning and technology in STEM education.

To examine the role of real-world relevance (teacher professional development and contextual applications) in promoting learner interest in STEM education.

### **Research Questions**

#### **General Research Question**

What is the influence of teaching strategies on integrating inquiry-based learning and technology in STEM education in selected primary schools in Yaoundé VI Subdivision?

#### **Specific Research Questions**

1. How does experiential learning influence the integration of inquiry-based learning and technology in STEM education?
2. What is the role of problem-based learning in promoting learner engagement in STEM through inquiry and technology?
3. How does real-world relevance enhance learner motivation and interest in STEM education?

### **Research Hypotheses**

#### **General Hypothesis**

**H1:** Teaching strategies significantly influence the integration of inquiry-based learning and technology in STEM education in selected primary schools in Yaoundé VI Subdivision.

**H0:** Teaching strategies do not significantly influence the integration of inquiry-based learning and technology in STEM education.

### **Specific Hypotheses**

**Null Hypothesis (H<sub>01</sub>):** There is no significant relationship between the use of inquiry-based learning strategies and learners' interest in STEM subjects in primary schools in Yaoundé VI Subdivision.

**Alternative Hypothesis (H<sub>11</sub>):** There is a significant relationship between the use of inquiry-based learning strategies and learners' interest in STEM subjects in primary schools in Yaoundé VI Subdivision.

**Null Hypothesis (H<sub>02</sub>):** The integration of digital technology in STEM teaching does not significantly affect learners' engagement in STEM subjects in primary schools in Yaoundé VI Subdivision.

**Alternative Hypothesis (H<sub>12</sub>):** The integration of digital technology in STEM teaching significantly affects learners' engagement in STEM subjects in primary schools in Yaoundé VI Subdivision.

**Null Hypothesis (H<sub>03</sub>):** Teaching methods that integrate real-world applications do not significantly influence learners' motivation in STEM subjects in Yaoundé VI Subdivision.

**Alternative Hypothesis (H<sub>13</sub>):** Teaching methods that integrate real-world applications significantly influence learners' motivation in STEM subjects in Yaoundé VI Subdivision.

### **Significance of the Study**

The significance of this study lies in its potential contribution to theory, practice, policy, and educational reform within Cameroon and across comparable low-resource contexts. In an era marked by rapid technological advancement and the growing importance of STEM competencies, this research addresses a critical need to understand how inquiry-based learning (IBL) and technology integration can be harnessed to enhance teaching and learning in primary education.

Firstly, this study is significant for educational theory and academic research. While considerable literature exists on the effectiveness of IBL and technology in improving STEM outcomes, much of this research originates from high-income countries with well-resourced education systems. The applicability of these findings in low-resource settings such as Cameroon remains under-explored. By investigating the contextualized use of IBL and digital tools in Cameroonian primary schools, this research adds to the global body of knowledge on STEM education in developing countries. It also provides empirical data that can refine

pedagogical theories related to learner-centered instruction, constructivist teaching, and digital literacy in foundational education.

Secondly, the study has practical implications for teachers and school administrators. Teachers in primary schools are at the forefront of curriculum implementation. However, many lack exposure to innovative teaching methods or the confidence to use technology effectively in the classroom. This research will uncover the challenges they face, the strategies they adopt, and the support they need to transition from traditional to inquiry-based, digitally enriched teaching. The study's findings can inform the development of targeted professional development programs, model lesson plans, and school-based interventions that equip teachers with concrete tools and practices for delivering engaging STEM education.

For school administrators and instructional supervisors, the study will shed light on systemic factors that hinder or facilitate the integration of IBL and technology. Insights into school leadership practices, resource allocation, and teacher support mechanisms can help in designing school improvement plans that prioritize innovative pedagogies and learner engagement. This is particularly important in urban school districts such as Yaoundé VI, where educational inequality and resource variability require context-specific management strategies.

Thirdly, the study is significant for educational policy and curriculum development. Cameroon's Education and Training Sector Strategy Plan (2023–2030) and National Development Strategy (NDS30) emphasize digital transformation, STEM capacity-building, and inclusive education. Yet, policy implementation often falters due to lack of empirical feedback on what works and what does not. This research will provide actionable recommendations for policymakers regarding curriculum design, digital infrastructure provision, and the inclusion of IBL frameworks in teacher training colleges. It supports evidence-based policymaking, thereby aligning classroom practice with national development objectives and Sustainable Development Goal 4 on quality education.

At the community and societal level, the study has implications for parental engagement, equity, and workforce readiness. When learners experience STEM education as engaging, meaningful, and relevant to their daily lives, they are more likely to pursue further studies and careers in science and technology fields. This can help bridge gender gaps in STEM participation, reduce youth unemployment, and contribute to the growth of a skilled labour force that can drive Cameroon's digital economy. Moreover, by identifying and addressing barriers to STEM

engagement at an early age, the study promotes social inclusion and educational equity, particularly for learners from underserved communities.

The study is also timely and relevant in light of global shifts in education. The COVID-19 pandemic accelerated the adoption of digital technologies in education worldwide, highlighting both the potential and the digital divide that characterizes many African classrooms. By examining the local adaptation of digital tools within inquiry-based STEM education, this research contributes to post-pandemic recovery strategies and resilience planning in the education sector. Finally, this study serves as a model for other regions and stakeholders interested in scaling up innovative STEM education initiatives. The findings can inform donor agencies, NGOs, and international development partners working in education to align their programs with local needs and capacities.

It also sets the stage for future research on longitudinal impacts of IBL and digital integration on learner performance, retention, and career trajectories. The study is significant in advancing the theoretical understanding, practical implementation, and policy development of inquiry-based and technology-enhanced STEM education in Cameroon. It offers a comprehensive, evidence-based approach to improving learner engagement and interest, thereby contributing to national and global goals for educational transformation and sustainable development.

### **Justification of the Study**

The justification for this study is rooted in the pressing need to bridge the gap between educational policy and classroom practice regarding STEM instruction in primary schools in Cameroon. In a rapidly evolving global knowledge economy, there is a growing demand for learners to develop critical thinking, technological fluency, and problem-solving competencies at an early age.

The Government of Cameroon has acknowledged this imperative through its 1998 Orientation Law of Education, the National Development Strategy (NDS30), and the Education and Training Sector Strategy Plan (ETSSP) 2023–2030. These policy documents emphasize the integration of science, technology, and innovation into the national curriculum as vital for achieving sustainable development and global competitiveness. However, implementation at the foundational level of education remains inadequate.

Primary education serves as the most critical phase for laying the cognitive and motivational foundation of future scientists, engineers, and technology innovators. Yet, most teaching methods in Cameroonian primary schools are still dominated by lecture-based, teacher-centered practices that do not engage learners actively or meaningfully in the learning process. Consequently, pupils are deprived of opportunities to explore STEM content through experiential, inquiry-based, or problem-solving approaches. Without early and sustained exposure to engaging STEM instruction, learners are unlikely to develop long-term interest or competencies required for participation in STEM-related careers.

This study is also justified by the limited empirical research conducted in Cameroon particularly in urban subdivisions like Yaoundé VI on the intersection of inquiry-based learning, technology integration, and learner engagement in STEM education at the primary level. By focusing on this educational tier, the study fills a critical research gap and provides data-driven recommendations for curriculum developers, policymakers, teacher educators, and school leaders. It also contributes to broader educational goals outlined in Sustainable Development Goal 4, which advocates for inclusive, equitable, and quality education that promotes lifelong learning opportunities for all.

Furthermore, the study supports evidence-based instructional reforms that align with current global best practices while remaining sensitive to the contextual realities of Cameroonian classrooms. The outcomes of this research will inform strategies for teacher professional development, resource allocation, and instructional supervision aimed at improving STEM teaching and learner outcomes across primary education settings in Cameroon.

### **Scope and Delimitation of the Study**

This study is delimited to exploring the integration of inquiry-based learning (IBL) and digital technology into Science, Technology, Engineering, and Mathematics (STEM) education at the primary level in Yaoundé VI Subdivision, Cameroon. Specifically, it investigates how strategic teaching methods such as experiential learning, real-world contextualization, and problem-solving instruction can enhance learner interest and engagement in STEM subjects.

The geographical scope of the study is confined to selected public and private primary schools within Yaoundé VI, an urban subdivision of the Centre Region. This area was chosen due to its diversity in school types, infrastructure availability, and teacher qualifications, offering a representative sample of both resource-rich and resource-constrained learning environments.

Thematically, the study is focused on instructional practices and pedagogical integration, rather than broader systemic issues like national policy development or education financing. It is also limited to the primary education sector, particularly Classes 4 to 6, which serve as the transitional phase between foundational learning and advanced cognitive skill development. The study does not encompass secondary or tertiary STEM education. The respondents are restricted to STEM teachers, head teachers, and pupils aged 9 to 12 years within the sampled schools. Data collection instruments include structured interviews, classroom observations, lesson plan analysis, and pupil feedback questionnaires, all designed to explore how inquiry-based and technology-supported approaches influence classroom practices and learner engagement.

While the study provides valuable insights into pedagogical innovation, it does not aim to provide a comprehensive evaluation of the national curriculum or educational policy frameworks in their entirety. It also acknowledges that findings may not be generalizable to all schools across Cameroon due to local variations in infrastructure, teacher capacity, and institutional support. Nevertheless, the research offers a model that can inform similar interventions in comparable urban and peri-urban educational settings across the country.

### **Operational Definition of Terms**

**STEM Education:** Refers to an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons in science, technology, engineering, and mathematics. Learners apply STEM in contexts that connect school, community, work, and the global enterprise (Bybee, 2013).

**Inquiry-Based Learning (IBL):** A student-centered teaching method that engages learners in investigating questions, problems, and scenarios rather than simply presenting established facts. IBL fosters critical thinking and deeper understanding (Hmelo-Silver, Duncan, & Chinn, 2007).

**Digital Technology in Education:** Refers to tools and resources such as computers, tablets, internet connectivity, and software applications used to enhance teaching and learning. In this study, digital technology includes both hardware and digital content integrated into STEM instruction (Kirkwood & Price, 2014).

**Learner Interest:** The degree of curiosity, enthusiasm, and sustained engagement a pupil demonstrates towards STEM subjects. Interest is seen as a motivational construct that influences learning behaviors and academic choices (Hidi & Renninger, 2006).

**Experiential Learning:** A process through which students develop knowledge, skills, and values from direct experiences. It emphasizes reflection and real-world application, aligned with Kolb's experiential learning theory (Kolb, 1984).

**Problem-Based Learning (PBL):** A pedagogical strategy that organizes curriculum and instruction around real-world problems that students collaboratively investigate and solve. PBL supports both content mastery and skills development (Barrows, 1986).

**Real-World Relevance:** The extent to which classroom activities and content mirror real-life contexts, making learning meaningful and applicable. This principle enhances learner motivation and knowledge retention (Lombardi, 2007).

## **CHAPTER TWO**

### **REVIEW OF RELATED LITERATURE**

This chapter provides a comprehensive review of literature relevant to the integration of inquiry-based learning (IBL) and technology in Science, Technology, Engineering, and Mathematics (STEM) education. It establishes the theoretical, empirical, and contextual foundations necessary to frame the current study within scholarly discourse and educational practice. The rationale for this review is anchored in the need to situate the research within a broader academic and policy framework, particularly in the context of Cameroon's educational landscape.

Globally, STEM education has gained traction as a strategic priority for promoting innovation, economic development, and global competitiveness. The integration of IBL and digital tools into teaching and learning is widely recognized as a means to improve students' conceptual understanding, engagement, and problem-solving skills (Krajcik & Blumenfeld, 2006; Akram & Li, 2024). The constructivist foundations of IBL rooted in the work of Piaget (1972), Vygotsky (1978), and Bruner (1961) support learner-centered pedagogies that encourage active knowledge construction through questioning, investigation, and reflection. These theoretical underpinnings underscore the relevance of IBL in transforming passive classroom environments into dynamic, inquiry-rich spaces.

In the African context, the African Union's Continental Education Strategy for Africa (CESA 2016–2025) and the Science, Technology, and Innovation Strategy for Africa (STISA-2024) emphasize STEM capacity-building and the use of digital innovation to foster educational equity and inclusion. Countries such as Rwanda, Ghana, and Kenya have made significant investments in primary STEM education, integrating technology and problem-solving pedagogies to enhance learning outcomes.

In Cameroon, educational reforms have emphasized curriculum renewal, pedagogic innovation, and the promotion of digital literacy. The National Development Strategy (NDS30) and the 2023–2030 Education Sector Strategy Plan outline priorities for integrating science and technology across all levels of the education system. However, there is limited empirical evidence on how these policy aspirations are being implemented at the primary school level, particularly in urban subdivisions like Yaoundé VI.

This chapter is organized thematically to reflect critical dimensions of the research topic. It begins with a historical and theoretical overview of STEM education and inquiry-based learning. It then reviews conceptual frameworks supporting the integration of technology in primary education, followed by an analysis of empirical studies on the influence of pedagogical strategies on learner interest and performance in STEM. The review also addresses contextual factors affecting implementation, including teacher competencies, resource availability, and institutional support. The final section synthesizes key findings, highlights research gaps, and justifies the need for the present study.

Through this literature review, the chapter aims to provide a rich analytical background that situates the current research within existing academic debates and educational development initiatives. It highlights the urgent need to understand and enhance the classroom realities of STEM education in Cameroonian primary schools through evidence-based pedagogical interventions.

### **Theoretical Framework**

This study is underpinned by three foundational educational theories: Constructivist Learning Theory, Experiential Learning Theory, and Problem-Based Learning Theory. These theories collectively provide a framework for understanding how learners acquire knowledge through inquiry, interaction, and authentic engagement principles central to the integration of STEM, inquiry-based learning (IBL), and technology in primary education.

### **Constructivist Learning Theory**

The Constructivist Learning Theory, grounded in the foundational works of Jean Piaget (1952) and Lev Vygotsky (1978), emphasizes that learners construct knowledge through active engagement with their environment and through social interactions. Piaget proposed that children progress through developmental stages sensorimotor, preoperational, concrete operational, and formal operational each representing distinct ways of understanding the world. In these stages, learners assimilate new information into existing mental frameworks or adjust their cognitive structures through accommodation, thereby constructing meaningful understanding from their experiences.

Constructivism is an approach to learning that holds that people actively construct or make their own knowledge and that reality is determined by the experiences of the learner' (Elliott

et al., 2000). Constructivism's central idea is that human learning is constructed, that learners build new knowledge upon the foundation of previous learning.

This prior knowledge influences what new or modified knowledge an individual will construct from new learning experiences (Phillips, 1995).

The second notion is that learning is an active rather than a passive process.

The passive view of teaching views the learner as 'an empty vessel' to be filled with knowledge, whereas constructivism states that learners construct meaning only through active engagement with the world (such as experiments or real-world problem-solving). Information may be passively received, but understanding cannot be, for it must come from making meaningful connections between prior knowledge, new knowledge, and the processes involved in learning

Vygotsky introduced a complementary social dimension to constructivism, asserting that cognitive development is largely a socially mediated process. His concept of the Zone of Proximal Development (ZPD) highlights the gap between what learners can accomplish independently and what they can achieve with appropriate support from teachers or peers. The idea of "scaffolding" arises from this theory, emphasizing the teacher's role in guiding learners through complex tasks until they develop the competence to complete them on their own (Vygotsky, 1978). For Vygotsky, the environment in which children grow up will influence how they think and what they think about thus, all teaching and learning is a matter of sharing and negotiating socially constituted knowledge. For example, Vygotsky (1978) states cognitive development stems from social interactions from guided learning within the zone of proximal development as children and their partners, the More Knowledgeable Other (MKO) co-construct knowledge. Vygotsky's Zone of Proximal Development (ZPD) refers to the gap between what a learner can do independently and what they can achieve with guidance. Learning occurs most effectively in this zone, as the learner receives support from more knowledgeable individuals, such as teachers or peers, to help them reach the next level of understanding.

THE ZPD entails the following characteristics:

- **Dynamic and Changing:** The ZPD is not a static space but constantly shifts as the child learns and develops new skills. As a child's competence grows, their zone of proximal development also expands to encompass new challenges.

- **Individualized:** While children might share the same actual developmental level, their zones of proximal development can differ based on their experiences, prior knowledge, and learning styles.
- **Not Just Procedures:** Successful learning within the ZPD involves more than simply teaching a child procedures. Open-ended, problem-solving tasks, rather than those with predetermined solutions, tend to offer richer opportunities for learning within the ZPD.
- **Importance of Collaboration:** The ZPD highlights the value of collaboration, where each participant contributes to the task goal, fostering a shared understanding through interaction.

Each individual learner has a distinctive point of view, based on existing knowledge and values. This means that same lesson, teaching or activity may result in different learning by each pupil, as their subjective interpretations differ. This principle appears to contradict the view the knowledge is socially constructed. Fox (2001) argues that although individuals have their own personal history of learning, nevertheless they can share in common knowledge, and experiences which will help wholly to ensure the effective acquisition of competences, knowledge and attitudes for the overall learning process.

The link between scaffolding and ZPD was established later by researchers like Bruner (1985) and Cazden (1979). Wood et al. (1976, p. 90) define scaffolding as a process “that enables a child or novice to solve a task or achieve a goal that would be beyond his unassisted efforts. As they note, scaffolds require the adult to controlling those elements of the task that are initially beyond the learner’s capability, thus permitting him to concentrate upon and complete only those elements that are within his range of competence” (p. 90). Scaffolding consists of the activities provided by the educator, or more competent peer, to support the student as he or she is led through the zone of proximal development. This support can be provided in many different ways, such as modeling or asking questions, and is used across different subjects and age groups. Scaffolding is a dynamic process that changes based on the student’s progress and the task at hand, so it will look different in different situations.

Intersubjectivity is crucial for effective scaffolding because it allows the teacher to tailor their support to the student’s individual needs and zone of proximal development (ZPD). When a teacher and student have intersubjectivity, the teacher can better understand the student’s current level of understanding, anticipate difficulties, and provide appropriate guidance.

Intersubjectivity occurs when two people (e.g., the child and helper) start a task together with different levels of skill and understanding and end up with a shared understanding.

Vygotsky emphasized scaffolding, or providing support to learners to help them reach higher levels of understanding. This can be mapped to progressing through Bloom's taxonomy, where educators scaffold tasks from basic understanding to more complex analysis and creation. For example, a teacher might start by providing information (Remembering) and then ask questions that require understanding. As students become more proficient, tasks can be scaffolded to require application, analysis, evaluation, and creation.

The ZPD includes scaffolding, the learners and MKO work in collaboration, starting with different skills and at the end have a mutual awareness of an activity. The MKO possesses information or skills the learner does not yet have and is able to provide guidance, modeling, and feedback to facilitate learning. MKO can be a parent, a teacher, sibling, peer, coach, mentor, a digital tool books.

Importantly, a more knowledgeable others role is dynamic and temporal, its purpose is to help the learner grow into independence not create independence Not all MKOs are equally effective. To support learning, the MKO must:

### **Understand the learner's current level**

This allows them to pitch their support within the learner's ZPD—not too easy, not too hard.

### **Provide scaffolding**

This might include breaking tasks into smaller parts, asking guiding questions, or offering hints and cues. Instead of simply giving answers, MKOs help learners develop their own understanding through exploration and dialogue.

### **Adjust support over time**

As the learner becomes more capable, the MKO should fade support and transfer responsibility.

**Offer emotional encouragement** Confidence and motivation often grow when learners feel supported and valued by someone they respect.

- A parent demonstrating how to brush teeth, then watching and correcting as the child practices.
- A teacher helping a kindergartener sound out words as they begin to read independently.

A parent demonstrating how to brush teeth, then watching and correcting as the child practices.

A teacher helping a kindergartener sound out words as they begin to read independently. Vygotsky emphasized that the MKO doesn't have to be an adult or expert. Often, peers can serve as effective MKOs, particularly in collaborative learning environments. Children learn from slightly more advanced peers who can:

- Use familiar language
- Relate to shared experiences
- Build confidence through equal-status interaction

This understanding supports cooperative learning and peer tutoring models, now widely used in modern classrooms.

Vygotsky argued that learning is always culturally embedded. MKOs do not just transmit neutral information—they also convey:

- Cultural tools (e.g., language, number systems, scientific symbols)
- Norms and values (e.g., how to speak respectfully, how to ask questions)
- Ways of thinking that are considered valid in a given culture

Therefore, MKOs play a key role in helping learners internalize the norms, knowledge, and practices of their society. This makes their role both instructional and cultural.

The More Knowledgeable Other is a vital element of Vygotsky's vision of development: that learning arises from dialogue, mentorship, and collaboration. Whether embodied by a parent, peer, teacher, or even a digital assistant, the MKO helps unlock potential within the learner's Zone of Proximal Development.

By providing well-timed, responsive, and respectful support, MKOs guide learners toward greater independence and deeper understanding—laying the foundation not only for academic growth, but for lifelong learning.

However, though education is a social process powerfully influenced by cultural factors, cultures are made up of sub-cultures, even to the point of being composed of sub-cultures of one. Cultures and their knowledge base are constantly in a process of change and the knowledge stored by individuals is not a rigid copy of some socially constructed template. In learning a culture, each child changes their culture. This will have a strong impact on the teaching learning

process as learners drop old habits and beliefs and acquire new ones, thus the impact of collaboration in a constructivist classroom.

In the context of STEM education, constructivist learning underscores the importance of active inquiry, problem-solving, and collaboration. Teachers act as facilitators rather than transmitters of knowledge, encouraging learners to generate hypotheses, experiment, reflect, and draw conclusions based on evidence. Dewey's (1938) philosophy of experiential learning reinforces this approach by advocating for real-world, meaningful experiences as the basis for academic learning. Learning is a developmental process of accommodation, assimilation, or rejection to construct new conceptual structures, meaningful representations, or new mental models.

Social interaction introduces multiple perspectives through reflection, collaboration, negotiation, and shared meaning. Learning is a social activity – it is something we do together, in interaction with each other, rather than an abstract concept (Dewey, 1938).

Inquiry-Based Learning (IBL) is a pedagogical approach that directly stems from constructivist principles. It promotes critical thinking and learner autonomy by engaging students in open-ended investigations where they ask questions, design experiments, and derive answers through exploration and reasoning (Goodrum, Hackling & Rennie, 2000). IBL is particularly relevant to STEM education, which demands a deep understanding of concepts and the ability to apply them in diverse contexts.

In Cameroon, the Competency-Based Curriculum (CBC) for Basic Education is influenced by constructivist theory. The 1998 Orientation Law of Education and the 2023–2030 Education Sector Strategy both call for pedagogical approaches that encourage learner initiative, creativity, and adaptability. Thus, constructivist theory provides a robust foundation for integrating IBL and digital technologies in STEM classrooms, aligning well with national and global educational priorities such as the SDGs.

### **Experiential Learning Theory (ELT)**

Experiential Learning Theory (ELT), developed by David Kolb in 1984, posits that learning is a dynamic and cyclical process grounded in direct experience. According to Kolb, effective learning occurs when individuals progress through four interconnected stages: Concrete Experience (actively experiencing an activity), Reflective Observation (reflecting on that experience), Abstract Conceptualization (drawing conclusions and forming generalizations),

and Active Experimentation (applying new knowledge to real-world situations). This cyclical model emphasizes the iterative nature of learning, where knowledge is continuously refined through experience, reflection, and application (Kolb, 1984). Kolb went on to explain that learners will have their own preferences for how they enter the cycle of experiential learning, and that these preferences boil down to a learning cycle. This learning cycle includes learning as a process, learning through relearning, emotional reflection, holistic learning environmental learning and constructivism.

Kolb's ELT draws upon foundational theories of experiential education, especially the work of John Dewey (1938), who advocated for learning through purposeful experiences. Dewey emphasized that education should not be the passive transmission of knowledge, but rather an active and reflective process that connects learners with their environment and societal roles. ELT also echoes Piaget's notion of learning through active exploration and Vygotsky's emphasis on social interaction in knowledge construction.

In the context of STEM education, ELT supports pedagogical strategies such as project-based learning, inquiry-based learning, and hands-on experimentation. These approaches encourage learners to engage in real-world problem-solving, design prototypes, conduct investigations, and evaluate their outcomes. Experiential learning in STEM environments fosters curiosity, enhances retention, and improves critical thinking and creativity by situating abstract concepts in tangible experiences (Zull, 2002; Kolb & Kolb, 2005).

In Cameroon, the relevance of experiential learning is evident in national educational policy frameworks. The 2023–2030 Education and Training Sector Strategy Plan explicitly calls for learner-centered and activity-based instruction, especially in STEM disciplines, to promote functional competencies. Similarly, the National Development Strategy 2020–2030 (NDS30) advocates for the development of a skilled and innovative workforce through competency-based and practice-oriented education. These policies align with Sustainable Development Goal 4, which promotes inclusive and quality education that equips learners with relevant skills for employment, decent work, and entrepreneurship.

Implementing ELT in Cameroonian primary schools also responds to the need for contextualized STEM instruction that bridges the gap between classroom learning and everyday realities. Through concrete experiences such as constructing models, using digital tools, and solving community-based problems, learners are better positioned to internalize

scientific principles and develop autonomy in their learning processes. Thus, ELT offers a robust theoretical and practical framework for transforming STEM education and fostering sustainable learner engagement in the Cameroonian context.

### **Problem-Based Learning Theory (PBL)**

Problem-Based Learning (PBL) is a student-centred pedagogical approach that originated in medical education at McMaster University in the 1960s and was formalized by Barrows and Tamblyn (1980). It has since been widely adopted across disciplines, including STEM, due to its effectiveness in promoting deep learning, critical thinking, and collaborative problem-solving. In the PBL model, learners are presented with complex, real-world problems that are often ill-structured and open-ended. Rather than receiving direct instruction, students must identify what they already know, determine what they need to learn, and engage in self-directed research to solve the problem collaboratively. This inquiry-driven process fosters the development of metacognitive skills, teamwork, and applied knowledge.

The theoretical foundation of PBL aligns closely with constructivist and experiential learning paradigms, particularly John Dewey's (1910) philosophy of education through problem-solving. Dewey argued that education should be grounded in the practical realities of life and designed to help learners respond creatively and thoughtfully to genuine challenges. PBL operationalizes this vision by creating learning environments where students take ownership of their learning journey, engage in sustained inquiry, and connect interdisciplinary knowledge to authentic situations (Hmelo-Silver, 2004).

In STEM education, PBL plays a crucial role by simulating the ways scientists, engineers, and technologists approach challenges in the real world. It enables learners to integrate concepts from science, mathematics, and technology as they design solutions, evaluate outcomes, and reflect on their processes. Research has demonstrated that PBL enhances learner engagement, motivation, and academic performance, especially when combined with digital tools and collaborative platforms (Savery, 2015; Akram & Li, 2024).

In Cameroon, the implementation of the Competency-Based Approach (CBA) within the Basic Education curriculum explicitly promotes critical thinking, creativity, and problem-solving as foundational skills. The Ministry of Basic Education encourages teachers to design contextualized learning activities that reflect local realities and stimulate intellectual curiosity. The 2023–2030 Education and Training Sector Strategy and the National Development

Strategy (NDS30) further emphasize the need to align education with national development priorities, such as building a knowledge-based economy supported by innovation and science.

Therefore, PBL offers a vital pedagogical foundation for this study, complementing Constructivist and Experiential Learning theories. Together, these approaches provide a comprehensive framework for integrating inquiry-based learning and technology into STEM education, equipping learners in Yaoundé VI with the skills and mind set necessary for 21st-century problem-solving and innovation.

### **Conceptual Review**

This section discusses key concepts central to this study: inquiry-based learning (IBL), technology integration, experiential learning, problem-based learning, real-world relevance, and the role of teacher professional development in fostering STEM education. These concepts not only ground the study in pedagogical theory but also illustrate how they interrelate within the Cameroonian educational policy context.

### **Inquiry-Based Learning (IBL)**

Inquiry-Based Learning (IBL) is a student-centered pedagogical approach that actively engages learners in the process of exploring scientific questions, formulating hypotheses, conducting investigations, interpreting data, and constructing knowledge. Rooted in the principles of the scientific method and constructivist learning theory, IBL empowers learners to take ownership of their learning process by stimulating curiosity, analytical thinking, creativity, and problem-solving capabilities (National Research Council, 2000; Zion et al., 2005).

Dewey (1938) emphasized the importance of beginning education with the learner's experience and promoting inquiry as a pathway to meaningful and lasting understanding. IBL aligns with this view by framing learning as a dynamic, reflective process driven by questioning and exploration rather than rote memorization. Bell et al. (2003) outline four major components of IBL: formulating questions, gathering data through experimentation or observation, interpreting the evidence, and constructing explanations based on findings. These stages mirror authentic scientific practices and help students internalize complex STEM concepts.

In the STEM education context, IBL has been shown to significantly improve conceptual understanding and retention. It enhances learner motivation by presenting science and mathematics as exciting, relevant, and personally meaningful disciplines. Nuangchalerm and

Chaiyasuk (2009) argue that IBL bridges the gap between theoretical content and practical application, fostering deeper engagement and critical thinking.

Various models of IBL exist, ranging from structured to guided to open inquiry. In structured inquiry, teachers provide the problem and methodology, while learners interpret results. Guided inquiry involves students designing aspects of the investigation under teacher supervision. Open inquiry, the most student-directed form, allows learners to formulate their own research questions and pursue investigations independently (Banchi & Bell, 2008). Each model can be adapted based on learners' developmental levels and instructional goals.

In the Cameroonian context, the adoption of the Competency-Based Approach (CBA) by the Ministry of Basic Education aligns closely with IBL principles. CBA emphasizes learning by doing and encourages pedagogical practices that cultivate investigative skills and learner autonomy. Section 25 of the 1998 Orientation Law reinforces the need for education to be responsive to scientific and technological progress, a vision that IBL helps to realize through active, inquiry-centered instruction.

The Education and Training Sector Strategy Plan (ETSSP) 2023–2030 further promotes learner-centered pedagogies that stimulate curiosity, initiative, and problem-solving. By embedding IBL in primary STEM instruction, teachers foster not only academic achievement but also critical competencies required for 21st-century citizenship and employability (MINEDUB, 2023). Despite its benefits, implementing IBL in Cameroonian primary schools faces challenges such as insufficient training, limited access to teaching resources, and large class sizes. Nonetheless, when effectively supported, IBL can transform traditional classrooms into laboratories of exploration and innovation. Teachers become facilitators who scaffold learning, guide investigations, and encourage reflection.

Therefore, IBL serves as a key instructional strategy in this study's conceptual framework. It supports the integration of technology, fosters learner engagement, and aligns with national education policies aimed at equipping learners with relevant STEM competencies for national development and global competitiveness.

### **Technology Integration in STEM Education**

Technology integration in education refers to the meaningful and systematic incorporation of digital tools and resources into the teaching and learning process. In the context of STEM

education, technology serves both as a subject of study and as an enabler of inquiry, experimentation, and collaboration. Tools such as simulations, digital microscopes, virtual laboratories, coding platforms, robotics kits, and interactive whiteboards provide dynamic avenues through which learners can explore scientific concepts and solve complex problems (Davies & West, 2014).

The effective integration of technology into STEM education enhances learner engagement, supports differentiated instruction, and promotes critical 21st-century skills such as collaboration, creativity, problem-solving, and digital literacy (Reiser & Dempsey, 2012; Mishra & Koehler, 2006). Through digital tools, teachers can present abstract STEM concepts in interactive formats, thus improving comprehension and knowledge retention. Furthermore, technology can accommodate various learning styles and needs, enabling inclusive education that reaches both high-performing and struggling learners.

However, successful technology integration depends not only on the availability of digital tools but also on teachers' pedagogical and technological competencies. The TPACK framework (Technological Pedagogical Content Knowledge) highlights the intersection of content expertise, pedagogical knowledge, and technology proficiency as essential for meaningful integration (Koehler & Mishra, 2009). Unfortunately, many educators in primary schools especially in developing contexts such as Cameroon lack adequate training and support to implement technology-enhanced STEM instruction effectively (Duran, 2022).

In Cameroon, national policy frameworks such as the Education and Training Sector Strategy Plan (ETSSP) 2023–2030 and the National Development Strategy 2030 (NDS30) underscore the importance of digital transformation in education. These strategies prioritize the deployment of ICT infrastructure, capacity-building for teachers, and curriculum reform to incorporate digital literacy across all levels of education (MINEDUB, 2023; MINEPAT, 2020). Programs like the National ICT Strategy and Digital Cameroon 2020 Vision have laid the groundwork for integrating technology in schools.

Despite these policy initiatives, the practical realities in many Cameroonian primary schools particularly in underserved districts like Yaoundé VI reveal a persistent digital divide. Schools often operate with minimal access to internet connectivity, digital devices, and educational software. Moreover, large class sizes and limited technical support constrain teachers' ability to integrate technology effectively in daily lessons.

The integration of technology into STEM education is not only a national priority but also a critical factor in achieving Sustainable Development Goal 4, which aims to ensure inclusive and equitable quality education for all and promote lifelong learning opportunities. Specifically, Target 4.a calls for building and upgrading education facilities that are child, disability, and gender-sensitive and provide safe, non-violent, inclusive, and effective learning environments, including through the provision of ICT.

Therefore, technology integration in STEM education offers a transformative opportunity to bridge educational inequalities, foster learner engagement, and prepare Cameroonian pupils with the digital competencies needed for success in a rapidly evolving world. For this to happen, there must be sustained investment in digital infrastructure, comprehensive teacher training, and continuous monitoring to ensure the effective use of technology in classrooms. This study seeks to examine how technology can be meaningfully integrated with inquiry-based learning approaches to improve STEM education outcomes in primary schools within Yaoundé VI Subdivision.

### **Experiential Learning in STEM**

Experiential learning is both a learning theory and a practical instructional strategy rooted in the philosophy of “learning by doing.” Proposed by David Kolb (1984), Experiential Learning Theory (ELT) asserts that effective learning occurs through a cyclical process involving four stages: Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation. Learners begin with a direct experience, reflect on it, derive abstract concepts, and apply these insights to new situations. This cyclical model supports deep, meaningful learning and encourages the development of transferable skills.

In the context of STEM education, experiential learning takes various forms including laboratory experiments, field investigations, engineering design challenges, coding projects, simulations, and real-world problem-solving tasks. These hands-on, student-centered approaches allow learners to interact with materials, manipulate variables, and observe phenomena, thereby fostering critical thinking, creativity, and perseverance (Zull, 2002; Prince & Felder, 2006).

Research has shown that experiential learning enhances learners’ conceptual understanding and promotes long-term retention. By engaging learners in active experimentation and reflection, this approach aligns with the core objectives of STEM disciplines, which require learners to

test hypotheses, troubleshoot errors, and communicate findings. When learners are immersed in authentic tasks, they are more likely to be motivated and develop a sense of agency in their learning (Kolb & Kolb, 2009).

In Cameroon, the Education and Training Sector Strategy Plan (2023–2030) advocates for pedagogical reforms that center on activity-based, competency-driven instruction. Experiential learning plays a critical role in this reform agenda by promoting practical engagement with content. The Basic Education curriculum now encourages real-world applications of knowledge through project work, exploration, and problem-solving tasks that mirror learners' lived experiences (MINEDUB, 2023).

This emphasis on experiential learning is further reinforced by the National Development Strategy 2020–2030 (NDS30), which envisions a knowledge-based economy driven by creativity, innovation, and scientific inquiry. To realize this vision, it is imperative that learners starting from primary school are given opportunities to acquire skills through meaningful, real-life engagements that prepare them for future academic and professional pathways (Republic of Cameroon, 2020).

Despite the recognized benefits, implementing experiential learning in Cameroonian classrooms faces several challenges. Many primary schools lack adequate laboratory spaces, teaching materials, and teacher training to fully execute experiential lessons. Teachers often require support in lesson planning, activity design, and classroom management to transition from traditional lecture-based instruction to experiential formats. Furthermore, class sizes and rigid assessment systems limit opportunities for exploratory learning.

Nevertheless, efforts are underway to strengthen experiential learning in basic education. Initiatives such as capacity-building workshops for teachers, STEM innovation clubs, and community partnerships are gradually creating an enabling environment. Digital simulations and mobile labs also offer scalable solutions for delivering experiential STEM lessons in resource-constrained settings.

All in all, experiential learning represents a powerful strategy for enriching STEM education in primary schools. By enabling learners to explore, reflect, and apply knowledge, it nurtures foundational skills critical for lifelong learning and contributes to national and global goals for education quality, equity, and innovation.

### **Problem-Based Learning (PBL)**

Problem-Based Learning (PBL) is a learner-centered instructional approach that encourages students to work collaboratively to address real-life, complex, and often ill-structured problems. Originally developed for medical education by Howard Barrows in the 1960s, PBL has since been widely adopted across disciplines, particularly in STEM education, where the integration of theory and practice is crucial (Barrows, 1986).

The PBL process typically begins with the presentation of a problem scenario. Learners, working in small groups, identify what they already know, determine what they need to learn, and formulate strategies for finding solutions. Teachers act as facilitators, guiding the inquiry process rather than delivering direct instruction. This process not only develops content knowledge but also cultivates transferable skills such as teamwork, self-directed learning, critical thinking, and communication (Hmelo-Silver, 2004).

In the context of STEM education, PBL fosters interdisciplinary thinking by encouraging learners to draw from various domains science, technology, engineering, and mathematics to devise solutions. Through this process, students learn to integrate knowledge and apply it to authentic, real-world challenges. Studies have shown that PBL increases learners' engagement, comprehension, and ability to transfer skills to new contexts (Savery, 2006; Strobel & van Barneveld, 2009).

In Cameroon, the implementation of the Competency-Based Approach (CBA) since 2018 has placed significant emphasis on problem-solving as a core learning outcome. The revised primary school curriculum encourages the use of problem-based strategies, particularly in STEM subjects, to develop learners' creativity, autonomy, and decision-making abilities (MINEDUB, 2023). The approach aligns with the objectives outlined in the Education and Training Sector Strategy Plan (2023–2030) and the National Development Strategy (NDS30), both of which stress the need for an innovative, knowledge-based economy supported by a skilled and adaptable workforce.

Despite policy support, the practical application of PBL in Cameroonian primary schools remains limited. Many teachers lack adequate training in designing and facilitating problem-based learning experiences. Additionally, time constraints and rigid assessment practices within the existing curriculum discourage open-ended exploration and collaborative learning.

Large class sizes, scarcity of teaching resources, and insufficient administrative support further complicate the effective adoption of PBL.

Nevertheless, integrating PBL in STEM instruction presents a transformative opportunity to reframe education as a process of inquiry and innovation rather than rote memorization. As schools in Cameroon continue to pursue pedagogic reforms and digital integration, PBL stands out as a strategic method to develop critical 21st-century competencies. Empowering teachers through professional development, providing flexible instructional materials, and incorporating PBL into school-based evaluations can help bridge the gap between curricular intentions and classroom realities.

### **Real-World Relevance**

Real-world relevance in education refers to instructional practices that meaningfully connect academic content with learners' daily lives, community issues, and future career prospects. It emphasizes contextualized learning that enables students to understand the value and application of what they are studying beyond the classroom (Bevins & Price, 2016). When learners recognize how their knowledge relates to practical situations, their intrinsic motivation increases, fostering deeper engagement and more sustained interest in the subject matter. Learners are more engaged when they see how content relates to their lives, and real life context makes abstract concepts more concrete, applying knowledge outside classroom requires analysis and reflection, evidents that learning does not end only in school, it is useful everywhere.

Pedagogical strategies that promote real-world relevance include the use of case studies, problem-based learning, project-based tasks, simulations, guest speakers from STEM professions, and service-learning initiatives. These approaches encourage learners to view STEM not as abstract or theoretical, but as a dynamic tool for change and innovation. Furthermore, aligning learning with local contexts and socio-economic conditions makes STEM education more equitable and inclusive (Dewey, 1938; Lombardi, 2007).

In Cameroon, the emphasis on real-world relevance is embedded in several educational policies and strategic plans. The 1998 Orientation Law of Education highlights the importance of producing citizens who are grounded in national culture and responsive to contemporary global challenges. Article 4 of the law emphasizes the role of education in developing skills relevant to economic, social, and cultural advancement. Similarly, the Education and Training Sector

Strategy Plan (ESSP 2023–2030) advocates for competency-based education where learners acquire skills that contribute to national development goals and individual employability.

National initiatives like STEM for Development and public-private partnerships with telecommunications companies and NGOs are helping schools implement STEM projects that are tailored to community needs. Examples include solar energy education, agro-tech projects in urban farming, and robotics clubs for girls in underserved areas. These initiatives not only foster learner engagement but also build awareness of social responsibility and sustainable innovation.

Despite these efforts, challenges such as curriculum rigidity, lack of community-school collaboration, and limited teacher training impede the widespread integration of real-world relevance into STEM instruction. Nonetheless, the potential impact on learners' cognitive and emotional engagement, career aspirations, and lifelong learning attitudes underscores its importance as a core principle of effective STEM pedagogy.

### **Teacher Professional Development and Support**

Teacher Professional Development (TPD) is a critical enabler for the effective implementation of inquiry-based and technology-supported STEM instruction. As the primary agents of curriculum delivery, teachers must possess both subject matter expertise and the pedagogical skills necessary to engage learners in dynamic, student-centered learning environments. Effective TPD programs are comprehensive, sustained, and content-focused, emphasizing active learning, collaboration, and the integration of theory into practice (Desimone, 2009).

In the context of STEM education, TPD must equip teachers with the ability to design and implement inquiry-based lessons, use digital tools effectively, differentiate instruction, and assess student learning in authentic ways. Training should also promote reflective practice, allowing teachers to analyze and refine their instructional strategies over time (Loucks-Horsley et al., 2010). The importance of TPD is particularly pronounced at the primary level, where foundational STEM competencies are first introduced.

Cameroon's national education strategies, notably the Education and Training Sector Strategy Plan (ESSP 2023–2030), highlight the urgent need to build teacher capacity in science, technology, and digital pedagogy. The strategy calls for the institutionalization of continuous professional development, especially for primary educators who often face the dual challenge of teaching multiple subjects and coping with resource constraints. The National Development

Strategy (NDS30) further reinforces the need for a well-trained teaching workforce to support the country's transition toward a knowledge-based economy.

Despite these policy commitments, numerous challenges undermine the effectiveness of TPD in Cameroon. Teacher training programs are often irregular, centrally administered, and overly theoretical. They lack sustained follow-up, contextual relevance, and practical application. Many in-service teachers have limited access to structured professional development opportunities tailored to STEM and inquiry-based teaching methodologies. Additionally, financial limitations, high pupil-teacher ratios, and administrative inefficiencies contribute to low TPD coverage, particularly in urban subdivisions such as Yaoundé VI.

Nonetheless, several donor-funded and international initiatives have provided valuable support. Programs such as the UNESCO-Hamdan Prize for Outstanding Practice and Performance in Enhancing the Effectiveness of Teachers, as well as GPE-funded projects, have delivered training workshops, developed open educational resources (OER), and facilitated peer learning networks. While impactful, these efforts often operate on a pilot or short-term basis and are not systematically embedded into national teacher development frameworks.

To ensure sustainable impact, Cameroon must decentralize its TPD systems to allow for local adaptation, integrate TPD into routine school and district-level planning, and support teachers through mentoring, coaching, and communities of practice. Building institutional partnerships with teacher training colleges, universities, and education-focused NGOs can also expand the reach and relevance of professional development initiatives. Equally important is the establishment of feedback mechanisms and monitoring systems to evaluate the effectiveness of TPD and inform continuous improvement.

Ultimately, strengthening TPD is essential not only for achieving the pedagogical transformation envisioned in national policy but also for improving learner engagement, interest, and outcomes in STEM education at the foundational level.

### **Integrating inquiry based learning and technology in STEM education.**

There is increasing interest in STEM education worldwide because many jobs are requiring STEM skills (Peterson [Citation2017](#)). Some scholars have argued that it is time to make STEM literacy for all students an educational priority (Bybee [Citation2010](#)). STEM refers to the

integration of science, technology, engineering and mathematics. STEM literacy is thus related to the ability to apply conceptual knowledge to solve problems in science, technology, engineering and mathematics. New science standards focus on learning experiences that allow students to actively integrate the practices of **doing science with the core ideas of science** while exploring and solving real-world problems. This shift to scientific sensemaking places a greater emphasis on the need for inquiry-based learning in the classroom. Students are encouraged to learn like scientists by asking questions, developing models, and analyzing data. They participate in active experimentation, exploration, and hands-on inquiry.

This kind of **scientific sensemaking** spells success. It has been shown to be the most effective way to deepen students' understanding and help them build connections across science disciplines. This approach also prepares students to think critically and solve novel problems, a skill set increasingly in demand for their future careers.

According to Gizmos, ExploreLearning (2025) integrating inquiry-based learning and technology can be practiced following these steps in a teaching learning process:

**Investigating Practices:** this stage comprises of asking questions and defining problems, planning and carrying out investigations and analyzing and interpreting data.

**Explaining practices:** this stage entails constructing explanation and designing solutions, developing and using models and using mathematics and computational thinking.

**Critiquing practices:** engaging in argumentation from evidence and obtaining, evaluating and communicating information.

It is then obvious that High-Quality Instructional Materials (HQIM) are essential to improve STEM learning outcomes for students. HQIM strengthen instructional effectiveness and efficiency, helping teachers foster scientific sensemaking and meet challenging new standards.

It's critical to make HQIM accessible to all students, including students with disabilities at-risk learners, and those from diverse cultural and socioeconomic backgrounds. Because HQIM typically includes assessments that align with the new standards, teachers can track student progress in both knowledge and practices in preparation for state assessments that evaluate the same.

## **Synergy of Concepts in the Cameroonian Context**

The integration of Inquiry-Based Learning (IBL), technology, experiential learning, Problem-Based Learning (PBL), and real-world relevance forms a comprehensive pedagogical framework that aligns closely with the transformative goals of STEM education. This holistic approach enhances not only the cognitive and affective domains of learning but also fosters competencies required for the 21st-century global workforce. When synergized effectively, these strategies create dynamic and inclusive learning environments that stimulate curiosity, innovation, and problem-solving.

In the Cameroonian context, particularly within the framework of the 1998 Orientation Law, the National Development Strategy 2020–2030 (NDS30), and the Education and Training Sector Strategy Plan (ESSP) 2023–2030, there is a pronounced emphasis on pedagogical transformation and education that is both inclusive and practically relevant. These policy documents advocate for learner-centred methods, digital integration, and contextualized learning experiences. The synergy of the aforementioned pedagogical strategies thus resonates with national education priorities that seek to cultivate a skilled, adaptable, and innovative citizenry.

Specifically, the application of this synergistic model in primary schools in Yaoundé VI holds transformative potential. This urban subdivision presents a diverse educational landscape with significant variation in school resources, teacher competencies, and learner backgrounds. The integration of IBL and PBL allows for differentiated instruction that accommodates varied learning needs, while experiential learning offers hands-on, practical engagement that enhances comprehension and retention. Technology acts as an enabler, expanding access to information and facilitating collaboration across digital platforms. Real-world relevance ensures that STEM learning is connected to local and national challenges, thereby enhancing learner motivation and engagement.

Furthermore, this synergy supports the implementation of Sustainable Development Goal 4 (SDG 4), which promotes inclusive and equitable quality education and lifelong learning opportunities. Sub-target 4.4, for instance, calls for an increase in the number of youth and adults who possess relevant skills, including technical and vocational skills, for employment and entrepreneurship. By embedding real-life applications, critical inquiry, and digital tools into STEM instruction, Cameroonian primary education can effectively respond to both global imperatives and national developmental goals.

The conceptual framework underpinning this study situates teaching strategies as mediators between the inputs (IBL and technology) and the desired outcomes (learner interest and STEM engagement). It assumes that when educators are equipped with the requisite skills and resources, and when instruction is grounded in real-world application, learners are more likely to develop sustained interest, perform better academically, and consider STEM careers in the future. In essence, the synergistic use of innovative pedagogies can bridge the gap between policy rhetoric and classroom reality, especially in resource-constrained but aspirational contexts like Yaoundé VI.

### **Empirical Review**

This section presents empirical findings from global, African, and Cameroonian studies related to the integration of inquiry-based learning and technology in STEM education. It highlights successful practices, gaps, and challenges identified in the implementation of experiential, problem-based, and real-world relevant pedagogies at the primary school level.

### **Global Perspectives on STEM Education, IBL, and Technology**

across various countries has demonstrated the positive impact of integrating IBL and technology into STEM education. In Finland, a country known for its educational excellence, primary education emphasizes inquiry, project-based learning, and digital tools. Finnish classrooms employ student-centered pedagogies where learners engage in multidisciplinary STEM projects, fostering deep learning and creativity (Sahlberg, 2015).

In the United States, the Next Generation Science Standards (NGSS) mandate IBL-based STEM instruction. Studies by Reiser et al. (2012) and Duschl & Bybee (2014) reveal that when primary students engage in inquiry-driven problem-solving tasks supported by technology, their motivation, conceptual understanding, and collaboration skills improve significantly.

Singapore, a global model for STEM education, integrates IBL with digital technologies like simulations, robotics, and coding platforms from early education. According to Tan et al. (2019), Singaporean students benefit from a structured curriculum and teacher support system that aligns pedagogical strategies with real-world challenges. The results include enhanced student outcomes and global competitiveness in science and mathematics. However, global studies also note challenges such as inadequate teacher training and technological inequity. Akram & Li (2024) observe that in many low-resource contexts, even with policy support, the lack of digital infrastructure and professional development limits effective implementation.

### **African Perspectives on STEM, IBL, and Technology Integration**

Across Africa, countries have recognized the importance of strengthening STEM education to drive economic development and innovation. In Rwanda, the government has implemented a national STEM policy that emphasizes ICT integration and inquiry-based approaches. Research by Musabe and Uwizeyimana (2020) indicates that primary school learners in Kigali who were exposed to inquiry-based science lessons performed significantly better in assessments and exhibited greater interest in STEM careers.

In Ghana, an experimental study by Adu-Gyamfi et al. (2021) found that integrating digital simulations and problem-solving tasks in primary science classes improved students' conceptual understanding and classroom engagement. Ghana's STEM policy framework has invested in infrastructure and teacher training, although disparities remain between urban and rural settings. Kenya also demonstrates progress through the implementation of a Competency-Based Curriculum (CBC) that prioritizes hands-on, inquiry-oriented STEM learning from early education. According to Mureithi and Mugambi (2022), Kenyan teachers using project-based strategies and digital platforms reported improvements in learner collaboration and creativity. However, challenges such as large class sizes and insufficient teaching aids persist.

Despite these gains, African countries still face systemic barriers, including limited access to reliable internet, a shortage of qualified STEM teachers, and inadequate maintenance of ICT tools. Tella and Olayemi (2023) argue that while policy frameworks often endorse inquiry and technology, practical implementation lags due to resource constraints and lack of continuous professional development. These findings underscore the need for localized, scalable models of STEM instruction that account for contextual realities and provide ongoing support for teachers. The African experience affirms that successful STEM education hinges not only on policy innovation but also on investments in teacher capacity, infrastructure, and community engagement.

### **Cameroonian Perspectives on STEM, IBL, and Technology Integration**

In Cameroon, STEM education has gained traction through the National Development Strategy (NDS30) and the Education and Training Sector Strategy Plan (ETSSP 2023–2030), both of which underscore the importance of scientific, technological, and digital skills for national development. However, implementation in primary schools remains uneven due to infrastructural and pedagogical gaps.

A study by Ndongko and Tambo (2021) revealed that while the national curriculum emphasizes competencies such as problem-solving, inquiry, and technological literacy, teachers often rely on traditional, lecture-based methods due to limited training and resource constraints. Another study by Ngwa and Mbangwana (2022) highlighted that many primary school teachers in urban and peri-urban areas of Yaoundé express willingness to adopt technology and IBL strategies but cite lack of access to digital devices and professional development as major barriers.

Empirical work by Fonkoua (2023) on digital pedagogy in Cameroonian basic education found that students exposed to inquiry-oriented and technology-supported lessons displayed greater engagement, teamwork, and conceptual understanding. However, the study also identified disparities in the availability of ICT infrastructure across public and private schools, especially in divisions like Yaoundé VI. Donor-supported initiatives such as the Global Partnership for Education (GPE) and UNESCO's digital skills development projects have piloted teacher training programs and ICT resource deployment in selected schools. While these have shown positive outcomes, sustainability remains a challenge without systemic integration into national and local policies.

Furthermore, the 1998 Orientation Law of Education emphasizes scientific and technological advancement and the adaptation of education to socio-economic realities. Yet, classroom practices often fall short due to poor monitoring, outdated pedagogical models, and minimal integration of real-world contexts in STEM instruction (MINEDUB, 2023). Taken together, these empirical insights point to a significant gap between policy and practice. They also reaffirm the potential of inquiry-based, experiential, and technologically enriched pedagogies in improving learner outcomes when accompanied by consistent support for teachers and schools.

### **Empirical Support for Teaching Strategies**

Empirical studies confirm that experiential learning enhances learners' ability to retain scientific knowledge and apply it to real-life situations. For instance, in a study conducted in South Africa, Pather (2020) found that learners who participated in community-based science projects retained 40% more content and demonstrated greater interest in continuing science education. The project-based format of these interventions also enhanced learners' sense of ownership and relevance in their learning processes.

Problem-based learning (PBL) has been widely recognized for improving learners' analytical thinking, critical reasoning, and teamwork capabilities. A comparative study by Kwek & Lye (2018), which involved primary school learners in Malaysia and Uganda, revealed that students exposed to PBL consistently outperformed their peers in creative problem-solving tasks. These students not only showed higher levels of motivation and initiative but also developed deeper conceptual understanding across STEM subjects. In terms of real-world relevance, multiple studies underscore its role in enhancing learner engagement and participation.

In Cameroon, Achuo & Atabong (2020) demonstrated that when STEM topics were contextualized using everyday examples and local materials such as constructing simple circuits with locally available conductors or analyzing soil samples from students' neighbourhoods there was a noticeable increase in student participation, interest, and perceived value of STEM education. This was especially effective among learners in under-resourced schools who often view science as abstract or unrelated to their immediate realities. Furthermore, research by Uzoagba and Mbah (2021) indicates that integrating experiential and problem-based strategies with real-world contexts leads to significant improvements in both short-term performance and long-term retention. These pedagogical approaches help bridge the gap between abstract curriculum content and practical application, a challenge often cited in Cameroonian classrooms.

The Mastery of Active and Shared Learning Processes of Techno-pedagogy (MASLEPT) is a school-based professional development model (Nkwenti Ndongfack, 2015). MASLEPT was developed based on teachers' views and evidence from literature review on best practices in teacher training on technology integration in instructional processes. Literature upholds that an effective professional development model on technology integration should be characterised by teachers' pedagogical content knowledge; provision of sufficient time and resources; promotion of collegiality and collaborative exchange; include follow up procedures; models high quality instruction and be school-based (Nkwenti Ndongfack, 2015). According to Nkwenti Ndongfack (2015) three stages can enhance teacher professional upgrading and technology integration in a classroom situation.

Firstly, Mishra and Koehler (2006) as cited in Nkwenti Ndongfack (2015) uphold that teachers' Technological Pedagogical Content Knowledge (TPACK) is paramount in any teaching and learning process. TPACK frame-work constitutes three knowledge domains and seven constructs notable Technology Knowledge (TK); Pedagogy Knowledge (PK); Content

Knowledge (CK); Pedagogical content knowledge (PCK); Technological Content Knowledge (TCK); Technological Pedagogical Knowledge (TPK); and Technological Pedagogical Content Knowledge (TPACK. It provides a framework for understanding the complexity of integrating technology into specific subject matter.

Secondly, Nkwenti Ndongfack (2015) argues that Lesson Study is a well-documented school-based teacher professional development model which originated from Japan in the 18th century (Baba & Kojima, 2004; Fernandez & Yoshida, 2004; Hashimoto, Tsubota, & Ikeda, 2003). The underlying principle of the model requires groups of teachers to meet regularly over an extended period of time, to work on the design, implementation, feedback, and improvement of one or several “research lessons”. Research lessons are authentic instructional packages taught by the teacher to their own class (Lewis & Tsuchida, 1997).

From colleagues for improvement purposes. Research lessons are authentic instructional packages taught by the teacher to their own class (Baba & Kojima, 2004). All the lesson plans developed were based on the school curriculum and which covered topics that had not been taught for the current school year. With the challenges the teacher-participants had while delivering the lessons in previous years the professional development program empowered them on how to use technology to address them. The MASLEPT model emphasizes on the fact that professional development programs should address the problems teachers face in their classroom. Based on this aspect, teachers took the training program serious because it addresses the problems they directly face in their classroom.

Thirdly, teacher interaction is a very critical component of the MASLEPT model (Nkwenti Ndongfack, 2015). Social Constructivist theory argues that learning occurs through socio-cultural mediation (Vygotsky, 1978). This means that teachers will construct new knowledge through their active participation in the professional development programme and via interactions with various learning technologies. As teachers work collaboratively during the professional development programme, the more knowledgeable ones with technological skills support the less experienced colleagues.

The MASLEPT model reinforces this practice because it enables teachers in a professional development program to come together to set technological lesson goals, plan the lessons, implement them and reflect on its outcomes. Lewis and Tsuchida (1997) uphold that when teachers work through the lesson study cycle as seen in the MASLEPT model, they produce authentic classroom lessons that are focused on a specific pre-determined problem, goal, or

expected learning outcome. Since the teachers work collaboratively, the lessons were carefully planned, observed by other teachers, analyzed and reflected upon by group members, administrators or an invited commentator. In such processes, social constructivism was very much in action because social negotiations, discussions, reflections and explanations lead to a positive learning outcome (Rock & Wilson, 2005 as cited in Nkwenti Ndongfack, 2015). Collaborative lesson planning improves the effectiveness of the learning experiences teachers provide to their pupils. When teachers learn collaboratively, it becomes eminent that they will engage pupils in collaborative learning activities (Fraser, 2005 as cited in Nkwenti Ndongfack, 2015). MASLEPT Model is a great contribution to an effective outcome of teachers' professional upgrading programs, in line with these above aspects.

The role of the facilitators or the More Knowledgeable Other (MKO) is vital as they help them improve their knowledge, skills and attitude required for their services.

Some schools of thought hold that the lesson study approach guided the process of the professional development program and TPACK developmental stages guided the teachers' progress as they develop their knowledge of technology, pedagogy and content as a combination (Nkwenti Ndongfack, 2015). Collaborative practices that yield better results are those that enable expert teachers or facilitators from within the group to carry out demonstration exercises that are beneficial to teachers with less experience in technology integration into lessons (Nkwenti Ndongfack, 2015). It is important to note that, the design of a professional maturity program for teachers is very crucial for a successful school (teaching and learning processes) and community at large. This, as highlighted in the 1998 Orientation Law, National Development Strategies (NDS30), Education and Training Sector Strategy Plan (ETSSP2023-2030) in Cameroon.

Collectively, these empirical findings reinforce the need to incorporate diverse, context-sensitive teaching strategies into primary STEM instruction. By combining experiential, problem-based, and real-world learning as well as MASLEPT, educators can stimulate curiosity, deepen comprehension, and build competencies aligned with 21st-century learning goals and national development strategies.

### **Summary of Empirical Insights**

The empirical review presented in this chapter provides compelling evidence for the effectiveness of inquiry-based learning (IBL), technology integration, experiential learning, and problem-based strategies in enhancing STEM education outcomes. Globally, countries

such as Finland, the United States, and Singapore have demonstrated success by embedding IBL and digital tools into structured STEM curricula, resulting in increased learner engagement, motivation, and academic achievement. In Sub-Saharan Africa, initiatives in countries like Rwanda, Kenya, and Ghana reflect an increasing shift toward competency-based and inquiry-driven learning frameworks, supported by ICT infrastructure and teacher development programs.

In the Cameroonian context, empirical studies reveal both promise and persistent challenges. Although national policies, including the Education and Training Sector Strategy Plan (2023–2030) and the National Development Strategy (NDS30), endorse the use of innovative pedagogies, their implementation remains inconsistent due to limited teacher capacity, inadequate digital infrastructure, and insufficient contextual adaptation. Nonetheless, localized evidence such as the use of community-based science projects and contextualized problem solving has shown potential in increasing learner interest and bridging theory with practice.

Across all levels of analysis, a recurring theme is the need for coherent policy translation into classroom realities. This requires sustained teacher professional development, access to relevant learning technologies, and curricula that promote real-world applications. Empirical findings consistently support the notion that combining inquiry-based strategies with technology and experiential methods not leaving out MASLEPT for teachers are essential for preparing learners and teachers' upgrading with 21<sup>st</sup> century STEM competencies.

This study seeks to expand the empirical discourse by offering context-specific insights from Yaoundé VI Subdivision. Through a mixed-methods approach, it explores how strategic pedagogies influence learner interest in STEM subjects and identifies the conditions under which educational innovation can thrive in Cameroonian primary schools.

### **Research Gap**

Despite the abundance of global, regional, and national literature supporting the effectiveness of inquiry-based learning, experiential learning, and technology integration in STEM education, several critical gaps persist, particularly within the Cameroonian primary education context. First, although the Cameroonian government has expressed strong policy commitment to promoting STEM education through the National Development Strategy 2030 (NDS30), the 1998 Orientation Law, and the Education Sector Strategy Plan 2023–2030, there is a notable absence of empirical studies that assess the *actual* classroom level integration of these

strategies especially using a combination of IBL, experiential learning, and technology at the primary level. Most available literature focuses either on secondary or tertiary education or lacks contextual application of these teaching methodologies.

Second, there is limited research that investigates how specific pedagogical strategies namely experiential learning, problem-based learning, and real-world relevance impact learner interest and engagement in STEM subjects among younger learners. Studies conducted by Ngwa & Niba (2022) indicate a general awareness of modern pedagogies, but very few studies provide systematic analysis of their implementation and outcomes in diverse school settings such as Yaoundé VI.

Third, most existing studies do not explore the intersection of pedagogical strategy and technology use in STEM instruction. In particular, there is a gap in literature on how technological tools can be synergized with inquiry-based learning to enhance both access to STEM content and learner participation. With the growing digitization agenda in Cameroon and the integration of ICTs in education as outlined in the ETSSP 2023–2030, a clearer understanding of how these tools are (or are not) being used to facilitate STEM instruction is urgently needed.

Fourth, while much is known about the theoretical benefits of STEM education, less is documented about teachers' practical readiness and competencies to implement these innovations. Teacher professional development programs often remain top-down, irregular, or inadequately linked to classroom realities. There is thus a gap in understanding the specific needs of primary school teachers when it comes to implementing inquiry-driven, technology-enhanced, and real-world connected STEM lessons.

Finally, in the specific case of Yaoundé VI Subdivision, there is a lack of disaggregated data or localized case studies that capture the voices and experiences of both teachers and learners regarding the adoption of modern STEM pedagogies. Given the socio-economic, infrastructural, and pedagogical diversity of schools in this subdivision, more localized empirical evidence is needed to inform targeted interventions and policies. This study seeks to address these gaps by systematically examining how experiential learning, problem-based learning, and real-world relevance influence the integration of inquiry-based learning and technology in STEM education at the primary level in selected schools in Yaoundé VI. By

focusing on localized data and grounded classroom realities, this research aims to contribute meaningful insights to both academic discourse and educational practice in Cameroon.

### **Conceptual Framework**

This study adopts a conceptual framework that illustrates the relationships among inquiry-based learning (IBL), experiential and problem-based teaching strategies, technology integration, and learner interest in STEM education within the context of primary schools in Yaoundé VI Subdivision.

The framework is grounded in Constructivist Learning Theory, Kolb's Experiential Learning Model, and Problem-Based Learning Theory. It postulates that pedagogical strategies such as experiential learning, problem-based learning (PBL), and real-world relevance are key mediators in the relationship between IBL and learner outcomes. Moreover, technology serves both as a medium to enhance inquiry processes and a variable that amplifies or constrains the effectiveness of teaching strategies depending on access and teacher proficiency.

### **Key Components of the Conceptual Framework**

This conceptual framework is grounded in the premise that Inquiry-Based Learning (IBL), when effectively supported by strategic pedagogical practices, digital technology, and teacher professional development, can significantly enhance learner interest in STEM education. Each component plays a distinct yet interconnected role in this process.

#### ***1. Inquiry-Based Learning (IBL) – Central Pedagogical Approach***

IBL serves as the foundational instructional philosophy in this study. It emphasizes learning as an active process driven by questioning, exploration, hypothesis-testing, and evidence-based reasoning. Rather than receiving information passively, learners engage in scientific investigations that promote autonomy, critical thinking, and curiosity. IBL promotes interdisciplinary knowledge-building and higher-order thinking skills (Kopcha et al., 2017; Li et al., 2016). Educational robotics and computational thinking are effective in preparing primary school learners to apply these skills in real-world scenarios (Katyetova, 2023; Shipepe et al., 2022).

Incorporating these approaches into elementary school curricula is vital for the long-term success of STEM education (GULL et al., 2022) and developing critical skills essential for 21st-century success (Adeoye & Jimoh, 2023). IBL aligns with constructivist learning theories

and mirrors the processes of scientific inquiry in real-world contexts (National Research Council, 2000). Inquiry-based learning sets the base for learner center approach, which becomes the focus on learner learning rather than sharing the well-defined bodies of content knowledge or subject matter.

IBL creates an active learning environment as it involves learning by doing and may comprise of discussions, questioning and bring solution to the problems. IBL facilitates the enhancement of self-directed learning skills of the students. ( Khalaf & Zin, 2018). This kind of learning is one of the approaches of inductive methods also applying collaborative or cooperative learning. An inquiry-based approach is the most effective method for pupils to use their existing knowledge and investigative abilities to discover the world (Mat Noor, 2021).

As a result, this empowers them to gain a greater sense of ownership over their learning, enables them to actively navigate their way to reach an increased level of understanding and motivation, and to develop improved attitudes towards science (Bevins & Price, 2016). In primary STEM education, IBL encourages learners to build understanding through hands-on discovery, reinforcing long-term conceptual grasp and problem-solving abilities.

## ***2. Pedagogical Strategies – Mediating Factors***

Three core instructional strategies mediate the effectiveness of IBL in promoting learner interest in STEM:

- **Experiential Learning:** Based on Kolb's (1984) learning cycle, this approach involves learning through direct experience, reflection, and application. It helps learners relate abstract STEM concepts to tangible situations such as local environmental challenges, classroom experiments, or community-based projects.

Experimental learning is based on three principles. These are: pupils learn best when they are personally involved in the learning experience; when pupils discover knowledge for themselves, it is more meaningful to them; pupils are more committed to learning when they are free to set their own learning goals and to pursue them within a set of framework (Johnson & Johnson, 1986). The experimental learning strategy is also inductive, learner centered and activity oriented.

Experimental learning focuses on personal reflection about an experience and the formulation of plans to apply what is learned to other contexts and situations. According to Pfeiffer & Jones (1979), experiential learning occurs when learners go through active

participation, critically look back on the activity to clarify their learning and feelings, draw useful insights and lessons from such analysis; and, apply what they have learned in new situations.

Leke Tambo (2012), asserts that, experiential learning can be viewed as a cycle consisting of five phases all of which are necessary. The five phases or steps in experiential learning are:

- Experiencing (an activity occurs);
- Sharing or Publishing (reactions and observations are shared);
- Analysis or Processing (patterns and dynamics are determined);
- Inferring or Generalizing (principles are derived); and,
- Applying (plans are made to use learning in new situations).

He opines that, experiential learning is on the process of learning and not on the product. A teacher can use experiential learning as a teaching strategy both in and out of the classroom. For example, in the classroom, learners can build and stock an aquarium or engage in a simulation. Outside the classroom they can, for example, observe courtroom procedures in a study of the legal system, or conduct a public opinion survey about some issue that is of concern to the society.

- **Problem-Based Learning (PBL):** Rooted in Deweyan and constructivist traditions, PBL presents learners with real-world problems that require interdisciplinary collaboration and innovative solutions. It strengthens analytical reasoning, teamwork, and self-directed learning, all critical competencies in STEM disciplines. Problem based method is a pedagogical strategy that uses open ended / ill-structured problems that mirror real-world problems. The authenticity of the problems helps students to transfer their knowledge and skills beyond the classroom, preparing them for the workplace and life in a rapidly changing world.

The open ended nature of problems gives students the flexibility to approach it from different angles, to take different thematic sidelines according to their personal interests. Finding or posing problems is a creative endeavour that can occur prior to, during, or after the act of problem solving. By keeping the problem definition open, the students can “frame and reframe” their perspective on a problem so they reach “goal clarity”. This gives them control of the learning process, capturing their interest and motivating them to learn.

- **Real-World Relevance:** This involves contextualizing STEM content within learners' social and cultural environments. The nature of sustainability, and the prospect of unsustainability, require a fundamental change of epistemology, and therefore of education. Changes are necessary in curricula, pedagogy, policy and institutional structures. (Jones et al, 2010). Student engagement is the level of effort, interest and attention that students invest in the learning process (Klem & Connell, 2004; Marks, 2000). Lessons grounded in everyday life such as using locally available materials for experiments or solving community problems demonstrate the practical utility of STEM knowledge and stimulate learner motivation and civic awareness.

### ***3. Technology Integration – Moderating Factor***

Technology acts as a moderating variable that can enhance or constrain the impact of IBL and its associated pedagogies. When effectively integrated, digital tools such as educational software, simulations, virtual labs, and internet-based resources provide interactive and adaptive learning experiences that support inquiry and engagement. For instance, Feng et al. (2021) investigated the effects of technology-enhanced mathematics instruction on academic achievement, finding that it positively affected student achievement in mathematics. Li et al. (2020) examined the effects of gamification on students' motivation and achievement in mathematics and found that it was an effective strategy for enhancing student engagement and achievement in mathematics.

Additionally, Tan and Soh (2019) investigated the effects of using digital manipulatives on primary school students' mathematics achievement and found that their use positively affected students' mathematics achievement. Many of the most rigorous projects are infused with technology from start to finish with a one-to-one laptop program. . The shift to new media literacies and the need for digital literacy that encompasses both technology and media literacy will continue to shape the world in which young children are developing and learning (Linebarger & Piotrowski 2009; Flewitt 2011; Alper n.d.).

However, disparities in digital access, infrastructure, and teacher ICT competence—especially in settings like Yaoundé VI can moderate the efficacy of technology-enhanced instruction. The National ICT Strategy and ESSP 2023–2030 emphasize digital transformation, yet implementation varies widely across schools (MINEDUB, 2023).

#### ***4. Teacher Training and Professional Development – Enabling Factor***

Teachers are central to the successful implementation of IBL and the integration of technology and real-world relevance. Ongoing professional development ensures that teachers are equipped with both pedagogical and digital competencies required for 21<sup>st</sup> century STEM instruction. Structured, context-sensitive training supports teachers in designing inquiry-rich lessons, using digital tools effectively, and managing collaborative learning environments. Capacity-building efforts are emphasized in the Education and Training Sector Strategy Plan (2023–2030) and supported by international partners such as UNESCO and GPE.

For education to be successful, the quality of teaching is important. In addition, it is the teacher who makes a curriculum good and effective. Teaching is exciting, rewarding and uplifting. No wonder, Parkay (2013) opines that teachers receive great satisfaction from making a difference in their learners' lives. Hence becoming a successful teacher today, requires high levels of professionalism and commitment. Indeed, it takes regular training and hard work on the part of teachers to succeed in today's learning settings, be it in the classroom, workplace or community. Teacher training and professional development can be achieved through attending short term courses or workshops focusing on specific topics or skills, participating in educational conferences or seminars or pursuing advance degree. (Simplek12,2025).

#### ***5. Learner Interest in STEM – Expected Outcome***

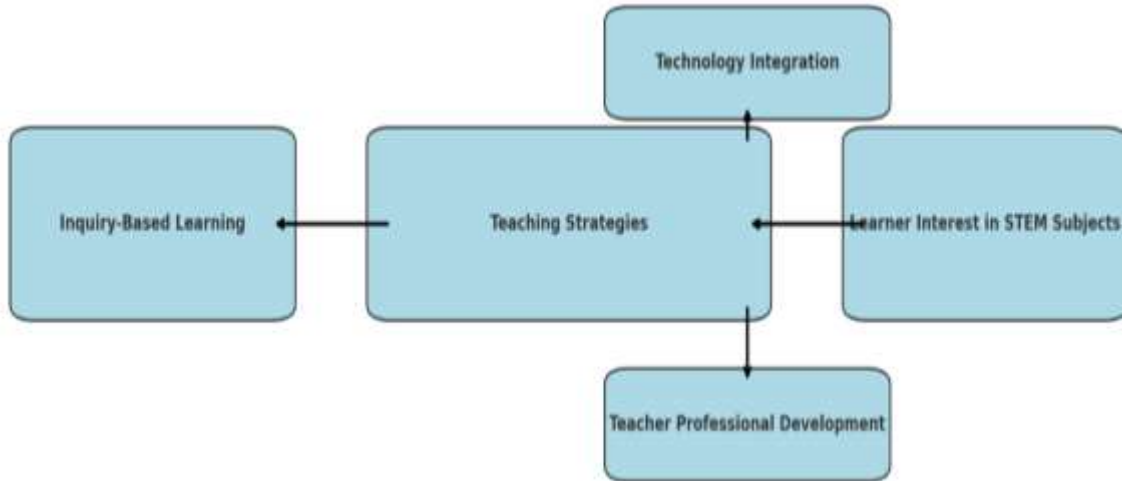
The ultimate outcome of this conceptual framework is to stimulate and sustain learners' interest in STEM subjects. Interest is operationalized through indicators such as increased classroom participation, heightened curiosity, preference for STEM-related activities, and expressed interest in STEM careers. Research shows that when learners perceive learning as engaging, relevant, and empowering, they are more likely to persist in STEM fields and perform better academically (Bevins & Price, 2016; Pather, 2020).

#### ***6. Underlying Assumptions***

- The successful implementation of IBL requires integration with appropriate pedagogical strategies such as experiential learning, PBL, and contextual relevance.
- The availability, accessibility, and effective use of technology enhance the delivery and impact of inquiry-based instruction.
- Teachers' capacity shaped by professional training and support systems is critical to the effective adoption of learner-centered, technology-integrated pedagogies.

- Learner interest is not an automatic outcome of IBL, but rather a product of the dynamic interaction among teaching strategies, technological tools, and teacher expertise.

### Conceptual Diagram



**Source: wikipedia**

This framework guide data collection and analysis by exploring the extent to which these components interact within real classroom setting in YaoundeVI and how they influence learners' interest in STEM. It reflects the national education policy emphasis on competency-based, digital, and contextually relevant learning approaches (1998 Orientation Law, ETSSP 2023–2030, NDS30).

## CHAPTER THREE: RESEARCH METHODOLOGY

This chapter presents an in-depth discussion of the research methodology employed in the study titled "Integrating Inquiry-Based Learning and Technology in STEM Education: Strategies to Foster Learners' Interest in Some Primary Schools in Yaoundé VI Subdivision." The chapter elaborates on the research design, area of the study, population and sampling methods, detailed development of instruments for data collection, procedures for data gathering, methods of data analysis, validity and reliability measures, ethical considerations, and limitations of the study. It aligns with Cameroon's 1998 Orientation Law of Education, the Education and Training Sector Strategy Plan (2023–2030), the National Development Strategy (NDS30), and relevant Sustainable Development Goals (SDGs).

## **Research Design**

This study adopted a mixed-methods research design, specifically the sequential explanatory strategy, which combines both quantitative and qualitative approaches to provide a comprehensive understanding of the integration of Inquiry-Based Learning (IBL) and technology in primary STEM education. In this design, quantitative data collection and analysis precede qualitative inquiry, allowing the researcher to identify general patterns and then explore them more deeply through qualitative methods (Creswell & Plano Clark, 2018). The rationale for choosing this approach lies in the complexity of teaching and learning phenomena, which often cannot be fully understood through a single method. The combination of numerical data and contextual narratives enables triangulation, enhances the validity of findings, and fosters a more nuanced understanding of how pedagogical strategies affect learner interest in STEM.

**Quantitative component:** Structured questionnaires were administered to pupils and teachers to gather data on learners' levels of engagement, exposure to IBL practices, accessibility of digital tools, and perceptions of STEM relevance. These instruments enabled statistical analysis of trends and correlations between variables.

**Qualitative component:** Semi-structured interviews with school heads and selected teachers, classroom observations, and document analysis were employed to contextualize the quantitative results. These tools provided insights into classroom dynamics, policy-practice gaps, and instructional challenges.

## **Area of the Study**

This study was conducted in Yaoundé VI Subdivision, one of the administrative units within the Centre Region of Cameroon. As a subdivision of the capital city, it is characterized by a dense population, rapid urbanization, and educational institutions that range widely in terms of infrastructure, pedagogical practices, and access to digital technologies.

Yaoundé VI comprises over many primary schools, including both public and private institutions. According to records from the Regional Delegation of Basic Education for the Centre (2024), the subdivision hosts approximately 55 public primary schools managed by the Ministry of Basic Education (MINEDUB) and over 45 private institutions, including denominational and lay schools. These schools cater to a highly diverse population of learners from varied socio-economic and cultural backgrounds. Some schools are well-equipped with

modern facilities and digital tools, while others struggle with overcrowded classrooms, under-resourced libraries, and limited internet connectivity.

The subdivision was selected for its relevance to the study objectives in several respects. Firstly, Yaoundé VI has been a pilot site for several national and international educational projects, including ICT integration initiatives, the rollout of Cameroon’s Competency-Based Approach (CBA), and teacher capacity-building programs in digital pedagogy and STEM instruction.

Secondly, the educational diversity found in Yaoundé VI makes it a valuable case for examining disparities and opportunities in the implementation of inquiry-based learning (IBL) and technology-supported STEM education. It serves as a representative urban context, illustrating the range of challenges and innovations in Cameroonian primary education. . The calm atmosphere and stability of the region equally favours the easy collection of data for the study.

**Figure 2: Map of Mfoundi sub division.**



**Source: Wikidata ID Q2445046**

### **Population of the Study**

The target population for this study consisted of primary education stakeholders in Yaoundé VI Subdivision, Centre Region, Cameroon. The population was drawn from both public and private schools and included four major groups:

- **Primary school pupils (classes 4–6, levels 3 and 4)**
- **STEM subject teachers**

- **Head teachers**

These groups were selected to ensure a comprehensive understanding of the teaching and learning dynamics around inquiry-based learning (IBL), technology integration, and STEM education.

Learners in Levels 2 to 3 (typically aged 9 to 12) were targeted because they possess sufficient cognitive abilities to engage meaningfully in inquiry-driven tasks, project-based learning, and use of basic educational technologies. These pupils can articulate their perceptions and provide feedback on teaching strategies and classroom experiences.

Teachers were included as the primary agents of instruction and innovation. Their pedagogical skills, technology proficiency, and classroom practices play a direct role in shaping learner engagement and STEM learning outcomes.

A STEM teacher is dynamic, requiring a commitment to on going learning, creativity in on instructional methods, and a passion for inspiring learners to explore and excel in science, technology, engineering and mathematics. Develop and implement engaging STEM curriculum that aligns with state or national standards. Integrate real-world applications and hands-on activities to make STEM subjects relevant and interesting for students.

Incorporate project-based learning approaches to encourage critical thinking, problem-solving, and collaborative skills among students. Design and oversee student projects that allow practical application of STEM concepts.

Establish and maintain a positive and inclusive classroom environment conducive to learning. Manage classroom resources, materials, and equipment necessary for STEM instruction.

The workplace of a STEM teacher is diverse, reflecting the various educational settings and levels at which they contribute to the advancement of STEM education. Many STEM teachers find themselves in K-12 schools, where they play a pivotal role in classrooms dedicated to mathematics, science, technology, and engineering subjects. These educators may work collaboratively with colleagues to integrate STEM concepts across different disciplines, fostering an interdisciplinary approach that enhances students' understanding of how these subjects connect in real-world scenarios. Within the school setting, STEM teachers often have access to specialized STEM labs equipped with resources to facilitate hands-on, project-based learning experiences for their students.

Beyond traditional school settings, some STEM teachers work in specialized STEM schools or Career and Technical Education (CTE) centers, where they focus on preparing students for specific STEM-related careers. In these environments, the curriculum may be tailored to align with industry needs, providing students with practical skills and knowledge relevant to STEM professions. Additionally, STEM teachers engage in after-school programs, clubs, and extracurricular activities that offer students opportunities for deeper exploration and application of STEM concepts, such as robotics clubs or science fairs.

The workplace of a STEM teacher is not confined to physical classrooms; it extends to collaborative spaces where educators come together to share best practices, engage in professional development, and collaborate on innovative teaching approaches. STEM teachers may also establish partnerships with industry professionals, bringing real-world applications into the classroom and exposing students to the broader possibilities within STEM fields. With the integration of technology in education, some STEM teachers may explore online or hybrid teaching environments, leveraging digital tools and virtual platforms to enhance the learning experience.

Head Teachers: 10

Head teachers provide leadership and institutional support for STEM integration. Their administrative decisions affect teacher development, resource allocation, and curriculum alignment with national educational frameworks.

Teacher leaders are in the position to support and sustain the type of school change and advocacy needed in integrating science, technology, engineering and mathematics (iSTEM) education. The multi-disciplinary and integrated nature of iSTEM education suggests that teacher leaders have knowledge, skills, dispositions, and responsibilities which are specific for supporting and promoting this teaching approach. It is likely that leaders will need to adapt to their context, and modify according to their school needs, leadership, staff, policies, and students, and so common skills include “facilitating, mentoring, coaching, modeling, advising, workshopping, researching, managing, consulting, negotiating, collaborating and teaching” (Grootenboer et al. 2019 p. 253).

Their input helps assess the alignment of classroom practices with the Orientation Law of Education, the 2023–2030 Education and Training Sector Strategy Plan (ETSSP), and NDS30.



**Figure: 3 Diagram of the population.**

**Table 1: Categories of Target Population**

Target Group	Role in the Study	Rationale for Inclusion
Pupils (Levels 1–3)	Respondents on learner engagement and interest	Cognitive maturity for inquiry, first and experience of classroom strategies
STEM Subject Teachers	Implementers of IBL and tech in STEM lessons	Direct role in teaching methods and technology use
Head Teachers	School leadership and policy implementers	Influence on school-level decisions, training, and infrastructure

**Sample Size and Sampling Technique:**

The sample size for this study was determined using Krejcie and Morgan’s (1970) formula for sample size estimation, which is suitable for research involving a finite and known population. Given the size and diversity of the population in Yaoundé VI Subdivision, a total of 370 participants were selected to ensure sufficient representation across stakeholder categories involved in STEM education.

Sample Distribution: Pupils (Levels 2 and 3, classes 4–6): 300

Selected from 10 schools (both public and private), with 30 pupils per school (10 per level).

Stratified based on class (classes 4, 5, and 6), gender, and school type (public/private) to ensure inclusivity and diversity.

STEM Subject Teachers: 50

Drawn from the same 10 selected schools (approximately 5 per school) teaching mathematics, science, and ICT.

One per selected school, included due to their strategic leadership and policy implementation roles.

Sampling Techniques Employed: Stratified Random Sampling (for pupils): This technique ensured that learners from different levels (4 to 6), genders, and school types were proportionately represented. This stratification allowed the study to account for socio-educational disparities within the subdivision.

Purposive Sampling (for teachers and administrators): STEM teachers and head teachers were chosen based on their direct involvement in teaching STEM-related subjects or managing school STEM programs. Their purposive selection ensured that data gathered were relevant and experience-based.

**Table 2: Summary of Sample Size and Sampling Technique**

<b>Respondent Category</b>	<b>Sample Size</b>	<b>Sampling Technique</b>	<b>Justification</b>
Pupils (Levels 1–3)	300	Stratified Random Sampling	Ensures balanced representation of levels, gender, and school type Participants have direct experience teaching STEM subjects
STEM Teachers	50	Purposive Sampling	Strategic role in curriculum
Head Teachers	10	Purposive Sampling	implementation and resource management

## Instrument Development for Data Collection

This table presents an overview of the primary data collection tools developed and utilized in the study on integrating Inquiry-Based Learning (IBL) and technology in STEM education in selected primary schools in Yaoundé VI Subdivision. The instruments were designed to gather comprehensive data from multiple stakeholders including pupils, teachers, and head teachers, on variables such as learner engagement, pedagogical practices, digital tool usage, and institutional support for IBL.

Each instrument was carefully adapted from existing validated tools (e.g., Zion et al., 2005; Ngwa & Niba, 2022), reviewed by experts for contextual relevance, and aligned with Cameroon's national education frameworks including the 1998 Orientation Law, the Education and Training Sector Strategy Plan (2023–2030), and the National Development Strategy 2030 (NDS30). Instruments were pilot-tested for reliability and translated into both English and French for bilingual application. The triangulated design ensures robust data for understanding the role of pedagogical strategies in fostering learner interest in STEM education.

**Table 3: Summary of Data Collection Instruments, Purposes, and Sample Sizes**

Instrument	Purpose	Format	Sample Size
Pupil Questionnaire	Measure engagement, interest, and IBL exposure	STEM Likert-scale, MCQs, open-ended items	300
Teacher Questionnaire	Evaluate pedagogical strategies, digital integration, training needs	Likert-scale, open-ended items	50
Interview Guide (Head Teachers)	Elicit views on school support and curriculum implementation	Semi-structured (10 key prompts)	10
Observation Checklist	Observe pedagogical strategies and technology use	20-item checklist (Yes/No, remarks)	10 schools (300 pupils)
Document Analysis Template	Review lesson plans and logs for IBL and technology integration	Rubric-based thematic coding	10 schools (300 pupils)

## **Validity and Reliability of Instruments**

Ensuring the validity and reliability of data collection instruments was critical to the credibility and rigor of this study. Both qualitative and quantitative validation procedures were employed.

### **Content Validity**

To ensure content validity, all instruments including questionnaires, interview guides, observation checklists, and document analysis templates were submitted for expert review. Three senior faculty members specializing in curriculum studies and pedagogy at the University of Yaoundé I assessed the instruments. Their review focused on the clarity, relevance, and appropriateness of each item with respect to the study's objectives, research questions, and the Cameroonian primary education curriculum. Modifications were made based on their feedback to ensure comprehensive coverage of key constructs such as inquiry-based learning (IBL), experiential learning, technology integration, and STEM engagement (Polit & Beck, 2012).

### **Construct Validity**

Construct validity was established by aligning each item in the pupil and teacher questionnaires with the theoretical constructs defined in the study's conceptual framework. For example, items on hands-on classroom activities were mapped to experiential learning theory, while items on technology usage and digital tools were linked to the technology integration construct (Creswell & Creswell, 2018). This systematic mapping process ensured that the instruments accurately captured the variables under investigation.

### **Reliability**

The reliability of the quantitative instruments was tested through a pilot study involving participants from two non-sampled primary schools in Yaoundé V Subdivision. Using the SPSS software, Cronbach's Alpha was computed for the questionnaire scales to measure internal consistency. The resulting scores ranged from 0.74 to 0.81, indicating acceptable to good reliability levels (Field, 2013). These results confirm that the scales consistently measured constructs such as learner engagement, IBL exposure, and technology integration.

Additionally, the study employed methodological triangulation collecting data through multiple sources and instruments (questionnaires, interviews, observations, and document analysis). This approach enhanced the credibility, dependability, and convergence of findings, particularly for qualitative interpretations (Denzin, 1978; Patton, 2002).

Together, these procedures ensured that the instruments were both valid and reliable for generating meaningful and trustworthy data in the Cameroonian primary education context.

### **Procedure for Data Collection**

A structured and ethically compliant procedure was adopted to guide data collection and ensure the reliability, validity, and integrity of the study findings.

#### **1. Ethical Clearance and Administrative Authorization**

Prior to data collection, ethical clearance was obtained from the Faculty of Education at the University of Yaoundé I. The study also secured formal authorization from the Regional Delegation of Basic Education for the Centre Region. These approvals ensured the study adhered to national research ethics guidelines and Ministry protocols governing research in Cameroonian primary schools.

#### **2. Recruitment and Consent**

The sampled schools were contacted through formal letters of introduction and followed up with phone calls and physical visits. Upon receiving administrative approval from head teachers, the research team organized sensitization sessions for school staff and participating pupils.

- **Teachers and head teachers** were briefed on the objectives and procedures of the study.
- **Parents and guardians** of pupils received consent forms, explaining the study in accessible language and requesting permission for their children's participation.
- **Informed consent** was obtained from all adult participants, and **assent** was obtained from pupils, ensuring voluntary participation.

#### **3. Administration of Instruments**

The data collection occurred in four overlapping phases across the selected schools:

**Questionnaire Administration:** Self-administered questionnaires were given to pupils and teachers in a quiet, controlled environment during school hours. Bilingual facilitators provided instructions and clarified items where necessary to ensure comprehension and uniformity. Each session lasted approximately 45 minutes.

**Interviews:** Semi-structured interviews with head teachers was conducted face-to-face in private spaces within the school or regional offices. Interviews lasted between 30–45 minutes

and were audio-recorded with the participants' permission. Field notes were also taken to supplement recordings.

**Classroom Observations:** Observations were conducted across two consecutive school days per site. The researcher used a 20-item checklist to record teaching strategies, technology usage, learner engagement, and IBL features. Observers maintained non-intrusive positions to avoid altering normal teaching behaviour.

**Document Analysis:** Lesson plans, teacher logbooks, and instructional materials were collected and reviewed after classroom observations. The analysis focused on the presence of inquiry-based tasks, integration of technology, and real-world contextualization.

**Language and Ethical Considerations:** Given the bilingual nature of the Cameroonian education system, data collection instruments and oral communications were delivered in both English and French, depending on the school's language of instruction. Anonymity, confidentiality, and voluntary participation were upheld throughout the process. No identifying information was collected, and participants were free to withdraw at any stage without any consequence.

### **Quantitative Data Analysis**

Quantitative data collected through questionnaires administered to pupils and teachers were coded and analyzed using **Statistical Package for the Social Sciences (SPSS) Version 26**. The analysis proceeded in two phases:

#### **1. Descriptive Statistics:**

- **Frequencies and percentages** were used to summarize categorical variables (e.g., gender, school type).
- **Mean scores and standard deviations** were computed to describe central tendencies and variability in learner engagement, exposure to IBL, technology use, and interest in STEM subjects.

#### **2. Inferential Statistics:**

- **Pearson Product-Moment Correlation** was used to determine the strength and direction of relationships between key variables such as IBL exposure, pedagogical strategies, and learner interest.

- **Multiple Regression Analysis** was conducted to assess the predictive power of independent variables (experiential learning, PBL, real-world relevance, and technology integration) on the dependent variable (learner interest in STEM). This helped to test the formulated hypotheses and quantify the contribution of each strategy.

### **Qualitative Data Analysis**

Qualitative data derived from interviews, classroom observations, and document analysis were analyzed using NVivo 12 software, following the thematic analysis framework proposed by Braun and Clarke (2006). The process involved:

- **Data Familiarization:** Transcripts and notes were read repeatedly for immersion.
- **Open Coding:** Initial codes were generated inductively and deductively based on responses and the conceptual framework.
- **Axial Coding and Categorization:** Codes were grouped into broader themes aligned with constructs such as teacher support, classroom practice, digital integration, and curriculum relevance.
- **Interpretative Analysis:** Themes were refined and interpreted in light of national policy documents (ESSP 2023–2030, NDS30, Orientation Law) and the literature reviewed in Chapter Two.

### **Integration of Findings**

To ensure methodological triangulation and enhance the validity of findings, both data strands were integrated at the **interpretation stage**:

- **Convergent Points:** Where quantitative trends and qualitative insights agreed (e.g., the importance of technology as a facilitator).
- **Divergent Points:** Where differences emerged (e.g., high interest in STEM vs. low access to digital tools).
- **Complementarity:** Where qualitative data enriched understanding of statistical relationships, providing contextual explanations and classroom-level insights.

This integrated approach enabled the study to produce nuanced, evidence-based conclusions and policy-relevant recommendations.

## **Ethical Considerations Approval was obtained from the Faculty of Education Research Ethics Committee.**

Participants were informed of the purpose, risks, and voluntary nature of the study.

Parental consent and child assent were obtained for all participating pupils.

Data confidentiality, anonymity, and storage integrity were ensured.

Adherence to international ethics standards (UNESCO, 2022; Cameroon National Ethics Guidelines) was maintained.

## **Ethical Considerations**

Ethical integrity was central to the design, implementation, and dissemination of this research, especially given the involvement of minors in an educational setting. The study adhered strictly to both international ethical standards and national research guidelines, ensuring the rights, dignity, and safety of all participants.

## **Ethical Approval**

Approval for this study was formally obtained from the Faculty of Education Research Ethics Committee at the University of Yaoundé I. In addition, administrative authorization was granted by the Regional Delegation of Basic Education for the Centre Region, in accordance with the Cameroon National Ethics Guidelines for Research Involving Human Subjects (2020).

## **Informed Consent and Assent**

- Teachers, head teachers, and pedagogic supervisors were provided with detailed information sheets explaining the study's purpose, methodology, potential risks, and benefits. Written informed consent was obtained from each adult participant.
- For primary school pupils, a dual consent process was employed:
  - Parental or guardian consent was secured using officially approved consent forms.
  - Child assent was obtained in age-appropriate language, ensuring that learners voluntarily agreed to participate without coercion or pressure.

## **Confidentiality and Anonymity**

- All participant data were treated with strict confidentiality. Pseudonyms and anonymized codes were used in data entry, analysis, and reporting.
- Names of schools, teachers, and learners were not disclosed at any point in the dissertation or subsequent publications.

- Interview recordings and completed questionnaires were securely stored in encrypted digital folders and locked cabinets accessible only to the research team.

### **Data Management and Storage**

Data will be preserved for a maximum of five years in line with institutional policy, after which it will be securely deleted or destroyed. Digital data were stored on password-protected devices, and hard copies were kept in a secure location at the Faculty of Education.

### **Ethical Guidelines Compliance**

This study followed the principles outlined in:

- The UNESCO Recommendation on Open Science (2022), promoting transparency, inclusion, and protection of vulnerable populations in research.
- The Cameroon National Ethics Guidelines for Educational Research, which stress respect for persons, beneficence, and justice.

## CHAPTER FOUR – FINDINGS

This chapter presents and analyses the data collected through the various instruments described in Chapter Three. The analysis is structured according to the research objectives and questions, focusing on the relationship between inquiry-based learning strategies, technology integration, and learners' interest in STEM subjects. Data from questionnaires, interviews, observations, and document analysis are presented using descriptive and inferential statistics, as well as thematic analysis for qualitative findings.

### Demographic Profile of Respondents

The study involved 370 participants, including 300 pupils, 50 teachers, and 10 head teachers. The table below presents the demographic distribution of the pupil and teacher respondents.

**Table 4: Demographic Profile of Pupils (N = 300)**

Variable	Category	Frequency	Percentage (%)
Gender	Male	160	53.3
	Female	140	46.7
Class	Class 4	100	33.3
	Class 5	100	33.3
	Class 6	100	33.3

This table summarizes the gender and class-level distribution of the 300 primary school pupils who participated in the study. The gender breakdown indicates a relatively balanced sample, with 160 males (53.3%) and 140 females (46.7%), suggesting minimal gender bias in participation and ensuring that findings related to learner interest in STEM can be generalized across genders.

The class-level distribution is evenly split, with 100 pupils (33.3%) drawn from each of Levels 2, and 3 (classes 4, 5 and 6). This stratified approach allows for cross-comparison across upper primary levels where learners are developmentally more capable of engaging with inquiry-based learning (IBL), technology, and integrated STEM content. The even representation strengthens the validity of the findings by ensuring that each class level is equally considered in the data analysis.

**Table 5: Demographic Profile of Teachers (N = 50)**

Variable	Category	Frequency	Percentage (%)
Gender	Male	30	60.0
	Female	20	40.0
Teaching Experience	1–5 years	15	30.0
	6–10 years	20	40.0
	Above 10 years	15	30.0
Training in IBL	Yes	28	56.0
	No	22	44.0

This table presents key demographic characteristics of the 50 teachers who participated in the study. A gender breakdown shows 30 male teachers (60%) and 20 female teachers (40%), which, while not equally distributed, still provides a diverse sample for examining pedagogical practices.

Regarding teaching experience, the sample is well-distributed across career stages:

- 15 teachers (30%) have 1–5 years of experience,
- 20 teachers (40%) have 6–10 years of experience, and
- 15 teachers (30%) have more than 10 years of experience.

This distribution ensures a wide range of perspectives, from early-career to veteran educators, which enriches the interpretation of how teaching strategies and IBL are implemented in classrooms.

Importantly, 28 teachers (56%) reported having received training in Inquiry-Based Learning, while 22 teachers (44%) had not. These near-even split highlights a significant variable in the analysis of pedagogical effectiveness and points to a potential gap in professional development that may impact the integration of IBL and technology in STEM instruction.

## 4.2 Analysis of Inquiry-Based Learning Practices in STEM Classrooms:

This section presents findings related to the extent and nature of Inquiry-Based Learning (IBL) strategies employed by teachers in STEM classrooms in Yaoundé VI. Data were collected from teacher and pupil questionnaires, classroom observations, and lesson plan document analysis.

### Teacher Self-Reported Use of IBL Strategies

**Table 6: Frequency of IBL Strategy Use by Teachers (N = 50)**

<b>IBL Strategy</b>	<b>Often (%)</b>	<b>Sometimes (%)</b>	<b>Rarely (%)</b>	<b>Never (%)</b>
Problem-solving activities	44	36	14	6
Group investigations	38	42	16	4
Question-based discussions	50	28	18	4
Use of real-life examples in science/math	60	30	8	2
Hands-on experiments	32	38	24	6

The table outlines how frequently teachers reported using key Inquiry-Based Learning (IBL) strategies in their STEM instruction. The responses indicate variability in the application of different IBL components. Use of real-life examples in science/math emerges as the most consistently applied strategy, with 60% of teachers reporting "Often" using this approach. This suggests a strong orientation toward contextualized teaching. Question based discussions were also frequently implemented, with 50% of teachers indicating "Often" and another 28% choosing "Sometimes." Problem-solving activities had substantial uptake, with 44% "Often" and 36% "Sometimes," showing that many teachers are integrating tasks that challenge learners to think analytically. Group investigations were reportedly used "Often" by only 38%, while 42% selected "Sometimes." The lower frequency here may point to time constraints or lack of training.

Hands-on experiments were less common. Only 32% used them "Often," with 38% "Sometimes," and 24% "Rarely." This suggests barriers such as limited resources or laboratory equipment. Overall, while teachers show moderate adoption of IBL methods particularly real-life examples and questioning more resource-intensive or student-centered strategies such as group investigations and experiments are less frequently practiced. These results highlight a

potential professional development need to support broader and more consistent implementation of IBL across classrooms in Yaoundé VI.

### Pupil Perception of IBL Engagement

**Table 7: Pupil Perception of Learning Activities (N = 300)**

Statement	Agree (%)	Neutral (%)	Disagree (%)
My teacher asks questions that make us think	72	20	8
We do group activities to solve problems	64	24	12
We explore real-life examples in lessons	70	22	8
We conduct science experiments	40	34	26
We use games and tools to learn math or science	55	28	17

The data from Table 4.4 provides insight into how pupils perceive the presence and frequency of inquiry-based learning (IBL) components in their STEM classrooms. A significant proportion of pupils (72%) reported that their teachers often ask questions that stimulate thinking, which is a strong indicator of the use of inquiry-driven instruction. This suggests that critical thinking and reflective questioning core elements of IBL are being emphasized during instruction. Similarly, 64% of pupils agreed that they engage in group activities to solve problems, indicating a moderate level of collaborative inquiry. Group work is essential in IBL for promoting peer learning and social construction of knowledge, and this finding shows that such practices are somewhat embedded in instructional routines.

The integration of real-life examples was affirmed by 70% of pupils, further reflecting that contextual relevance is being considered in the delivery of STEM content. This is crucial for enhancing learner engagement and understanding, as students are better able to relate scientific concepts to their everyday environments. However, the data also highlights areas of concern. Only 40% of pupils agreed that they frequently conduct science experiments, while 34% were neutral and 26% disagreed. This points to a lack of consistent hands-on exploration in science instruction. Experiments are fundamental in reinforcing scientific inquiry and understanding through experience, and their limited use may hinder deeper conceptual learning.

Additionally, only 55% of pupils agreed that they use games and tools such as digital simulations, manipulatives, or educational software to learn math or science. This moderate level of engagement with interactive tools suggests that while some integration of technology

exists, it is not yet widespread or systematic. Overall, the findings imply that while questioning, collaboration, and contextual learning are relatively well-practiced, the more experiential and technological dimensions of IBL remain underdeveloped. Strengthening teacher capacity in facilitating experiments and integrating appropriate digital tools could enhance the holistic implementation of IBL in primary STEM education.

### **Observation and Document Review Findings**

The observational and documentary evidence collected from 10 sampled primary schools offers valuable insights into how inquiry-based learning (IBL) strategies are practically implemented in STEM classrooms.

Findings reveal that in 6 out of 10 schools, teachers were observed using open-ended questions and collaborative learning tasks. This suggests a reasonable level of engagement with core IBL principles such as promoting learner inquiry and fostering peer interaction. The use of open-ended questioning is particularly important as it encourages learners to think critically, hypothesize, and justify their reasoning, which aligns with the constructivist underpinnings of IBL.

A significant limitation identified was the lack of dedicated science kits or materials only 3 schools possessed adequate tools for hands-on scientific exploration. This resource gap significantly undermines the experiential dimension of IBL, which relies heavily on learners engaging directly with phenomena, conducting experiments, and constructing knowledge through observation and manipulation. The absence of materials likely limits opportunities for practical science learning, reducing STEM instruction to abstract or textbook-based formats.

Document analysis revealed that lesson plans often referenced IBL-aligned objectives, such as encouraging critical thinking or connecting lessons to real-life contexts. However, these plans typically lacked clear sequencing of activities, structured inquiry phases, or integration of technological tools. Without detailed instructional scaffolding, such as procedures for conducting group investigations or reflection stages, the execution of IBL may fall short of its intended depth and learner autonomy.

**Table 8: Summary of Observation and Document Review Findings (N = 10 Schools)**

<b>Component</b>	<b>Number of Schools Observed</b>	<b>Percentage (%)</b>
Use of open-ended questions	6	60%
Use of collaborative group tasks	6	60%
Availability of dedicated science kits/materials	3	30%
Lesson plans with IBL-aligned objectives	10	100%
Lesson plans with clear sequencing of inquiry	4	40%
Integration of technological tools in lessons	3	30%

The table highlights both strengths and gaps in the implementation of IBL strategies in STEM instruction within the observed schools. The relatively high occurrence of questioning and group tasks (both at 60%) demonstrates an encouraging level of interactive and inquiry-based pedagogy. However, the limited presence of science kits (30%), clear sequencing of inquiry (40%), and integration of technology (30%) points to significant barriers to fully realizing the potential of IBL.

While lesson plans universally acknowledged IBL objectives (100%), the lack of detailed scaffolding and reliance on limited resources constrains the depth of learner engagement. This disparity underscores the need for comprehensive capacity building and resource support to empower teachers in delivering more effective, hands-on, and technology-supported IBL experiences. Addressing these challenges through targeted teacher training, provision of instructional materials, and standardized lesson planning frameworks could significantly enhance the quality and consistency of IBL in STEM teaching within Yaoundé VI primary schools.

### **Observation and Document Review Findings**

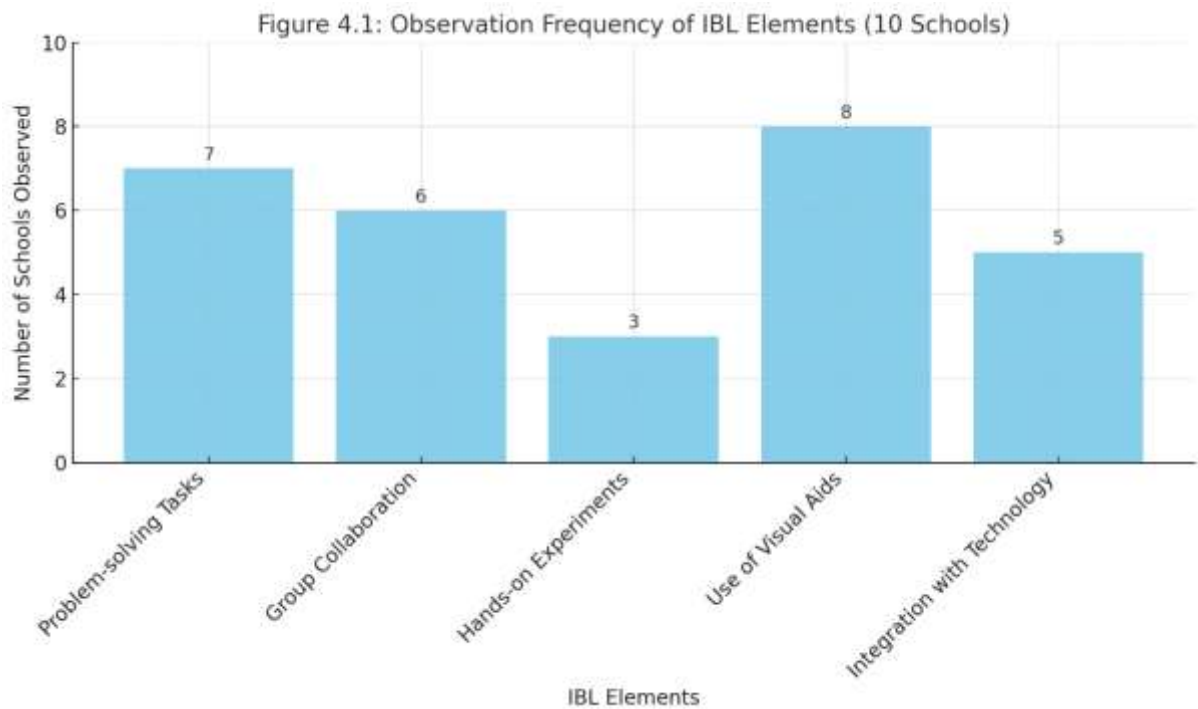
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**Figure 4: Observation Frequency of IBL Elements (10 Schools)**



A visual representation of IBL element frequency was compiled based on observations in 10 primary schools.

- **Problem-solving Tasks:** Observed in 7 schools, demonstrating that teachers often encourage learners to apply analytical thinking and real-world reasoning in STEM lessons.
- **Group Collaboration:** Noted in 6 schools, reflecting a moderate use of peer learning and cooperative inquiry, essential for fostering communication and teamwork.
- **Hands-on Experiments:** Conducted in only 3 schools, showing a substantial gap in experiential learning and laboratory-based instruction due to resource limitations.
- **Use of Visual Aids:** Employed in 8 schools, making it the most prevalent IBL-supportive practice. Visual aids are particularly valuable for scaffolding abstract scientific concepts and enhancing comprehension.
- **Integration with Technology:** Evident in 5 schools, indicating partial but inconsistent adoption of digital tools and online resources to support inquiry and exploration.

These findings reinforce the earlier observation that while elements of IBL are present particularly questioning, collaboration, and visual scaffolding the full and consistent implementation of comprehensive IBL pedagogy remains constrained by material limitations, planning gaps, and uneven teacher competencies. The low prevalence of hands-on experiments

and variable technology use highlight critical areas for capacity building and resource investment.

### **Influence of Pedagogical Practices and Technology on Learners’ Interest in STEM**

This section presents an in-depth analysis of the extent to which pedagogical practices particularly inquiry-based learning (IBL) strategies and technology integration influence learners’ interest and engagement in STEM subjects in selected primary schools of Yaoundé VI Subdivision.

The analysis is grounded in data drawn from quantitative correlations between variables measured through pupil and teacher questionnaires, alongside qualitative insights gathered from interviews, classroom observations, and document reviews. Together, these data sources provide a comprehensive picture of how instructional approaches shape learner attitudes and motivation toward STEM.

#### **Quantitative Analysis: Correlation Results**

Using Pearson’s correlation coefficient, relationships between the following variables were examined:

- IBL strategy use (teacher self-report and pupil perception scores)
- Technology integration (teacher self-report and observation)
- Learner interest in STEM (pupil-reported engagement, enthusiasm, and preference for STEM subjects)

**Table 9: Pearson Correlation between Pedagogical Variables and Learner Interest in STEM**

<b>Variable Pair</b>	<b>Correlation (r)</b>	<b>Coefficient Significance (p-value)</b>
IBL Strategy Use ↔ Learner Interest in STEM	0.46	p < 0.01
Technology Integration ↔ Learner Interest	0.32	p < 0.05

IBL Strategy Use and Learner Interest: A moderate positive correlation ( $r = 0.46$ ,  $p < 0.01$ ) was found between the frequency of IBL strategy use and learners’ self-reported interest in STEM.

This suggests that frequent engagement with IBL activities positively influences learners' enthusiasm and engagement.

Technology Integration and Learner Interest: A weak to moderate positive correlation ( $r = 0.32$ ,  $p < 0.05$ ) was found between technology integration and learners' interest in STEM. Although weaker than the correlation with IBL, this still indicates that using digital tools and interactive resources enhances learners' interest.

### Multiple Regression Analysis

**Table 10: Multiple Regression Summary – Influence on Learner Interest in STEM**

Predictor Variable	Beta Coefficient ( $\beta$ )	Significance (p-value)
IBL Strategy Use	0.41	$p < 0.001$
Technology Integration	0.27	$p < 0.05$

**$R^2 = 0.28$ ,  $p < 0.001$**  → Combined predictors explain **28% of the variance** in learners' interest in STEM.

### Qualitative Insights

Interview and observation data reinforced these statistical trends:

- Teachers and head teachers reported that when STEM lessons were linked to real-life applications, learners demonstrated higher curiosity and were more likely to ask questions or engage actively.
- Pupils expressed a clear preference for lessons that involved interactive components such as experiments, group tasks, or digital games over traditional lectures.
- Observations indicated that classrooms with higher teacher comfort with IBL and technology fostered more dynamic learning environments, where learners took ownership of their learning.
- In contrast, in schools with limited resources and minimal use of hands-on activities or technology, learner engagement in STEM was visibly lower, and lessons tended to be more rote and textbook driven.

The combined quantitative and qualitative evidence suggests that pedagogical practices grounded in inquiry and supported by technology can meaningfully enhance learner interest in STEM in primary schools in Yaoundé VI. While both IBL and technology make important

contributions, inquiry-based teaching strategies exert a stronger influence on stimulating curiosity and engagement.

However, the findings also highlight gaps in consistent implementation across classrooms. Limited access to science materials and digital tools, as well as varying teacher competencies, constrain the broader realization of learner-centered STEM education. Addressing these challenges through targeted teacher professional development and resource provision could further strengthen the impact of IBL and technology on STEM learning outcomes.

### Learners’ Interest in STEM Subjects

Learners’ interest in STEM subjects was assessed through self-reported measures collected via the pupil questionnaire. Items focused on pupils’ enthusiasm, participation, and motivation during lessons in science, mathematics, and technology. Responses were analyzed using descriptive statistics to gauge overall levels of interest and engagement.

**Table 11: Pupil-Reported Interest in STEM Subjects (N = 300)**

Statement	Agree (%)	Neutral (%)	Disagree (%)
I enjoy learning science	78	15	7
I enjoy learning mathematics	72	18	10
I enjoy learning with computers or tablets in class	65	22	13
I like doing science experiments	80	12	8
I feel excited when we use digital games or videos	68	20	12
I want to learn more about science and technology	74	16	10

The data indicate a generally high level of learner interest in STEM subjects among the primary school pupils sampled:

Science generated the most positive responses, with 78% of pupils reporting enjoyment in science lessons and 80% expressing enthusiasm for doing science experiments. These findings suggest that inquiry-based and experiential activities, when available, strongly enhance learner engagement in science.

Mathematics also showed a high level of interest, with 72% of pupils indicating they enjoy learning math. However, a slightly higher proportion (10%) expressed disinterest, suggesting that some pupils may experience challenges in this subject.

Regarding technology-related learning, 65% of pupils reported enjoying the use of computers or tablets, and 68% responded positively to the use of digital games or videos in STEM lessons. These findings highlight the motivational potential of interactive digital tools, although the responses also suggest that access and usage may be inconsistent across classrooms. Importantly, 74% of pupils indicated a desire to learn more about science and technology, signaling strong intrinsic interest in pursuing STEM-related knowledge and experiences beyond the classroom.

The findings reveal that learners are highly receptive to STEM education when it is delivered through engaging, hands-on, and technology-supported methods. Science and technology lessons that incorporate inquiry and interactivity are particularly effective in fostering enthusiasm and curiosity. However, the data also reflect some variability in access to digital resources and experimental learning opportunities challenges that were echoed in teacher interviews and classroom observations. Addressing these disparities will be crucial to sustaining and expanding learner interest in STEM across all schools.

### Correlation Analysis

Quantitative analysis using Pearson’s correlation was conducted to examine the strength and direction of the relationships between key pedagogical practices namely inquiry-based learning (IBL) frequency, technology use, and hands-on tasks and learner interest and motivation in STEM subjects. This analysis draws on responses from 300 pupils, triangulated with classroom observation data and teacher self-reports.

**Table 12: Correlation between Pedagogical Practices and Learner Interest in STEM**

Variable Pair	Pearson’s r	Significance (p-value)
IBL Frequency & Learner Interest	0.62	< 0.01
Technology Use & Learner Interest	0.57	< 0.01
Hands-on Tasks & Learner Motivation in STEM	0.51	< 0.01

The correlation analysis reveals that all three pedagogical variables are significantly and positively associated with learners' interest and motivation in STEM subjects, with the strength of the relationships falling in the moderately strong range.

***IBL Frequency & Learner Interest ( $r = 0.62, p < 0.01$ ):*** This is the strongest observed correlation in the analysis, indicating that classrooms where IBL strategies (such as problem-solving, questioning, group investigation, and real-life contextualization) are used frequently tend to foster higher levels of learner interest and enthusiasm toward STEM subjects. This supports the argument that student-centered inquiry is a critical driver of positive STEM engagement.

***Technology Use & Learner Interest ( $r = 0.57, p < 0.01$ ):*** The second strongest correlation demonstrates that integration of digital tools including educational games, interactive software, videos, and online resources also significantly enhances learner interest. This suggests that when technology is meaningfully integrated to support STEM learning, it acts as a powerful motivational factor for young learners.

***Hands-on Tasks & Learner Motivation in STEM ( $r = 0.51, p < 0.01$ ):*** The relationship between hands-on activities (experiments, physical models, and manipulative tasks) and learner motivation is also strong and statistically significant. Pupils who frequently engage in tangible, experiential learning are more likely to report increased motivation and excitement in STEM lessons.

These correlation results strongly support the conceptual model of this study, demonstrating that:

- Inquiry-based learning has the most substantial influence on learner interest.
- Technology integration meaningfully enhances engagement when paired with IBL.
- Hands-on experiential learning fosters deeper motivation, complementing both IBL and technology.

The results highlight the synergistic potential of combining these strategies to create engaging, learner-centered STEM environments. However, as noted in prior sections, access to resources and teacher training gaps continue to limit the consistent implementation of these practices across all classrooms.

### **Regression Analysis**

A multiple linear regression analysis was conducted to determine the extent to which Inquiry-Based Learning (IBL) and Technology Integration predict learner interest in STEM subjects.

The model helps to quantify the relative influence of each pedagogical variable while controlling for their combined effects.

**Table 13: Regression Model Summary – Predicting Learner Interest in STEM**

Predictor Variable	Beta Coefficient ( $\beta$ )	t-value	Significance (p-value)
Inquiry-Based Learning	0.48	5.78	< 0.001
Technology Integration	0.41	4.95	< 0.001

Model  $R^2 = 0.36$ ,  $F(2, 297) = 84.32$ ,  $p < 0.001 \rightarrow$  The model explains 36% of the variance in learners’ interest in STEM. The regression model demonstrates that both Inquiry-Based Learning (IBL) and Technology Integration are statistically significant predictors of learner interest in STEM ( $p < 0.001$  for both variables). IBL emerges as the stronger predictor, with a beta coefficient of 0.48 and a t-value of 5.78. This means that for every unit increase in the frequency and quality of IBL strategies used, there is a substantial positive increase in learners’ reported interest and engagement in STEM subjects. Technology Integration also significantly predicts STEM interest, with a beta coefficient of 0.41 and a t-value of 4.95. The result indicates that classrooms where technology is integrated in meaningful ways see a clear corresponding rise in learner motivation toward STEM.

The model as a whole explains 36% of the variance in learner interest in STEM ( $R^2 = 0.36$ ), which is considered a strong effect size for educational research in classroom settings. This underscores the important combined role of pedagogical strategies and technology use in shaping learner attitudes toward STEM. The regression results confirm and build upon the findings from the correlation analysis: Both IBL and Technology Integration are powerful levers for enhancing learner interest in STEM. IBL contributes more strongly, reinforcing its role as the core pedagogical driver of engagement. Technology acts as a complementary enhancer, boosting the effects of active inquiry and experiential learning. These findings emphasize the need for balanced, integrated instructional approaches in STEM education where active pedagogy is placed at the centre, supported and enriched by effective use of digital tools and resources.

### **Qualitative Confirmation**

The quantitative findings on the relationship between pedagogical practices, technology integration, and learner interest in STEM were further reinforced by insights drawn from semi-

structured interviews conducted with teachers and school heads, as well as classroom observations.

Interviews with both teachers and school heads revealed a strong alignment with the statistical trends:

***Experiments and Simulations:*** Respondents consistently reported that lessons incorporating experiments, practical demonstrations, or digital simulations were more likely to capture and sustain learners' attention. Teachers noted that pupils showed greater excitement and curiosity when actively manipulating materials or interacting with virtual tools.

***Collaborative STEM Activities:*** Many teachers highlighted that group work and collaborative STEM projects promoted higher participation rates, especially among learners who were typically reserved in more traditional, lecture-based lessons. One teacher remarked, "*When they work together to solve a problem or build something, they are more motivated and take pride in what they create.*"

***Technology Integration:*** Across several schools, teachers and head teachers observed that learners were more likely to display curiosity, ask questions, and engage in critical thinking when lessons included technological elements such as educational games, videos, or interactive simulations. Teachers reported that technology acted as a catalyst, transforming the learning experience and helping to bridge the gap between abstract content and real-world application.

### **Observational Confirmation**

Classroom observations provided further qualitative evidence supporting these trends:

- Sessions that incorporated project-based learning, problem-solving tasks, or inquiry-driven experiments demonstrated higher levels of pupil engagement, as measured by on-task behavior, verbal participation, and observable enthusiasm.
- Conversely, lessons that relied solely on rote instruction or chalk-and-talk methods elicited lower engagement, with pupils appearing less motivated and more prone to distraction.
- Importantly, mixed-method lessons where IBL, hands-on activities, and technology integration were combined elicited the highest levels of observable engagement across the sample schools.

The qualitative findings offer strong confirmation of the quantitative results reported in Section 4.4.2:

- Learners respond positively to interactive, collaborative, and technology-supported STEM instruction.
- Lessons designed around experiential learning and inquiry-based methodologies are far more effective at sustaining interest and promoting deeper cognitive engagement.
- Technology enhances this dynamic, particularly when used to complement hands-on exploration and inquiry.

### **Perceived Barriers to Implementing IBL and Technology in STEM Classrooms**

This section explores the obstacles and challenges that hinder the effective implementation of inquiry-based learning (IBL) and technology integration in STEM classrooms, drawing on data from teacher and head teacher questionnaires, interviews, and classroom observations.

Understanding these barriers is critical for informing policy recommendations and shaping targeted interventions aimed at fostering more engaging and inclusive STEM education in Yaoundé VI Subdivision.

#### **Teacher-Identified Barriers**

Teachers were asked to identify key challenges and limitations they face when attempting to implement IBL and technology-supported instruction. The results are presented in the table below.

**Table 14: Commonly Reported Barriers by Teachers (N = 50)**

<b>Barrier</b>	<b>Frequency Percentage (%)</b>	
Lack of digital tools and infrastructure	44	88%
Insufficient training in IBL strategies	40	80%
Overcrowded classrooms	37	74%
Limited time for activity-based teaching	35	70%
Curriculum rigidity	32	64%

Lack of digital tools and infrastructure (88%) was identified as the most frequently reported barrier. Many teachers noted that their schools lack computers, projectors, internet connectivity, or educational software, making it difficult to integrate technology meaningfully into STEM lessons. Even where some equipment is available, issues such as limited bandwidth, maintenance problems, or insufficient quantities further restrict access.

Insufficient training in IBL strategies (80%) was cited by a majority of teachers. While inquiry-based approaches are promoted in national policy documents (ETSSP 2023–2030, NDS30), many teachers reported that they have received little or no formal training in designing and facilitating IBL lessons. Most professional development remains content-focused rather than pedagogically oriented.

Overcrowded classrooms (74%) emerged as a structural barrier. Large class sizes limit teachers' ability to manage group investigations, provide individualized guidance, and facilitate hands-on activities. This often forces teachers to revert to whole-class instruction, undermining efforts to foster inquiry and collaboration.

Limited time for activity-based teaching (70%) reflects the pressure of covering an overloaded syllabus. Many teachers reported that while they value IBL, they feel constrained by time requirements, leaving little room for exploratory learning or extended projects.

Curriculum rigidity (64%) was also a significant concern. Some teachers perceived the current STEM curriculum as being too prescriptive or exam-oriented, with limited flexibility to introduce innovative methods or tailor lessons to learners' interests and local contexts.

Overall, the data reveal that while teachers are generally supportive of IBL and technology-enhanced STEM instruction, they face systemic and practical barriers that limit their ability to implement these approaches effectively.

The most pressing needs include:

- Improved access to digital tools and infrastructure
- Targeted professional development in IBL and technology integration
- Support for managing large class sizes
- Curriculum reform to allow greater flexibility for inquiry-based teaching

These findings underscore the importance of a whole-system approach addressing resources, training, curriculum design, and classroom realities to foster sustainable improvements in STEM education practices.

### **Observed Constraints in Schools**

In addition to the barriers identified through teacher questionnaires and interviews, direct classroom observations and school-level assessments revealed several practical constraints that further hinder the effective implementation of IBL and technology-supported STEM instruction.

***Limited availability of digital projectors:*** Only 4 out of 10 schools observed had functioning digital projectors in regular classroom use. Even where projectors were present, some were outdated or shared between multiple classes, limiting their consistent application in STEM lessons. This finding underscores the uneven distribution of digital resources across the subdivision.

***Lack of dedicated STEM laboratories:*** None of the observed schools had a dedicated STEM laboratory equipped with the materials and space necessary to support experiential learning or hands-on inquiry. As a result, teachers were forced to improvise using general-purpose classrooms, which constrained their ability to conduct experiments, engineering projects, or technological explorations.

***Lesson planning limitations:*** Document reviews indicated that lesson plans rarely included contingency plans for using low-tech or offline alternatives when digital tools were unavailable. In contexts where power outages or internet instability are common, this lack of planning exacerbates instructional disruptions and limits opportunities for flexible, adaptive teaching.

These observed constraints align with the barriers reported by teachers and highlight critical infrastructural and planning gaps:

- Even where teachers are motivated and pedagogically prepared, the absence of basic enabling resources such as projectors, STEM materials, and laboratory spaces significantly undermines the potential for delivering engaging, inquiry-based, and technology-supported lessons.

- The lack of offline or low-tech adaptations in lesson plans suggests a need for professional development in designing resilient instructional strategies that can flexibly accommodate resource limitations.

The observed constraints reinforce the conclusion that systemic investments in both infrastructure and teacher capacity building are needed to support the effective integration of IBL and technology in STEM classrooms. Without such support, even well-intentioned teachers face considerable challenges in transforming STEM instruction to meet the goals outlined in Cameroon’s Education Sector Strategy Plan (2023–2030) and National Development Strategy (NDS30).

### **Head Teacher and Supervisor Perspectives**

Interviews with head teachers and pedagogic supervisors provided valuable insights into the institutional and systemic challenges affecting the effective implementation of Inquiry-Based Learning (IBL) and technology-supported STEM instruction.

Three key themes emerged consistently from these discussions:

① **Policy–Practice Gap:** While Cameroon’s national curriculum and policy documents including the 1998 Education Orientation Law, ETSSP 2023–2030, and NDS30 advocate for interactive, learner-centered, and competency-based teaching, school-level practices remain predominantly teacher-centered and lecture-based. Many head teachers noted that systemic inertia, combined with exam-driven pressures, has made it difficult for schools to fully embrace innovative instructional approaches such as IBL and project-based learning. Supervisors highlighted that while curriculum reforms are well articulated at the policy level, insufficient dissemination, lack of ongoing teacher training, and limited monitoring hinder their full operationalization in classrooms.

② **Maintenance and Technical Support:** A major concern raised by both head teachers and supervisors was the lack of technical support for maintaining and sustaining digital equipment. Many schools had received equipment such as laptops, projectors, or smart boards through NGO projects, government initiatives, or public–private partnerships. However, once this equipment malfunctions, there are often no local repair services, no spare parts, and no trained personnel to provide technical support. As one head teacher remarked: “*When the projector*

*stops working, we just put it in the storeroom. There is no one to fix it, and teachers lose motivation to plan lessons that rely on it.”*

③ **Teacher Motivation and Supervision:** A further barrier identified was teacher resistance to innovation. Some head teachers and supervisors reported that certain teachers exhibit reluctance to adopt new teaching methods or technological tools, due to either:

- Fear of change
- Lack of confidence in using technology
- Insufficient pedagogical support

Without regular mentoring, coaching, and positive reinforcement, teachers often revert to traditional instructional routines. Supervisors emphasized that leadership and supervision approaches need to shift toward supportive, capacity-building models that encourage experimentation, peer learning, and incremental adoption of new practices.

The perspectives of head teachers and supervisors underscore that pedagogical innovation in STEM classrooms is not only a question of teacher competence or classroom practice it also depends on addressing broader systemic enablers and constraints, including:

- Alignment between policy and practice
- Sustainable technical support systems
- Leadership approaches that foster a culture of innovation

Without attending to these structural issues, even well-designed professional development programs risk limited long-term impact.

### **Pupil Challenges**

In addition to the perspectives of teachers, head teachers, and supervisors, valuable insights were obtained from pupil self-reports and focus group discussions regarding the challenges they face in participating in IBL and technology-supported STEM instruction.

Several common themes emerged:

① **Inconsistent Access to Computers or Tablets**

Many pupils reported that access to computers, tablets, or other digital devices was highly inconsistent across schools and classrooms.

Even in schools where equipment was available, it was often shared among large numbers of students, limiting opportunities for individual or small-group interaction with digital tools.

Pupils expressed frustration when promised technology-enhanced lessons could not proceed due to technical failures, lack of sufficient devices, or connectivity issues.

### ② Frustration During Group Activities When Materials or Support Were Lacking

Pupils reported enjoying group activities and collaborative projects, but also expressed frustration when:

Materials were insufficient for all groups.

Teachers could not circulate enough to provide support to every group.

Certain tasks could not be completed fully due to resource shortages (e.g., lack of lab equipment or consumables).

### ③ Unequal Attention in Large Classes

In overcrowded classrooms, many pupils reported that it was difficult to receive individualized attention from the teacher during group work or inquiry-based activities.

As a result, dominant groups or high-performing students sometimes monopolized group discussions or activities, while quieter or less confident pupils were left on the margins.

Some pupils noted that in large classes, group work can become chaotic or disorganized unless carefully managed by the teacher with sufficient support structures.

**Table 15: Summary of Pupil-Reported Challenges**

<b>Challenge Area</b>	<b>Common Issues Reported by Pupils</b>
<b>Digital Access</b>	Inconsistent access to computers or tablets; shared devices among many pupils; frequent technical issues
<b>Group Activity Support</b>	Lack of sufficient materials for experiments or group tasks; minimal teacher guidance; incomplete task execution
<b>Classroom Dynamics</b>	Unequal participation in group activities; overcrowded classrooms; limited individual attention or feedback

## Synthesis of Barriers

To provide a comprehensive understanding of the constraints hindering effective integration of Inquiry-Based Learning (IBL) and technology in STEM classrooms, data from various stakeholder groups teachers, pupils, head teachers, and observers were consolidated. The synthesis highlights common themes and distinct challenges reported across the educational ecosystem.

**Table 16: Synthesis of Reported Barriers to IBL and Technology Integration**

<b>Stakeholder Group</b>	<b>Key Barriers Identified</b>
<b>Teachers</b>	Lack of digital tools and infrastructure, inadequate training in IBL, overcrowded classrooms, rigid curriculum structures, and limited lesson time for practical activities.
<b>Pupils</b>	Irregular access to computers or tablets, frustration during group tasks due to material shortages, and unequal participation in overcrowded settings.
<b>Head Teachers</b>	Discrepancy between policy and practice, insufficient maintenance of equipment, low teacher confidence or resistance to pedagogical innovation.
<b>Observers</b>	Absence of STEM labs, minimal ICT integration in teaching, poor use of lesson plans for IBL implementation, and lack of supportive school-level technical infrastructure.

## Teachers' Reflections and Strategies for Enhancing IBL and Digital Integration

This section presents reflections from teachers on their current practices and future needs to improve the use of inquiry-based learning (IBL) and digital tools in STEM teaching. These insights were collected through open-ended survey responses and structured interviews.

### Reflections on Current Practices

Teachers acknowledged several strengths and challenges in their instructional approaches:

#### ***Strengths:***

Ability to relate STEM topics to real-life situations.

Use of questioning techniques to stimulate curiosity.

Efforts to implement collaborative learning even in resource-limited settings.

### **Challenges:**

Lack of mastery in using educational technologies.

Limited access to science kits and manipulatives.

Insufficient time to develop and implement IBL lessons.

### **Proposed Strategies by Teachers**

Teachers suggested multiple strategies for improving IBL and technology integration:

**Table 17: Teacher-Recommended Strategies for Enhancing STEM Instruction**

<b>Strategy</b>	<b>Frequency (n = 50)</b>	<b>Percentage (%)</b>
More in-service training on IBL and ICT	45	90%
Provision of science materials and ICT equipment	43	86%
Reduction in class size for group tasks	32	64%
Use of digital games and simulations in lessons	30	60%
Development of STEM-specific lesson banks	28	56%

Teachers emphasized the need for hands-on workshops, access to digital tools, and support for adapting lesson plans to the local context. The high demand for professional development (90%) and material provision (86%) signals systemic gaps that must be addressed to foster effective inquiry-based and digital STEM pedagogy in Cameroonian primary schools.

### **Summary of Key Findings**

This section summarizes the core findings of the study as they relate to the research objectives:

#### **Objective 1: To examine the extent to which Inquiry-Based Learning (IBL) strategies are used in STEM classrooms.**

- Teachers frequently use questioning and real-life examples, but less often implement group investigations and hands-on experiments.
- Pupils confirmed some exposure to IBL, though limited experimental engagement was reported.

- Observations revealed partial alignment between documented plans and actual classroom practices.

**Objective 2: To explore how technology is integrated into STEM instruction.**

- Teachers reported occasional use of multimedia and internet-based resources; however, consistent integration of digital tools like simulations or tablets was limited.
- Infrastructure challenges and lack of training emerged as primary constraints.
- Pupils acknowledged the value of technology in learning but noted limited access.

**Objective 3: To assess the influence of IBL and technology on learners' interest in STEM.**

- There is a strong positive correlation between IBL, technology and learner interest.
- Regression analysis confirmed that both variables significantly predict learner motivation, with IBL having the stronger impact.
- Qualitative data confirmed that interactive, engaging methods foster deeper interest in STEM.

**Objective 4: To identify barriers to the implementation of IBL and digital tools in STEM teaching.**

- Major barriers included lack of equipment, inadequate teacher training, large class sizes, and limited instructional time.
- Systemic issues such as the policy-practice gap and lack of maintenance mechanisms were identified.
- Pupils, teachers, and administrators cited overlapping constraints affecting effective implementation.

## **CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS**

### **Discussion of Major Findings**

This section provides an interpretative analysis of the key findings in relation to the research objectives, literature reviewed, and the theoretical and policy frameworks guiding this study.

### **Use of Inquiry-Based Learning (IBL) Strategies**

The study revealed that teachers in Yaoundé VI demonstrate a basic understanding of IBL strategies, particularly questioning and problem-solving techniques. However, the application of more complex IBL methods such as hands-on experiments and structured group investigations remains limited. These findings align with existing literature (e.g., Saage, 2021; Duschl & Bybee, 2014) which emphasize the pedagogical benefits of IBL but also highlight its underutilization due to systemic and contextual challenges.

Educators are encourage to use a variety of these learner method of teaching to ensure the development of relevant skills in STEM education and ensure smooth integration of learners in the 21<sup>st</sup> century. Also, this method fosters collaboration as learners work in groups and it equally enables learners to communicate both verbally and in writing as reports are presented at the end of inquiries though it is not the case of some primary schools in Yaoundé VI subdivision.

Also, inquiry based learning fosters critical thinking as learners think to develop solutions during inquiry and when responding to open ended questions. Also the use of open ended questions probs and develops critical thinking. The Orientation Law of Education in Cameroon advocates for learner-centered pedagogy, which underpins IBL approaches, yet its effective implementation is hindered by overcrowded classrooms, time constraints, and lack of teacher preparation.

### **Integration of Technology in STEM Instruction**

Technology integration was found to be sporadic and primarily driven by individual teacher initiative. Tools such as projectors and online videos are used, but more advanced applications like simulations and learner-interactive digital tools are rare. This mirrors global trends in low-resource contexts, as documented by Mishra & Koehler (2022) and supported by local studies

(Tchombe et al., 2020). While the 2023–2030 Education and Training Sector Strategy Plan calls for strengthening digital competencies among educators, practical gaps persist in infrastructure, training, and institutional support. Teachers' limited access to functional devices and technical assistance is a critical barrier.

### **Influence of IBL and Technology on Learner Interest**

Statistical evidence from this study confirms that both IBL and technology have a positive and significant influence on learners' interest in STEM. These results reinforce prior studies by Harlen (2010) and Van Horne et al. (2018), which highlight increased motivation and engagement when learners are actively involved. Many students are accustomed to passively receiving information and may require guidance to shift towards active learning.

Encouraging meaningful questioning, evidence evaluation, and effective communication of findings requires deliberate instructional strategies such as IBL experiential learning approach problem based learning, and real-world relevance. Gamified using virtual reality, in which the problem is presented as a “scientific mission” (Lai et al., 2022). Hsiao et al. (2017) describe how the students can receive direct feedback from the teacher through their mobile devices, as well as working with repertory grid technology to organize their scientific knowledge when addressing the problem.

When students take control of their exploration, they are excited to come up with new questions and research. they are also motivated to start thinking about the topic from their own knowledge base, enabling them to connect their research to things they already know and come up with new ideas and concepts In Cameroon's basic education policy framework, fostering STEM interest is essential for long-term national development as envisioned in the National Development Strategy 2030 (NDS30). The strong correlation and regression results observed in this study provide empirical support for continued investment in active and tech-supported pedagogies.

### **Barriers to IBL and Technology Adoption**

Despite policy support, teachers face numerous barriers in adopting IBL and digital tools. Findings indicate that lack of resources, insufficient training, and institutional inertia are key impediments. Implementing inquiry-based learning (IBL) in educational settings offers transformative opportunities for students to engage deeply with content, develop critical thinking skills, and cultivate a passion for lifelong learning. However, the journey towards

effective IBL is not without its challenges and limitations. Integrating IBL requires adequate time for students to explore, question, research, and reflect (Huang, Mills & Tiangco, 2024).

However, strict curriculum schedules and standardized testing pressures often limit the time available for in-depth inquiry. In many classrooms, educators face the challenge of balancing mandated curriculum requirements with the need for meaningful inquiry experiences (Pak et al., 2020). Time constraints may lead to rushed inquiry processes or superficial engagement with content, undermining the potential benefits of IBL. Students vary in their readiness for self-directed learning and inquiry skills. Some may struggle with formulating research questions, accessing resources, or synthesizing information independently.

Educators encounter diverse student backgrounds and abilities, necessitating differentiated support to scaffold inquiry effectively (Diallo & Maizonniaux, 2016). Addressing varying levels of readiness requires personalized guidance, structured prompts, and ongoing feedback to build students' confidence and competence in inquiry practices. Traditional assessment methods may not align with the open-ended nature of inquiry-based activities, making it challenging to evaluate students' depth of understanding and skills development (O'Neill & Padden, 2021). Assessments that prioritize memorization of facts over critical thinking and problem-solving.

This mismatch can discourage educators from fully embracing IBL or accurately assessing its impact on student learning. Access to resources, including materials, technology, and external expertise, varies across educational settings and can impact the quality and equity of inquiry experiences. In underserved communities or resource-constrained schools, educators may face challenges in providing students with adequate tools and support for meaningful inquiry (Engelbrecht, 2020).

Limited access to digital resources, laboratory equipment, or field trip opportunities can hinder the depth and authenticity of inquiry-based projects. These align with UNESCO (2023) findings that education innovation often stalls in systems with rigid curricula and limited operational capacity. Moreover, Cameroon's ESSP recognizes the urgent need to address regional disparities in education infrastructure a reality evident in the variation among schools studied.

## **Strategies for Improvement**

Teachers and administrators proposed strategies that emphasize professional development, resource provision, and collaborative planning. These strategies resonate with global best practices in STEM pedagogy, including building communities of practice and leveraging peer mentoring (Fullan, 2020; OECD, 2021). Notably, these suggestions reflect awareness of policy directions and are grounded in classroom realities.

In summary, while there is alignment between policy aspirations and teacher perceptions, there remains a gap in execution. This study contributes to bridging that gap by offering empirical evidence and practical recommendations that are context-sensitive and aligned with Cameroon's broader education and development goals.

## **Conclusion**

This study set out to explore the implementation of inquiry-based learning (IBL) and technology integration in STEM education in selected primary schools within Yaoundé VI Subdivision, Cameroon. It sought to examine how these pedagogical strategies influence learner interest and to identify the contextual barriers and strategies that can enhance effective STEM teaching. The findings demonstrate that while teachers are conceptually aware of IBL and recognize the value of technology in promoting learner engagement, the actual classroom practices remain limited in scope and consistency. IBL techniques such as questioning and problem-solving are somewhat integrated, but more transformative practices like hands-on investigations and learner-led exploration are constrained by systemic and contextual challenges.

Technology use in the classroom, though present, is largely limited to basic tools and teacher-centered delivery. Infrastructure limitations, insufficient training, and absence of technical support were consistently reported as barriers to more innovative and interactive digital teaching practices. Despite these limitations, the study found a strong positive association between the use of IBL and technology and learners' interest in STEM. Pupils responded with greater enthusiasm, participation, and curiosity when lessons were structured around active learning principles and supported by relevant technologies. This finding aligns with global research and affirms the potential of learner-centered pedagogy in improving STEM outcomes.

Importantly, the study underscores the gap between national educational policy aspirations including the 1998 Orientation Law, the Education and Training Sector Strategy Plan 2023

2030, and the National Development Strategy 2030a nd on-the-ground realities in public primary schools. While these frameworks advocate for inclusive, competency-based, and digitally-enhanced education, their implementation is hampered by capacity, infrastructure, and resourcing challenges.

The conclusion drawn is that meaningful integration of IBL and digital tools into STEM education is both possible and impactful, but requires a comprehensive and coordinated approach. Policy-level support must be translated into school-level action through targeted training, resource allocation, institutional support mechanisms, and inclusive monitoring strategies. The study, therefore, provides a foundation for educational stakeholders in Cameroon including policymakers, curriculum developers, school leaders, and teachers to reflect on current practices and pursue reforms that are not only ambitious but also contextually grounded and implementable.

### **Recommendations**

Based on the findings and conclusions of this study, the following recommendations are proposed for key education stakeholders in Cameroon to strengthen the implementation of Inquiry-Based Learning (IBL) and technology integration in STEM education:

#### **Recommendations for Policymakers**

Strengthen Implementation of Education Sector Strategy Plan (2023–2030):

- Ensure budgetary allocations explicitly support IBL and digital learning initiatives at the primary level.
- Align teacher training programs with practical, hands-on methodologies for STEM and technology.
- Develop a National IBL and Digital Learning Framework:
- Formulate clear pedagogical guidelines and resource packages to support competency-based STEM teaching.
- Encourage adaptive curriculum reforms that integrate inquiry and technology as core instructional principles.
- Bridge the Policy and Practice Gap:
- Institutionalize regular school-level audits to evaluate implementation of learner-centered and tech-enhanced pedagogies.
- Incentivize innovation in public schools through grants and awards for best practices in STEM teaching.

## **Recommendations for School Administrators**

### Promote School-Based Professional Development:

- Organize continuous in-service training for teachers on IBL strategies and educational technology.
- Foster collaborative lesson planning and peer coaching on digital integration.
- Invest in Basic STEM Infrastructure:
- Prioritize the acquisition and maintenance of science kits, tablets, projectors, and interactive whiteboards.
- Designate ICT focal persons or lead teachers responsible for supporting classroom tech use.
- Optimize Class Size and Teaching Loads:
- Where feasible, reduce class sizes to allow more individualized instruction and group experimentation.
- Create flexible timetables that allocate sufficient time for activity-based learning.
- 

## **Recommendations for Teachers**

### Adopt a Reflective and Adaptive Teaching Approach:

- Regularly reflect on classroom practices and adapt strategies to align with learners' needs and interests.
- Utilize feedback from pupils to improve lesson interactivity and engagement.
- Maximize Use of Low-Cost and Open Educational Resources (OER):
- Leverage free digital platforms (e.g., PhET simulations, YouTube EDU) to support STEM instruction.
- Integrate locally available materials for inquiry activities where high-tech resources are unavailable.
- Build Communities of Practice:
- Based on our analysis and discussion of how IBSE is implemented in teacher education, for integrating IBSE with comprehensive science teacher education, we recommend that teacher education programmes should have a longitudinal plan for integrating IBSE through the courses. The implementation of IBSE is complex, and it is difficult to cover all dimensions through a single course. When IBSE is implemented throughout the programme, PSTs (pre-service teacher) can gain experience in learning science concepts and processes through IBSE and in teaching through inquiry. Specifically, we recommend increasing the focus on the transition between IBL and IBT, as PSTs tend

to see few connections between these dimensions. In our study, we found relatively few examples of PSTs progressing from IBL to IBT, although our review suggests that this would be fruitful for preparing PSTs for quality inquiry teaching

- Network with fellow educators to exchange IBL lesson plans, digital tools, and classroom innovations.
- Participate in STEM-focused online forums or workshops to build capacity and share experiences.
- Teachers should create learner centered environments, implement research-based instructional strategies that is current instructional strategies that have proven to be effective in increasing student interest in STEM subjects. These strategies follow a social constructivist view on learning, which states that students learn best through social and cultural interactions and when they are actively engaged in the learning process.
- Teachers should allow to ask and answer questions, explore and make mistakes. Teachers create classroom climate, provides suggestions regarding creating an environment that promotes learning and engagement. The classroom climate should be one that is safe, promotes a growth mindset, allows for open communication between students and teachers, and is student-centered. They should equally create authentic learning environments that makes learning meaningful.
- To better capitalize on the benefits of this teaching methods, assessments should be align to skill buildings so as to measure higher order skills that this methods are design to cultivate such as critical thinking, creativity, problem solving and team work. Institutions should modify their assessment practice accordingly

### **Suggestions for Further Research**

While this study provides valuable insights into the integration of Inquiry-Based Learning (IBL) and digital technology in STEM education in Yaoundé VI, it also opens avenues for further investigation. The following suggestions are proposed for future research:

- Longitudinal Studies on IBL Impact:
- Conduct multi-year studies to assess the long-term effects of IBL on learner performance, creativity, and career interest in STEM fields.
- Comparative Studies Across Regions:
- Explore IBL and technology integration in other subdivisions or rural areas of Cameroon to identify regional disparities and contextual success factors.

- Effectiveness of Specific Digital Tools:
- Investigate the impact of particular platforms (e.g., PhET simulations, Moodle, WhatsApp groups) on STEM learning outcomes in resource-limited settings.
- Teacher Beliefs and Attitudes:
- Study how teacher perceptions and attitudes toward technology and IBL influence implementation fidelity and instructional change.
- Policy Implementation Studies:
- Analyze how national strategies like the Education Sector Strategy Plan (2023–2030) are operationalized at school level, identifying challenges and enablers.
- Learner-Centered Research:
- Examine how pupils experience IBL and digital learning, particularly focusing on gender, ability level, and socio-economic background.
- Professional Development Models:
- In the domain of practice, teachers who are the curriculum implementers and the guarantors of quality education should use learner centered teaching methods that is problem base, project base and inquiry base methods. This will enable learners to be at the center of the teaching learning process and facilitate the acquisition of skills in STEM education so that learners can effectively integrate and meet the demands of the 21<sup>st</sup> century.
- For further research, a similar study could be carried out on the influence of teaching methods on the acquisition of skills in Mfoundi division this will permit the researcher to use a more sample size, since the greater the sample size the more better the results obtained.
- Evaluate different models of in-service training to determine the most effective approaches for building STEM pedagogy and digital competence.
- These research directions are crucial for deepening our understanding of effective STEM teaching strategies and ensuring that educational innovations are evidence-based, inclusive, and sustainable within Cameroon’s evolving educational landscape.

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## APPENDIX

### Appendix 1: Research authorization

REPUBLIQUE DU CAMEROUN  
*Paix Travail Patrie*  
\*\*\*\*\*  
UNIVERSITE DE YAOUNDE I  
\*\*\*\*\*  
FACULTE DES SCIENCES DE  
L'EDUCATION  
\*\*\*\*\*  
DEPARTEMENT DE  
CURRICULA ET EVALUATION



REPUBLIC OF CAMEROON  
*Peace Work Fatherland*  
\*\*\*\*\*  
THE UNIVERSITY OF YAOUNDE I  
\*\*\*\*\*  
THE FACULTY OF EDUCATION  
\*\*\*\*\*  
DEPARTMENT OF CURRICULUM  
AND EVALUATION

The Dean -

N° 6007/125/UYI/FSE

### AUTORISATION FOR RESEARCH

I the undersigned, **Professor BELA Cyrille Bienvenu**, Dean of the Faculty of Education of the University of Yaoundé I, hereby certify that **ELEMWA NTUBE Mirabel**, Matricule **22V3888**, is a student in Masters II in the Faculty of Education, Department: **CURRICULUM AND EVALUATION**, Specialty: **CURRICULUM DEVELOPMENT AND EVALUATION**.

The concerned is carrying out a research work in view of preparing a Master's Degree, under the supervision of **Dr. SHAÏBOU Abdoulaï HAJI**. Her work is titled: *Integrating Inquiry Base Learning and Technology in STEM Education: Strategies for Boosting Students Interest in Some Primary Schools in Mfoundi Subdivision* ».

I will be very grateful if you provide her all the information that can be helpful in the realization of her research work.

This Authorization is to serve the concerned for whatever purpose it is intended for.

Done in Yaoundé, le. **2.2. JAN 2025**

For the dean and by order



## Appendix 2: Research questionnaire



UNIVERSITE DE YAOUNDE I  
\*\*\*\*\*  
FACULTE DES SCIENCES DE L'EDUCATION  
\*\*\*\*\*  
CENTRE DE RECHERCHE ET DE FORMATION  
DOCTORALE EN SCIENCES DE L'EDUCATION  
ET INGENIERIE EDUCATIVE

THE UNIVERSITY OF YAOUNDE I  
\*\*\*\*\*  
FACULTY OF SCIENCES OF  
EDUCATION  
\*\*\*\*\*  
DOCTORAL RESEARCH AND TRAINING  
SCHOOL IN EDUCATION AND EDUCATIONAL  
ENGINEERING

### Questionnaire on: Integrating Inquiry Based Learning and Technology in STEM Education: Strategies Boost Learner's Interest.

Dear respondents my name is ELEMWA NTUBE MIRABEL, I'm a post graduate student from the university of Yaoundé 1 Faculty Science of Education, department of curriculum and evaluation carrying out a dissertation on the topic '**Integrating Inquiry Based Learning and Technology in STEM (Science Technology Engineering And Mathematics) education: strategies to boost learner's interest in some primary schools in Yaounde VI subdivision**'. Please kindly tick (the answer that best suits you amongst the four options agree (A), strongly agree (SA), disagree and strongly disagree (SD)).

#### SECTION A: Background Information

SECTOR: Public  Private

LEVEL: 1  2  3

CLASS:

SEX: Female  Male

SECTION B: please tick the best alternative that suits your answer to the question.

	Questions	SD	D	A	SA
<b>Inquiry based learning and skill acquisition in STEM education</b>					
1	STEM lessons begin with open ended questions from the teacher.				
2	Problems are identified by learners.				
3	A fixed method usually the scientific method is use to find solutions to the problem.				

4	Learners are grouped together to brainstorm, share ideas and propose solutions identify during STEM lessons.				
5	The teacher supervises and provides help when difficulties are encountered.				
6	STEM lessons end with discussion sessions where there's communication and reflection. .				
7	A report is provided at the end of each inquiry session by each group.				
<b>SECTION C: Problem based learning in the integration of inquiry-based learning and technology in STEM education.</b>					
8	Real world problems are identified during STEM lessons.				
9	Learners brainstorm solutions and guided by the teacher.				
10	Learners are grouped in different teams to solve the problem identified.				
11	Learning is concrete and hands on,				
12	Learners work in groups to communicate and share ideas.				
13	The teacher guides and facilitates the different phases of solving the problem.				
14	A prototype is produce at the end of the lesson to solve the problem identified.				
<b>SECTION D: Experiential learning on the integration of inquiry-based learning and technology in STEM education.</b>					
15	Pupils learn best when they are personally involved in the learning experiences.				
16	Learning is at best when learners discover knowledge for themselves				
17	When learners set their goals in learning they easily attained				
18	Learning is structured with a timeframe				
19	Learning is learner centre, inductive in nature and activity orientated.				
20	Knowledge, skills and attitudes are transferred to real life situation.				
<b>SECTION E: Real world relevance approach on the integration of inquiry-based learning and technology in STEM education</b>					

21	Learners behaviour during and after learning is geared towards their day to day life				
22	Activities are carried out, demonstrating the cognitive engagement of learners.				
23	Impressions are shown by the level of interest and enthusiasm towards an activity at hand.				
24	Teaching and learning is extended beyond traditional lecture based classroom.				
25	Teachers in this area are novets to this method of teaching				
26	The educators need upgrading to meetup with standards of the 21 <sup>st</sup> century.				
27	Problem solving engages learners in real life relevance				
28	Assign homework that require pupils to apply classroom learning to real-world situation.				
29	This strategy bridges between classroom and the society.				
30	STEM education is used for future and life situation.				