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THE USE OF TECHNOLOGY IN THE TEACHING OF BIOLOGY AND THE DEVELOPMENT OF STUDENTS COMPETENCES IN SELECTED SECONDARY SCHOOLS IN MFOUNDI DVISION.

A Dissertation Submitted to the University of Yaoundé I, Faculty of Education in Partial Fulfilment of the Requirements for the Award of a Master's Degree in Curriculum Development and Evaluation

Specialty: Curriculum Developer and Evaluator

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DECLARATION

I hereby declare that this dissertation is my original work and has never been submitted to any University or institution of higher learning for an academic award.

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CERTIFICATION

This is to certify that this work entitled: **"*The use of Technology in the Teaching of Biology and the Development of Competences in Some Secondary Schools in Mfoundi Division*"** was carried out by BERINYUY Evangeline WIRNGO (Registration Nº 19P3662) under my humble supervision.

Prof. KIBINKIRI Eric LEN

Faculty of Education

University of Yaoundé I

DEDICATION

To my parents:

Henry WIRNGO and BONGKEVEN Dorothy

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This research work could not have been realized by the researcher alone without assistance from others. I received moral, financial, intellectual, and emotional supports from many people and I remain indebted to them.

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ABSTRACT

This study examines the use of technology in teaching biology and the development of competences in some secondary schools in Mfoundi Division. The problem of this study emanates from the observed deficiencies in the competencies of secondary school graduates. The main objective of the study was to examine how the use of technology in teaching biology enhance learner's competence development. The main research question was how does the use of technology in teaching biology influence learners' competences development and the main research hypothesis was there is a relationship between the use of technology in teaching biology and learners' competence development. To conduct this study, we employed four main theories, social learning theory, constructivism, TPACK model and theory of academic performance. The five-chapter quantitative studies adopt the descriptive survey research design. The simple random sampling technique was employed to sample the population and via the Krejcie and Morgan table, we obtained a sample size of 86 participants. The data was collected using questionnaire and was analyses via SPSS vol 23 using the spearman rank correlation. The data was presented in tables, percentages and frequencies. The findings suggested that **RH1;** ICT teaching Materials significantly affects Learners' Competences development (CD) as the Pearson correlation (SC) value $\boldsymbol{r}$ = 0.265, indicating a low correlation. Also the level of significance is 0.014 less than 0.05, (alpha): $\boldsymbol{r}$ = 0.265, $\boldsymbol{P}$= 0.014 $\leq$ 0,05). **RH2**; Teachers ICT Skills significantly affects Learners' C D. Pearson correlation value $\boldsymbol{r}$ = 0.143, which indicates a low correlation between Teachers ICT Skills and Learners' C A. also the level of significance is 0.191 more than 0.05, (alpha). **RH3*;*** Multimedia Library significantly affects Learners' CD. the SC value $\boldsymbol{r}$ = 0.361. Also, the level of significance is 0.001 which is less than 0.05, (alpha). **RH4*;*** Computer assisted instructions significantly affects and Learners' CD. The SC value $\boldsymbol{r}$ = 0.281, which indicates a low correlation between computer assisted instructions and Learners' CD. also, the level of significance is 0.009 less than 0.05, (alpha). From the findings above, the results established that the use of technology in teaching biology have an increase in students' retention in biology and therefore contributed highly to the development of students' competences. We therefore recommend that teachers should be well trained to enhance the use of ICT in teaching biology and also schools should be well equipped with ICT tools for both learners and teachers

KEY WORDS: the use of technology, Teaching Biology, Competence development.

RÉSUMÉ

Cette étude examine l'application des Technologie dans l'enseignement de la biologie et le développement des compétences des élèves dans certains lycées dans le département de Mfoundi. La problématique de cette étude émane des lacunes constatées dans les compétences des diplômés du secondaire. L'objectif principal de l'étude était d'examiner comment l'application des TIC dans l'enseignement de la biologie améliore le développement des compétences de l'apprenant. La principale question de recherche était de savoir comment l'application des TIC dans l'enseignement de la biologie influence le développement des compétences des apprenants et la principale hypothèse de recherche était qu'il existe une relation entre l'utilisation des TIC dans l'enseignement de la biologie et le développement des compétences des apprenants. Pour mener cette étude, nous avons utilisé trois théories principales, la théorie de l'apprentissage social : le constructivisme, la théorie didactique, la compétence et la théorie de la performance scolaire. L'étudiant quantitatif en cinq chapitres adopte la conception descriptive de la recherche par sondage. La technique d'échantillonnage aléatoire simple a été utilisée pour échantillonner la population et via le tableau de Krejcie et Morgan, nous avons obtenu une taille d'échantillon de 110 participants. Les données ont été recueillies à l'aide d'un questionnaire et ont été analysées via SPSS vol 23 en utilisant la corrélation de rang Spearman. Les données ont été présentées sous forme de tableaux, de pourcentages et de fréquences. Les résultats suggèrent que Rh1 ; Le matériel d'enseignement des TIC a un effet significatif sur le développement des compétences des apprenants (DC) en tant que valeur de corrélation du lanceur (SC) r = 0,265, indiquant une corrélation élevée. De plus, le niveau de signification est de 0,013 (inférieur à 0,05, (alpha) : r = 0,697, P= 0,013≤ 0,05. HR2 : Il existe une relation significative entre les competences en TIC des enseignants et la valeur de correlation SC r = 0. 0,143 ce qui indique une corrélation modérée entre les méthodes d'illustration des instructions utilisant les TIC et l'AC des apprenants. De plus, le niveau de signification est de 0,191 inférieur à 0,05, (alpha). HR3 : Il existe une relation significative entre les bibliotheque multimedia et la valeur de corrélation de A. Pearson des apprenants r = 0,369, ce qui indique une corrélation modérée entre les compétences en TIC des enseignants et le C A des apprenants. Le niveau de signification est également de 0,001 inférieur à 0,05, (alpha). HR4: HR4: Il existe une relation significative entre les méthodes d'illustration des instructions utilisant les TIC et l'AC des apprenants. La valeur SC r = 0,281 ce qui indique une corrélation modérée entre les méthodes d'illustration des instructions utilisant les TIC et l'AC des apprenants. De plus, le niveau de signification est de 0,009 inférieur à 0,05, (alpha). Relation significative entre la bibliothèque multimédia et le CA des apprenants. La valeur SC r = 0,281. De plus, le niveau de signification est de 0,009, ce qui est inférieur à 0,05, (alpha). Nous recommandons donc que les enseignants soient bien formés pour améliorer l'utilisation des TIC dans l'enseignement de la biologie. Les écoles devraient également être équipées d'outils TIC pour les apprenants et les enseignants

MOTS CLÉS : utilisation des technologies, Enseignement de la Biologie, Acquisition de Compétences

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LIST OF ABBREVIATIONS AND ACRONYMS

CA:	Competences Acquisition
CBA:	Competency Based Approach
A/L:	Advance Level
AI:	Artificial Intelligence
CD-ROM:	Compact Disc Read-Only Memory
CISCO:	Computer Information System Company
DVD:	Digital Video Disc
GCE O/L:	General Certificate of Education Board
GSDL:	Greenstone Digital Library
LCCs:	Least Connected Countries
LDC:	Leaving the Least Developed Countries
O/L:	Ordinary Level
OLPC:	One Laptop Per Child
OER:	Open Educational Resources
ICT:	Information and Communication Technology
MINESEC:	Ministry of Secondary Education
MDGs:	Millennium Development Goals
RH:	Research Hypothesis
PC:	Personal Computer
PMID:	PubMed Indexing Number,
RAMSA:	Record Management Self-Assessment
SC:	Spearman's correlation
SPSS:	Statistical Package for Social Science
TAM:	Technology Acceptance Model
UNESCO:	United Nations Education Scientific and Cultural Organization
UNO:	United Nations Organization

GENERAL INTRODUCTION

Technology use in schools appears to be growing rapidly stemming from, the fact that rapid progress of information and communication technologies is considered as one of the key factors of change in human society. Information and communication technologies (ICT) have changed the pedagogy in education offering more student-centered learning incidents (Farhan and Ahmed, 2019). The main impact of ICT in education can be seen in improving the capabilities of instructors, changing the educational structure, creating opportunities for greater and more comprehensive learning, enhancing educational quality and improving teaching skills, (Ahmadi, Keshavarzi, and Foroutan, 2011). According to Albin (2006), the rapid progress of information and communication technologies has been combined with different aspects of life, including its effect on education, health, research and communications. Progress and development in information and communication technology are considered as positive elements of change in secondary education, and internet and network technology are used extensively in educational fields on the Earth (Hawkins 2005, Jackson et al 2004). Today, internet has become an instrument for searching information, social-international interactions and support of discoveries, and it has a fundamental role in the education process (Benbunan- Fich 2002, Jonassen et al 2003).

Studies have shown that in spite of the rapid progress of information and communication technologies, these technologies are not used effectively in classrooms (Albin 2006, Okojie M, Olinzock, Okojie B, & Tinukwa 2006). In most secondary schools in the center region of Cameroon, sometimes students do not know how to use internet effectively; even the instructors do not understand its use in educational schedules or how to use to enhance the teaching of their specific subjects (Jonassen et al 2003). Mbangwana, (2008). Opined that while technology is mostly used in administration and researches, it is rarely used in the teaching learning process since including computer technologies in instructional process challenges the secondary school teacher's methods, behaviors as well as mental abilities. According to performed researches, there are still a lot of secondary school teachers who do not use information and communication technologies effectively in the process of teaching and learning (Becker 2000).

Competence acquisition as actions that attempt to acquire (or implement) individual abilities to handle situations in a way that serve productive purposes in the firm (inspired by Hamel and Heene, 1994, Sanchez et al., 1996). This view acknowledges both the successful integration and productive nature of competence. The different subjects have varying stages

of implementing the envisaged competencies into their lessons to equip youth with skills necessary to adapt to a changing world. However, the national adoption and progressive implementation of competency-based teaching approach (CBA) in Cameroon secondary education midpoints is the activation of learner's competencies. This implies that upon successful completion of each subject at each level, like in biology program, students are expected to have gained competency in the following areas; gain a broad understanding of the primary disciplines in the biological sciences, including molecular biology, genetics, cell biology, biochemistry, and physiology, critically evaluate scientific data and scientific literature, identify important, novel questions and critically design and execute experiments to address these questions.

However, for the academic year 2022/2023, the ministry of secondary education in Cameroon instituted and unconditional use of digitalization in the teaching learning process. This entails all secondary school teachers have to begin employing ICT in the teaching of respective subjects. This goes in collaboration with the already existing competency-based approach (CBA) as the pedagogic technique in use in the secondary school. This study sets to examine how the inculcation of implementation of ICT in the teaching of biology as a subject could influence the student's ability in acquiring competencies. This mixed study is presented in five chapters, chapter one is the background to the study, chapter two is the literature review, chapter three is the research methodology, chapter four is data analysis and presentation of findings, and chapter five is discussion of findings.

CHAPTER ONE:

BACKGROUND TO THE STUDY

Introduction

This chapter provides an over view of the background of the study, statement of the problem, purpose of the study, objectives of the study, research questions and research, hypotheses, significance of the study. It also contains the scope and delimitation of the study, and operations definitions.

Historical background

In education, ICT has a long history. Technology first used in education a long time ago. But since it's came to people's acknowledgement, technology first use in education in 1600s.the first educational technology was originally introduced known as Slide Rule in 1654 by Robert Bissakar. The instrument was designed to be used only by scientist and engineers up to 1970s, till modern calculators were invented. The slide rule was eventually used in classroom in the teaching and learning of mathematics until it was replaced by electronic and graphic calculators. In 1646, the Magic Lantern was introduced, this device was used in homes, theatres and in classrooms to improve learning and student's engagement. Later in the 1800s, when technology first introduced in education with Slates and Chalk. The slates late to the discovery and introduction of the black boards in the 19th century. It was in 1822 that Charles Babbage first introduced the calculating engine which path the way to modern day digital computing. The engine was able to compute; he became known as the father of digital computing

Later in 1873, Christopher Sholes introduced the type writer which also debuted the QWERTY key board that is still used today. The type writer was used in printing books and other learning materials. In 1925, the film projector made its way into the classroom, displayed still images from film tripe and audios sounds. It was used in the classroom up to 1890s and were used to study particular topics until the coming of more modern projectors. In the last year of 1950, Xerox invented and introduced the photocopier in educational establishments, which was used to multiply learning material till today. In the 1980s, the International Business Machine (IBM) introduced the first personal computer. The PCs became available for everyone, and facilitate its use in the classroom setting. In the mid-1980s CD ROM were introduced in the educational setting. Both learners and students were able to store data in audio, video and sometimes the whole encyclopedia in a single compact

disk. In the 1990s, the internet was made available for public use, mostly in the transfer of smaller files. Before the 21st century, the interactive white board was introduced to be used in the classroom and today the latest include in modern education is virtual reality. Many teachers today improve their classroom experience using virtual or augmented reality.

According to Sindhu, (2013), now ICT in Schools is a component of the RMSA. The Information and Communication Technology (ICT) in Schools was launched in December, 2004 and revised in 2010 to provide opportunities to secondary stage students to mainly build their capacity on ICT skills and make them learn through computer aided learning process. The Scheme is a major catalyst to bridge the digital divide amongst students of various socio economic and other geographical barriers. The objective of the Scheme is to cover all Government and government aided secondary and higher secondary schools by giving priority for early coverage of schools in educationally backward blocks and in areas having concentration of SC/ST/minority/weaker section. Under the revised scheme, there is a provision of a suitably qualified full time computer teacher in each secondary and higher secondary school. In case of higher secondary school having computer related subjects as elective, there would be need for a post graduate in computers teacher.

The state of Cameroon is conscious of the input of technological advancement in the domain of economy, culture, governance and education. With regard to Information and Communications Technologies, the Cameroonian government has put in place a strategy of conceiving and implementing efficient and reliable programs in all state sectors, inscribed in a document entitled *National Development Strategy on Information and Communication Technologies.* (2007). This text is prefaced by Paul Biya the president of the Republic of Cameroon, an undoubted indication that the state prioritizes ICT in all spheres of political, economic, cultural, social and educational life. Another important text on Cameroon's ICT ambitions and advancement is documented by Tchinda Jousué. It maps and traces the extent to which the country is involved and has evolved in ICT in terms of varied initiatives, projects and experiments by the public and private sectors. The situation in Cameroon, the text clearly points out, is an ongoing one with difficulties but excellent promise, (Teke, 2012), Entitled "*ICT in Education in Cameroon*" is extracted and modified from the Survey of ICT in Education in Africa. Since 2007, ICT has been an integral part of the teaching and learning process in Cameroon schools. The theme of the 2022/2023 academic year was digitalization of education. these concludes the national determination to embrace ICT in the classrooms in Cameroon.

Contextual Background

The presidential declaration in 2001 on the integration of Information and Communication Technology (ICT) in primary and secondary schools in Cameroon constitute a major milestone for it is used in the teaching-learning process, (Tanyi, 2022). This immediately provoked others, such as the World Bank's cyber education initiative in 2001, and the development of a National ICT policy for the country in 2007 Tchinda (2007). Despite these efforts, it effective presence in the teaching-learning of many subjects may still be lagging.

Information and Communication Technology (ICT) is being developed as one of the pillars of modern society (UNESCO, 2002). Many countries believe that critical understanding of ICT along with mastering the skills and concepts of ICT as part of the core of education is as much important as reading, writing and arithmetic (UNESCO, 2002). It is widely believed that information and communication technology is changing the education system leading to the modernization of teaching and learning (Sindhu, 2013). Therefore, it is necessary to examine ICT in education as a socially organized knowledge and critically reflect upon the various processes of education enabled by ICT leading to social change and national development.

According to Teke, (2012), the Information and Communication Technology (ICT) in Schools was launched in December, 2004 and revised in 2010 to provide opportunities to secondary stage students to mainly build their capacity on ICT skills and make them learn through computer aided learning process. The Scheme is a major catalyst to bridge the digital divide amongst students of various socio economic and other geographical barriers. The objective of the Scheme is to cover all Government and government aided secondary and higher secondary schools by giving priority for early coverage of schools in educationally backward blocks and in areas having concentration of SC/ST/minority/weaker section. Under the revised scheme, there is a provision of a suitably qualified full time computer teacher in each secondary and higher secondary school.

Cameroon secondary schools are under the control of MINESEC headed by Minister Nalova Lyonga. The educational system is a shadow of the colonial history which left the country with a dual system (English and French sub-system). The English subsection is characterised thus: Secondary education -Length of Study: 5 years; Certification: GCE O/L and High school - Length of Study: 2 years; Certification: GCE A/L. The precondition for entry secondary school is the First School Living Certificate and or common entrance exams

at the end of primary six. The Student is then grilled for five (5) years of secondary education which consists of Form One (1) to Form Five (5).

The curriculum of study comprises all subjects from Home economics to physics and everything in between. By the end of Form 3 students are expected to select between an Arts or Science course of study. So studies between Forms 4 and 5 are more specialized and geared towards the final exams. At the end of Form 5 the students sit for the General Certificate of Education Ordinary Level, (Cameroon GCE O/L). The Cameroon GCE O/L consists of a broad selection of over 25 subjects examined during the course of two weeks. The student can select a maximum of eleven subject to sit from a Science based list or an Art-based list. Hence, Cameroon students often describe themselves as science or Arts students in the result is graded as A, B, C D, E and F grades with A being the best grade possible. Successful students are those with a passed grade (A, B or C) in four or more subjects.

In Cameroon secondary school, there are several subjects thought and learned. The subjects are divided into two main section; the science and the arts subjects. Among the science subjects we have biology. According to Freeman et al (2020), Biology is the scientific study of life. It is a natural science with a broad scope but has several unifying themes that tie it together as a single, coherent field. For instance, all organisms are made up of cells that process hereditary information encoded in genes, which can be transmitted to future generations. Another major theme is evolution, which explains the unity and diversity of life. Energy processing is also important to life as it allows organisms to move, grow, and reproduce. Finally, all organisms are able to regulate their own internal environments.

Biologists are able to study life at multiple levels of organization, from the molecular biology of a cell to the anatomy and physiology of plants and animals, and evolution of populations. Hence, there are multiple sub-disciplines within biology, each defined by the nature of their research questions and the tools that they use. Like other scientists, biologists use the scientific method to make observations, pose questions, generate hypotheses, perform experiments, and form conclusions about the world around them (Hillis et al, 2020).

Conceptual Background

Information and communication technology (ICT)

Information and Communication Technologies is a generic term referring to technologies, which are being used for collecting, storing, editing and passing on information

in various forms. Schools can use a diverse set of ICT tools to communicate, create, disseminate, store, and manage information. This involves using digital technology, communication tools and/or accessing, managing, integrating, evaluating and creating information in order to function in a knowledge society, (Korjuhina, 2018). What is more, most 21st century skill lists include ICT and ICT-related skills. ICT has changed the face of education in many ways. Even teaching has changed for the better due to ICT teaching strategies. In the context of teaching, and learning in general, ICT refers to a broad range of technological tools and resources necessary to create, transmit, store and manage information in a learning environment.

Worldwide research has shown that ICT can lead to improved student learning and better teaching methods, Korjuhina, (2018). A report made by the National Institute of Multimedia Education in Japan, for instance, proved that an increase in student exposure to educational ICT through curriculum integration has a significant and positive impact on student achievement, especially in subject areas such as mathematics, science, and social study. Addressing student needs to access technology supporting their learning, meeting teacher technology requirements, and providing digital tools within budget might be a challenging task. When teachers are digitally literate and trained to use ICT, their expertise can lead to higher order thinking skills, provide creative and individualized options for students to express their understandings, and leave students better prepared to deal with ongoing technological change in society and the workplace.

ICT Teaching materials / tools

The ICT tools are digital infrastructures like computers, laptops, printers, scanners, software programs, data projectors, and interactive teaching box. It is a requirement for schools and other educational institutions to put in place resources in terms of infrastructure that will necessitate the application of ICT in teaching and students' learning aspects (Kuskaya & Kocak, 2010, p. 102). Most schools make available resources to sustain the infrastructure. In many cases, the tools which come with ICT are instrumental in supporting the schools toward achieving this objective. The various tools used in teaching in secondary schools include laptops, cell phones, computers, video conferencing devices, and other objects of this nature. Devices of this nature have become very common today, and they reflect the spirit and nature of learning in the 21st century. Therefore, as a teacher, mastering the use of ICT skills is indispensable. In Cameron secondary schools, there may be severe lack of ICT resources for both teachers and students. Most schools may not be constructed or

classrooms are probably not adapted for the usage of ICT tools in teaching specific subjects like biology. This is probably one of the reasons for which students have some challenges in acquiring competences.

Computer Assisted Instructions (CAI)

Rapid advance in technology are forcing changes in educational content and methodology and are pointing out the necessity for preparing students who need to be technologically literate and ready for the future: This digital society has lured education to embrace and apply computer illustrated style in teaching subjects like Biology in secondary schools. Computer illustration is the use of computer tools produced images, videos using tools like Bipmap and Vector and drawing programs like Adope illustrator. Moreover, the computer illustration instruction is the act of describing information or ideas with examples usually in a visual manner in the form of an image. Or better still, it is the technique of teaching using computers to produce original art work. Apart from the adaptation in other subjects, it introduces students to computer use in virtual communication. Example of CAI drill practice, simulation, gaming, Socratic, questioning, testing and tutorial instruction. (Nora and Zsacks, 2008). The contemporary society demands the use of CAI in classroom. This implies the teacher will be well equipped with tools like projector, computer and the learner's tool. These tools whenever feasible should reflect and support content area standards in the subjects being thought: The ,materials should also foster creative thinking; technological processes; knowledge construction; analysis and evaluation: CBA emphasizes the Importance of connecting classroom, learning to real life situation: It is vital that the connections are relevant to students life and ,maintain the integrity off all subject areas addressed: In Cameroon secondary schools today, we still have deficiencies in the use of technology. Primarily, the classrooms are not adapted to its use, the classes are too crowded, the teachers sometimes do not have the projectors and computers, and constant power cuts thereby distorting the CAI process. This is probably one of the reasons for which learners have difficulties is acquiring competences in subjects like biology.

Teachers' ICT skills

The introduction of ICT in teaching in Cameroon secondary schools is an ongoing process: To achieve this appropriately policy framework must guide must guide ICT initiatives to promote quality education SDG 4. Shaibu AH; Gracemary EM; Innwoo P; (2017 assert that the use of ICT in Cameroon secondary schools mostly depends on school

leadership; dynamism and enthusiasm of teachers; there is no clear recognizable strategy plan for integration of modern technology within school curricular and pedagogical activities. Incorporating ICT usage in the teaching process demands quite a lot on the side of the teachers; they have to be industrious, energetic and persistent in order to overcome the challenges and the threats posed by ICT usage (Yelland, Cope & Kalantzis, 2008, p. 195). Careful planning on the ICT usage plays a crucial role in preparing the teachers mentally to tackle the anticipated challenges of ICT. This planning process demands a lot of time and dedication; relevant resources should be made available in order to achieve this. In the modern days, it is advisable for schools and learning institutions to subscribe to relevant publications and articles with the aim of providing insight to the teachers adequately (Voogt, 2010, p. 455).

There are a number of technological skill teachers require in order to use ICT strategies properly and reap all the benefits that come from their use. Some of these skills include word processing, spreadsheet, and database management skills. Use of email, understanding web navigation, and creation and use of electronic presentations is also important. Of course, these skills are based on a basic understanding of ICT such as learning to use mobile phones, the internet, computers and other ICT tools. However, in Cameroon secondary schools, many teachers still believe that the incorporation of educational technology in the learning process demands that the attitudes and strategies for learning should be reviewed. In order to achieve this, it is important for them to be endowed with the relevant practical ICT proficiency (Kumar, & D'Silva, 2008, p. 610). Some biology teachers still lack efficient proficiency in operating computers and managing the students, this could be one of the reasons for which students have difficulties competency acquisition.

Multimedia library

A library is a collection of materials, books or media that are accessible for use and not just for display purposes. A library provides physical or digital access materials, and may be a physical location or a virtual space, or both. A library's collection can include printed materials and other physical resources in many formats such as DVD, CD and cassette as well as access to information, music or other content held on bibliographic databases. According to Ely (1992, cited in Thomas, 1999), a consequence of online information seeking and Internet connections is that the school library is no longer a room, but a function.

Multimedia technology is one of the components of information technology that is also being used in libraries and information science or centers in the handling and

dissemination of information. It has affected all fields of the human life. Broadly speaking information technology deals with the information systems, data, storage, access, retrieval, analysis and is intelligent decision making for enhancing organizational effectiveness. Technological development has given rise the new ideas relating to collection, processing and dissemination of information. These developments and ideas including use of multi-media technology. Multimedia technology is a combination of several forms. The form of information could be text, audio, visual graphics, image, audio or video etc. Advancement of information technology, multi-media systems plays a more important role and put an impact students' lives (Shikh, 2011).

In Cameroon secondary schools, most institutions especially in the rural areas do not have libraries, talk less of digital libraries. Students study at the mercies of what the teacher tell them, they have no access to network for additional research and knowledge. The teachers in these areas have severe challenges in improving on themselves or learning innovations in their domain. At times there is no electricity to enable access to network and internet. By so doing, it becomes difficult to employ ICT in the implementation of Biology in schools. This could let to poor student's academic performance.

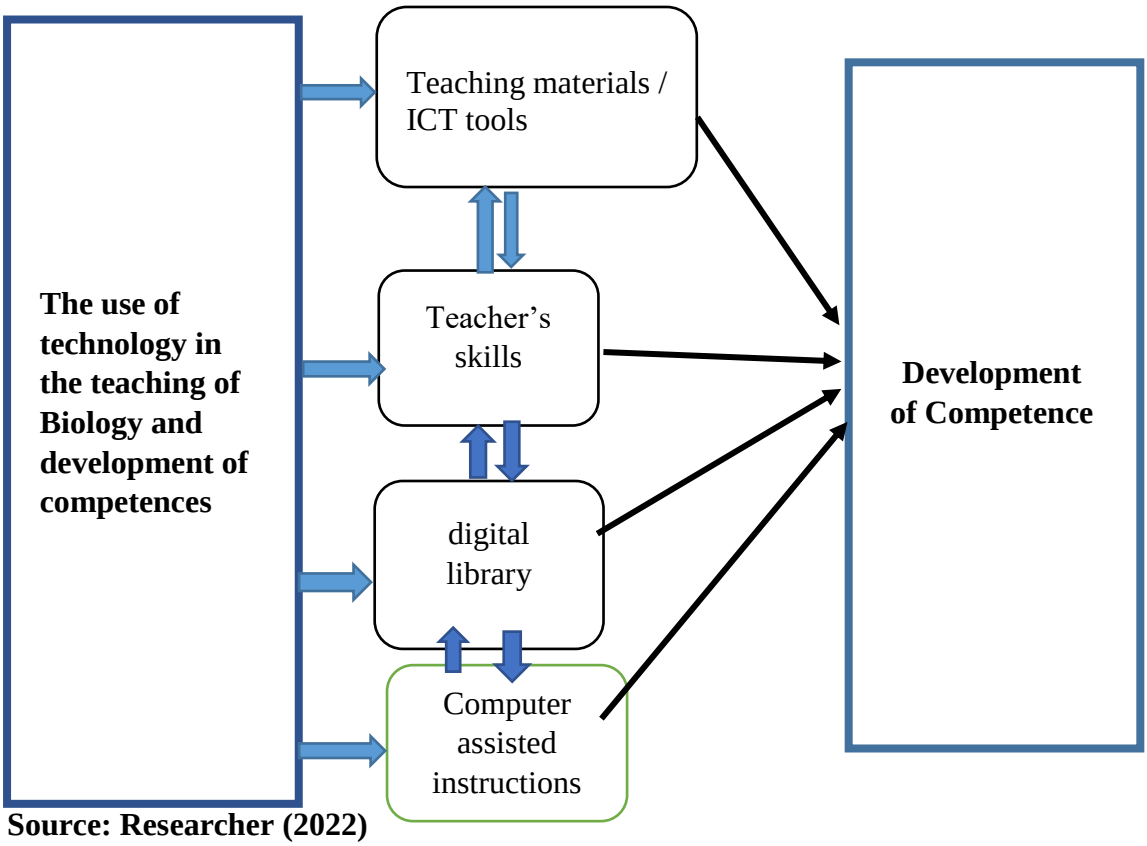
Development of Competences

Competence development is the process of adding value, increasing knowhow or additional knowledge to someone. A particular skill-set or competence could be designed for a particular group of people and specific teaching style and environment meted to enable them learn. (Hamel and Heene, 1994, Sanchez et al., 1996). As a scaffold for an improved curriculum, the Vision and Change report outlined five core concepts and six core competencies for undergraduate biology students. The six core competencies are: Ability to apply the process of science, Ability to use quantitative reasoning, Ability to use modeling and simulation, Ability to tap into the interdisciplinary nature of science, Ability to communicate and collaborate with others, Ability to understand the relationship between science and society.

Competency is viewed as learners' ability established by knowledge and experiences to reach their purpose. According to Colman (2009), competency is the capacity, skills, or the ability in doing something correctly and effectively. Acquiring English as both national and international language is the main indicator of English learning success for learners. Generally, the competences in English learning are cognitive, psycho-motorist, and affective competences. Specifically, the competence in the mean of language learning is

communicative competence between students and students, students and teachers in the form of interaction inside and outside the classroom as the realization of language use for communication (Shobikah, 2020). The theoretical relationship between ICT adoption and students' competence acquisition can be presented in figure 1.

Figure 1 Conceptual diagram



Source: Researcher (2022)

Figure 1 above is a theoretical demonstration of the relationship that could exist between ICT usage in biology teaching and students' competence acquisition.

Theoretical Background

Theories are meant to guide the research, while research provides the strength for theories, Amin (2005). Theories help us to understand the phenomenon with which it deals, predict the behavior of a system under study and provides a sound framework for organizing and interpreting results. According to Kerlinger, (1973) cited in Amin (2005), a theory is a predisposition that predicts a system view of specifying the relationship amongst variables with the purpose of explaining and predicting the phenomenon. As educators there are many theoretical approaches to take towards teachers' professional development. The approaches

are based on sets of assumptions that make the base on education, experience and other factors. With this in mind, we provide an analysis of in-service training perspectives including the major proponents and tenets and how each theory has been applied. For effective understanding of the work the following theories were used: Social learning theory: constructivism and social constructivist theories with initiators like, Jerome Brunner, John Dewey, Albert Bandura, Lev Vygosky, Piaget and others like TPACK model by Koehler and Mishra and the theory of academic performance by Reynolds and Walberg.

Constructivism and Social Constructivism

In this study we have chosen the constructivist theory as one of the approaches to learning that will orient our work. To this effect we shall make reference to the works of; Jerome Bruner, (1990), John Dewey (1933/1998), social constructivists; Bandura (1986), Piaget, (1972), and Vygosky, (1978). According to Tebogo M., (2014), constructivism is an epistemology (a theory of knowledge) which argues that humans generate knowledge and meaning from an interaction between their experiences and their ideas. Constructivism is a learning theory which holds that learning is a process of constructing meaning. Also, constructivism is seen as an approach to probe children's level of understanding and to show their level of thinking. Constructivism shows the way that learners can make sense of the materials and how the material can be taught effectively.

Social constructivism is a theory which developed from constructivism. This theory is seen as a transformation from constructivism and this explains why some advocates of constructivism like Dewey, Jerome Bruner, and Piaget, still appear to be advocate of social constructivism. Quoting Schwandt, (1994), Kathryn (1998), the claim of the social constructivists is that people perceive and describe the world using language and social artefacts. They believe that the process of knowledge construction is based on the social groups and the inter-subjectivity established through their interactions with the group. In the context of this study the constructivism theory is adopted to explain the teaching process involving the use of ICT. The social constructivism could help in examining the teaching process that involves the media which has strengthened the social interaction among learners.

Technological Pedagogical and Content Knowledge; TPACK Model

TPACK model was proposed by Koehler and Mishra (2009) and it identifies 3 kinds of knowledge teachers need to teach effectively with technology which are: technological knowledge, content knowledge and pedagogical knowledge which all work together to increase students' motivation and make content more accessible to learners.

Social learning theory by Albert Bandura (1977)

In the Social Learning Theory, Albert Bandura (1977) stated that behaviour is learned from the environment through the process of observational learning. This theory is based on the idea that we learn from our interactions with others in a social context. Separately, by observing the behaviours of others, people develop similar behaviours. After observing the behaviour of others, people assimilate and imitate that behaviour, especially if their observational experiences are positive ones or include rewards related to the observed behaviour. According to Bandura, imitation involves the actual reproduction of observed motor activities. (Bandura 1977). SLT has become perhaps the most influential theory of learning and development. This theory has often been called a bridge between behaviourist learning theories and cognitive learning theories because it encompasses attention, memory, and motivation. (Muro & Jeffrey2008). Bandura demonstrated that cognition plays a role in learning and over the last 30 years social learning theory has become increasingly cognitive in its interpretation of human learning; these points supported by (Newman, 2007).

Theory of academic performance by Reynolds & Walberg, (1992).

Walberg's theory of academic achievement posits that psychological characteristics of individual students and their immediate psychological environments influence educational outcomes (cognitive, behavioural, and attitudinal) (Reynolds & Walberg, 1992). Walberg's theory talks about the influences on learning that affects the academic performance of a student. It is an exploration of academic achievement wherein Walberg used a variety of methods on how to identify the factors that affects the academic performance of a student. He analysed his theory with the help of different theorists and integrated his study with over 3000 studies. In his theory, he classified 11 influential domains of variables, 8 of them were affected by social-emotional influences namely, classroom management, parental support, student-teacher interactions, social-behavioural attributes, motivational-effective attributes, the peer. Academic achievement or academic performance is the extent to which a student, teacher or institution has attained their short or long-term educational goals. Completion of educational benchmarks such as secondary school diplomas and bachelor's degrees represent academic.

The problem

Information and Communications Technology (ICT) offers innovative tools for restructuring teaching and learning processes in preparing students for the 21st Century skills (Hadji, Moluayonge and Park 2017). ICT is a term used to denote all computer and communication technologies. ICT has become an integral part of the educational system and

as a support to teachers in the implementation of the traditional teaching process as well as in the process of learning and teaching (Snezana, 2016). In Cameroon, since 2007, ICT became introduced in classroom and was reiterated in the academic year 2022/2023 as degitalisation. By this, the state engages in the application of ICT tools in teaching Biology as subject in secondary schools in Cameroon. This is a milestone to ensure learners acquired 21st century skills in sciences and become competitive in the world of work. Therefore, a lot is being invested in constructing schools, modernize libraries, training teachers and equipping them with ICT tools to ensure the teaching of biology is successful.

The parents spend heart earn money to sponsor students in schools, buy science books in order to enable them study biology, acquired competences that makes them successful in the career in biology. The students on their part desire to become competent biology experts, acquiring the skills and be able to solve human, animal and environmental problems using ICT in this degitalise age. Among the competences in biology, learners are expected to gain a broad understanding of the primary disciplines in the biological sciences, including molecular biology, genetics, cell biology, biochemistry, and physiology. Critically evaluate scientific data and scientific literature. Identify important, novel questions and critically design and execute experiments to address these questions.

Unfortunately, it has been observed by the researcher that many students from secondary schools in Mfoundi Division lack specific competences after studying biology for many years. Students graduate from secondary school and cannot solve basic life issues with competences of knowledge from biology. This is probably due to the lack of ICT tools in the teaching-learning process, low teacher's ICT skills, and lack of digital libraries where students could research and conduct practical experiments. Again, according to Haji, Moluayonge and Park, (2017), there is no sufficient and reliable data concerning how the use of ICT fit in different school cultures in Cameroon, and how teachers with varying pedagogical and domain expertise and learning experiences are able to function with various network learning environments The teacher's mange to use the school's ICT tools in teaching but the students may not have it to learn even at home. consequently, they do not acquire the competences imbedded in the lessons. Some schools do not even have ICT tools, no constant lighting system or energy to operate the few computers available, the number of students per class also impedes the use of ICT in teaching as students may not be opportune to practice one after another.

Once the secondary schools keep training students for seven years and graduating them with any competences acquired, it announces a blur future for them. It indicates that the

they have nothing to offer, they cannot produce anything and hence cannot be employed. Once the students are unable to access or pay for higher education, it means that they are prune to failure, despair, hunger, dependency and theft steps in. today, we have youths with advance level and BAC examinations rooming the streets aimlessly and indulging into several juvenile delinquency and others migrating to unknown destinations in search for jobs and greener pastures. Looking at the undesirable situation, the researchers ask, how long shall secondary schools in Cameroon keep graduating learners without competences?

Research objectives

The study employs the main and specific objectives

Main objective

To examine the effects of the use of technology in teaching Biology and the development of students' competences in some secondary schools in Mfoundi Division.

Specific research objectives

To examine the effects of teaching materials in teaching Biology and the development of students' competences in some secondary schools in Mfoundi division.

To examine the effects of teacher's ICT skills on teaching Biology and the development of students' competences in some secondary schools in Mfoundi division.

To study the effects of digital library in teaching Biology and the development of students' competences in some secondary schools in Mfoundi division.

To examine the effects of computer assisted instructions in biology and the development of students' competence in some secondary schools in Mfoundi division.

Research questions

The study employs the main and specific objectives.

Main research question

In what ways does the use of technology in teaching Biology influence students' competences development in some secondary schools in Mfoundi division?

Specific research questions

- To what extend does the use of ICT materials in teaching Biology affect the development of students' competences in some secondary schools in Mfoundi division?

- To what extend does teacher's ICT skills in teaching Biology affects the development of students' competences in some secondary schools in Mfoundi division?
- What are the effects of using digital library on secondary school students' competences development in Biology in Mfoundi division?
- To what extend does computer assisted instructions in teaching biology affects the development of competences in some secondary schools in Mfoundi division?

Research Hypothesis

The main hypothesis

Ha: The use of technology in teaching Biology significantly affects the development of students' competences in some secondary schools in Mfoundi division.

H0: The use of technology in teaching Biology does not significantly affects the development of students' competences in some secondary schools in Mfoundi division.

Specific research hypothesis

Ha1: The use of ICT materials in teaching biology statistically significantly affects the development of students' competences in some secondary schools in Mfoundi division.

H01: The use of ICT materials in teaching biology has statistical significant effects on the development of students' competences in some secondary schools in Mfoundi division.

Ha2: Teacher's ICT skills used in teaching biology statistically significantly affects the development of students' competences in some secondary schools in Mfoundi division.

H02: Teacher's ICT skills used in teaching biology has no statistical significant effects on the development of students' competences in some secondary schools in Mfoundi division.

Ha3: The use of digital library in teaching biology statistically significantly affects the development of students' competences in some secondary schools in Mfoundi division.

H03: The use of digital library in teaching biology has no statistical significant effects on the development of students' competences in some secondary schools in Mfoundi division.

Ha4: The use of computed assisted instructions in teaching biology statistically significantly affects the development of students' competences in some secondary schools in Mfoundi division.

H04: The use of computer assisted instructions in teaching biology has no statistical significant effects on the development of students' competences in some secondary schools in Mfoundi division.

Justification

This study is indispensable as it focuses on a timely issue in the Cameroon secondary schools. The issue of competence is making headlines in Cameroon education system from primary, through secondary and even the higher education. Viewing the evolution in the job market exigencies, the state, schools, parents and learners are hunting for competencies in order to access the job market. This study examines how competences could be acquired in biology and biology specialist make career in that domain. Therefore, the study is contextually relevant and worth conducting.

Moreover, the use of ICT in teaching subjects like biology is gaining grounds in education around the world. Educational systems unconditionally embrace the ICT as the age imposes on everyone. Therefore, this study is aimed at examining how ICT could be used in classroom in a way that they learners will acquire competence. In this light, since the computer programs as a didactic aid are often described in didactic literature all over the world, it is not enough that they play, for instance, motivational, exercising, synthesizing or supervising function; they are to be made an independent source of reliable, easily comprehensible information, given in a way that activates students. It is also important not to replace various functions and tasks of didactic aids applied in the process of teaching-learning Biology with each other, but only to interfere skillfully.

The study is being conducted in Cameroon secondary education. a scenario where ICT meets with traditional systems, practically unprepared to host and exploit ICT in the services of education. The secondary schools' infrastructures are not adapted to the use of ICT tools in schools, the constant epileptic power supply, and lack of the resources owing to poverty. This study becomes indispensable because it examines this situation, meet the stakeholders and make a way out for system with limited resources to embrace ICT.

The 21st century is focused on empowering learners of all ages with the knowledge, skills, values and attitudes to address the interconnected global challenges we are facing around the world. This brings the idea of academic competences to the center stage to show that students are expected to be well trained. Well trained student demonstrates on their performances, get promoted, graduates and solve problems around them. This study become very relevant because it focuses on this how to improve students' competence are highly recommended to ensure learners become problem solvers upon graduation from schools. Furthermore, Cameroon is a signatory to many international conventions and laws including the Education for All (2000), with UNESCO, and a confirmer of the Sustainable development

goal. Goal 4 is quality education. Therefore, the country is putting all hands on deck to ensure competences are acquired which entails more skills and knowledge in schools. This study is also relevant because it helps to bring out new ways of teaching strategies.

Again a study of this calibre is relevant to the educational actors. The weight of production of well trained, skilful youths who will propel the development envisaged for Cameroons emergence in 2035 lies mainly on the educational system (the type of curriculum, type of teachers, how the teachers teach, the type of students and youth who leave school to the job market). Looking at this situation, a study that focuses on students learning is of high importance and worth researching.

Scope of the study

Geographical scope

This study is conducted in centre region, Mfoundi division and specifically in Yaoundé municipality. This study involves selected secondary schools in this locality. This locality was ideal for this study due to its proximity, availability of schools, participants and presence of observed problem in the community.

Thematic scope

This study is centred on two main concepts and related concepts. The concept of information and communication technology and competence acquisition. ICT implementation is examined in the ICT tools; teacher's ICT skills, library and computer assisted instructions. These concepts are viewed from the perspective of the secondary schools in Mfoundi division. These terms are integral part of the causes studied in the faculty of education.

Periodic scope

This study is conducted with respect to specific period of time. The study started in the academic year, 2019 to 2023. During the first three semesters, the researcher had class work and became engaged with the research proper at the fourth semester. This was ample time for observation, examination, data collection and analysis to complete this study.

Theoretical scope

In this study, three relevant theories were adopted. Social learning theory: constructivism and social constructivist theories with initiators like, Jerome Brunner, John Dewey, Albert Bandura, Lev Vygosky, Piaget and others. Expectancy Theory by Victor Vroom, the Context, and the Didactic theory by Gerald Vergnaud, Pierre Pastre, Yves

Chevallard, Guy Brouseau. These educational theories helped us to explain the respective objectives of this study and other concepts. The theories are relevant in this study as they serve at various levels in explaining and connecting the concepts.

Significant of the study

To the ministry of secondary education (MINESEC)

This study is significant to the ministry of secondary education as the findings will enable the ministry to design updated training strategies for teachers to use in application ICT in teaching science subjects. Moreover, these findings will enable the ministry of secondary education to measure the success and failures of the digitalisation of secondary schools in Cameroon. The findings will enable the ministry to enhance teachers training in training schools and also improve on seminars and conferences on the use of ICT is classrooms.

To the principals and teachers

The results of this study will inform the principals and teachers the relevance of using ICT in teaching different subjects and further give the principals a convincing reason to invest in ICT tools, equip libraries with ICT resources and also organise institutional seminars to enhance teacher's knowledge and skills in using ICT in classroom.

To the students and parents

The results of this study will help the students to understand how the ICT could enable them acquire competences in different subjects like biology, chemistry, physics and others. The students will also understand the importance of digitalisation and invest in digital technology in order to enable a suitable study background for themselves.

To the scientific community

The results of this study will add enormous literature to the study of ICT and competence acquisition in biology from the perspective of Cameroon. It will bring in a scientific view to concretize the general intuitive and suspicious thoughts that teachers and students have.

Contextual Definition of key concepts

Information: Definite knowledge acquired or supplied about something or somebody: information also refers to facts about a situation; person; event etc. Oxford advanced learners' dictionary:

Communication: Communication is the activity or process of expressing ideas or of giving people information Oxford advanced learners dictionary 7th edition: Communication is the

transmission of facts; ideas; opinions and decisions but broadly speaking it involves dialogue that is based upon facts; promotes ideas and options and reaches decisions Tino 2003. In simpler terms the process of passing information from one person to another: Wikipedia 2010 define communication as process whereby information is enclosed in a package and channeled to a receiver through some medium: The receiver then decodes the message and gives the sender feedback.

Technology: Technology is scientific knowledge used in practical way in the industry Oxford advanced learner's dictionary: 7th edition; Technology is an artefact i.e. all things manufactured by man which can be material or immaterial used in management of things; events or situations around us: Technology can be viewed in a simple sense as man faced with a problem; he uses his intellect to create an object or technique to solve his problem; Everything has its technology; for example if one talk of technology of x he is referring to all artefacts material and immaterial put in place in the management of x:

Teaching: Teaching has been defined by Tambo (2O12 as cluster of activities that are noted about teacher such as explaining; telling; persuading; discussing; showing; demonstrating; guiding; directing; deducting; questioning; motivating taking attendance; keeping records of works; students' progress and students background information: Lev Vygotsky view teaching as an intimate contact between a more Mature personality or more knowledgeable other or a facilitator and a less mature one which is design to further the education of the later: He further says teaching is an interactive process primarily involving classroom talk which takes place between teacher and pupil and occurs during certain definable activities in order to facilitate learning;

Information and communications technology (ICT) is an extensional term for information technology (IT) that stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals) and computers, as well as necessary enterprise software, middleware, storage and audiovisual, that enable users to access, store, transmit, understand and manipulate information. ICT is also used to refer to the convergence of audiovisuals and telephone networks with computer networks through a single cabling or link system. There are large economic incentives to merge the telephone networks with the computer network system using a single unified system of cabling, signal distribution, and management (Murray, 2011).

Instructional materials

Instructional materials refer to any resource that is designed to aid a student in their learning experience. These tools can help a student improve their knowledge and understanding of the world through manipulation and experience.

Teachers ICT skills

It is the ability to use tools of information and communication technology to define one's information problem clearly, access information efficiently, evaluate, and teach students.

Competence acquisition

Competence acquisition Process to ensure that competence is attained by a person, a group of people, or an organization.

Computer assisted instructions

This is the use of digital tools for example to produce images usually via pointing device like graphic tablet or a mouse in order to facilitate learning

Conclusion

This chapter examines the background to the problem. It presents the study axis, the questions, objectives and hypotheses, thereby making a convenient background for the whole study. Its ushers us to chapter two of the study.

CHAPTER TWO

RELATED LITERATURE REVIEW AND THEORETICAL FRAMEWORK

This chapter focuses on the works and views expressed by some authors and researchers in related area of the study. Conceptual framework, theoretical framework, the review of empirical studies and as they are related to this study. It examines the knowledge gaps and controversies in the previous research.

Conceptual Framework

ICT

Information and communications technology (ICT) is an extensional term for information technology (IT) that stresses the role of unified communications, Murray, James (2011) and the integration of telecommunications (telephone lines and wireless signals) and computers, as well as necessary enterprise software, middleware, storage and audio-visual, that enable users to access, store, transmit, understand and manipulate information. ICT is also used to refer to the convergence of audio-visuals and telephone networks with computer networks through a single cabling or link system. There are large economic incentives to merge the telephone networks with the computer network system using a single unified system of cabling, signal distribution, and management. ICT is an umbrella term that includes any communication device, encompassing radio, television, cell phones, computer and network hardware, satellite systems and so on, as well as the various services and appliances with them such as video conferencing and distance learning. ICT also includes analog technology, such as paper communication, and any mode that transmits communication Ozdamli, et al. (2015). ICT is a broad subject and the concepts are evolving. It covers any product that will store, retrieve, manipulate, transmit, or receive information electronically in a digital form (e.g., personal computers including smartphones, digital television, email, or robots). Skills Framework for the Information Age is one of many models for describing and managing competencies for ICT professionals for the 21st century.

Education

Education is a purposeful activity directed at achieving certain aims, such as transmitting knowledge or fostering skills and character traits. These aims may include the development of understanding, rationality, kindness, and honesty. According to Livingstone, (2005). various researchers emphasize the role of critical thinking in order to distinguish

education from indoctrination. Some theorists require that education results in an improvement of the student while others prefer a value-neutral definition of the term. In a slightly different sense, education may also refer, not to the process, but to the product of this process: the mental states and dispositions possessed by educated people. Education originated as the transmission of cultural heritage from one generation to the next. Today, educational goals increasingly encompass new ideas such as the liberation of learners, skills needed for modern society, empathy, and complex vocational skills (Singh, 2015).

Types of education are commonly divided into formal, non-formal, and informal education. Formal education takes place in education and training institutions, is usually structured by curricular aims and objectives, and learning is typically guided by a teacher. In most regions, formal education is compulsory up to a certain age and commonly divided into educational stages such as kindergarten, primary school and secondary school. Nonformula education occurs as addition or alternative to formal education. According Singh, (2015), It may be structured according to educational arrangements, but in a more flexible manner, and usually takes place in community-based, workplace-based or civil society-based settings. Lastly, informal education occurs in daily life, in the family, any experience that has a formative effect on the way one thinks, feels, or acts may be considered educational, whether unintentional or intentional. In practice there is a continuum from the highly formalized to the highly informalized, and informal learning can occur in all three settings. For instance, home schooling can be classified as no formal or informal, depending upon the structure (United Nations' 1966).

Regardless of setting, educational methods include teaching, training, storytelling, discussion, and directed research. The methodology of teaching is called pedagogy. Education is supported by a variety of different philosophies, theories and empirical research agendas. There are movements for education reforms, such as for improving quality and efficiency of education towards relevance in students' lives and efficient problem solving in modern or future society at large, or for evidence-based education methodologies. A right to education has been recognized by some governments and the United Nations, (United Nations' 1966). Global initiatives aim at achieving the Sustainable Development Goal 4, which promotes quality education for all.

The application ICT in education

There is evidence that, to be effective in education, ICT must be fully integrated into the pedagogy. Specifically, when teaching literacy and math, using ICT in combination with

Writing to Learn produces better results than traditional methods alone or ICT alone. According to Genlott, (2016) the United Nations Educational, Scientific and Cultural Organisation (UNESCO), a division of the United Nations, has made integrating ICT into education as part of its efforts to ensure equity and access to education. The following, which was taken directly from a UNESCO publication on educational ICT, explains the organization's position on the initiative. Information and Communication Technology can contribute to universal access to education, equity in education, the delivery of quality learning and teaching, teachers' professional development and more efficient education management, governance, and administration. UNESCO takes a holistic and comprehensive approach to promote ICT in education. Access, inclusion, and quality are among the main challenges they can address. The Organization's Intersectoral Platform for ICT in education focuses on these issues through the joint work of three of its sectors: Communication & Information, Education and Science, (Blackwell et al. 2014)

Despite the power of computers to enhance and reform teaching and learning practices, improper implementation is a widespread issue beyond the reach of increased funding and technological advances with little evidence that teachers and tutors are properly integrating ICT into everyday learning. Intrinsic barriers such as a belief in more traditional teaching practices and individual attitudes towards computers in education as well as the teachers own comfort with computers and their ability to use them all as result in varying effectiveness in the integration of ICT in the classroom.

The application of ICT in African education

ICT has been employed as an educational enhancement in Sub-Saharan Africa since the 1960s. Beginning with television and radio, it extended the reach of education from the classroom to the living room, and to geographical areas that had been beyond the reach of the traditional classroom. As the technology evolved and became more widely used, efforts in Sub-Saharan Africa were also expanded. In the 1990s a massive effort to push computer hardware and software into schools was undertaken, with the goal of familiarizing both students and teachers with computers in the classroom. Since then, multiple projects have endeavoured to continue the expansion of ICT's reach in the region, including the One Laptop Per Child (OLPC) project, which by 2015 had distributed over 2.4 million laptops to nearly 2 million students and teachers, (Agence Française de Développement, 2015).

The inclusion of ICT in the classroom, often referred to as M-Learning, has expanded the reach of educators and improved their ability to track student progress in Sub-Saharan

Africa. In particular, the mobile phone has been most important in this effort. Mobile phone use is widespread, and mobile networks cover a wider area than internet networks in the region. The devices are familiar to student, teacher, and parent, and allow increased communication and access to educational materials. In addition to benefits for students, M-learning also offers the opportunity for better teacher training, which leads to a more consistent curriculum across the educational service area. In 2011, UNESCO started a yearly symposium called Mobile Learning Week with the purpose of gathering stakeholders to discuss the M-learning initiative.

Implementation is not without its challenges. While mobile phone and internet use are increasing much more rapidly in Sub-Saharan Africa than in other developing countries, the progress is still slow compared to the rest of the developed world, with smartphone penetration only expected to reach 20% by 2017. Additionally, there are gender, social, and geo-political barriers to educational access, and the severity of these barriers vary greatly by country. Overall, 29.6 million children in Sub-Saharan Africa were not in school in the year 2012, owing not just to the geographical divide, but also to political instability, the importance of social origins, social structure, and gender inequality. Once in school, students also face barriers to quality education, such as teacher competency, training and preparedness, access to educational materials, and lack of information management.

In modern society, ICT is ever-present, with over three billion people having access to the Internet. According to Kirsh, (2001), approximately 8 out of 10 Internet users owning a smartphone, information and data are increasing by leaps and bounds. This rapid growth, especially in developing countries, has led ICT to become a keystone of everyday life, in which life without some facet of technology renders most of clerical, work and routine tasks dysfunctional. The most recent authoritative data, released in 2014, shows "that Internet use continues to grow steadily, at 6.6% globally in 2014 (3.3% in developed countries, 8.7% in the developing world); the number of Internet users in developing countries has doubled in five years (2009-2014), with two-thirds of all people online now living in the developing world.

However, hurdles are still large. "Of the 4.3 billion people not yet using the Internet, 90% live in developing countries. In the world's 42 Least Connected Countries (LCCs), which are home to 2.5 billion people, access to ICTs remains largely out of reach, particularly for these countries' large rural populations. ICT has yet to penetrate the remote areas of some countries, with many developing countries dearth of any type of Internet. This also includes the availability of telephone lines, particularly the availability of cellular coverage, and other

forms of electronic transmission of data. For Kirsh, David (2001), the latest "Measuring the Information Society Report" cautiously stated that the increase in the aforementioned cellular data coverage is ostensible, as "many users have multiple subscriptions, with global growth figures sometimes translating into little real improvement in the level of connectivity of those at the very bottom of the pyramid; an estimated 450 million people worldwide live in places which are still out of reach of mobile cellular service.

Favourably, the gap between the access to the Internet and mobile coverage has decreased substantially in the last fifteen years, in which "2015 was the deadline for achievements of the UN Millennium Development Goals (MDGs), which global leaders agreed upon in the year 2000, and the new data show ICT progress and highlight remaining gaps. ICT continues to take on a new form, with nanotechnology set to usher in a new wave of ICT electronics and gadgets. ICT newest editions into the modern electronic world include smartwatches, such as the Apple Watch, smart wristbands such as the Nike+ Fuel Band, and smart TVs such as Google TV. With desktops soon becoming part of a bygone era, and laptops becoming the preferred method of computing, ICT continues to insinuate and alter itself in the ever-changing globe.

Information communication technologies play a role in facilitating accelerated pluralism in new social movements today. According to Bimber, (1998), the internet is accelerating the process of issue group formation and action and coined the term accelerated pluralism to explain this new phenomenon. ICTs are tools for enabling social movement leaders and empowering dictators in effect promoting societal change. ICTs can be used to garner grassroots support for a cause due to the internet allowing for political discourse and direct interventions with state policy as well as change the way complaints from the populace are handled by governments Hussain, and Philip (2013). Furthermore, ICTs in a household are associated with women rejecting justifications for intimate partner violence. According to a study published in 2017, this is likely because “access to ICTs exposes women to different ways of life and different notions about women’s role in society and the household, especially in culturally conservative regions where traditional gender expectations contrast observed alternatives.

Biology teaching

Biology is one of the scientific subjects studied by science students in Cameroon secondary education. It is the study of living things and their vital processes. The field deals with all the physicochemical aspects of life. The modern tendency toward cross-disciplinary

research and the unification of scientific knowledge and investigation from different fields has resulted in significant overlap of the field of biology with other scientific disciplines. Modern principles of other fields chemistry, medicine, and physics, for example are integrated with those of biology in areas such as biochemistry, biomedicine, and biophysics. Biology is subdivided into separate branches for convenience of study, though all the subdivisions are interrelated by basic principles. Thus, while it is custom to separate the study of plants (botany) from that of animals (zoology), and the study of the structure of organisms (morphology) from that of function (physiology), all living things share in common certain biological phenomena for example, various means of reproduction, cell division, and the transmission of genetic material.

Biology is often approached on the basis of levels that deal with fundamental units of life. At the level of molecular biology, for example, life is regarded as a manifestation of chemical and energy transformations that occur among the many chemical constituents that compose an organism. As a result of the development of increasingly powerful and precise laboratory instruments and techniques, it is possible to understand and define with high precision and accuracy not only the ultimate physiochemical organization (ultrastructure) of the molecules in living matter but also the way living matter reproduces at the molecular level. Especially crucial to those advances was the rise of genomics in the late 20th and early 21st centuries.

Cell biology is the study of cells the fundamental units of structure and function in living organisms. Cells were first observed in the 17th century, when the compound microscope was invented. Before that time, the individual organism was studied as a whole in a field known as organismic biology; that area of research remains an important component of the biological sciences. Population biology deals with groups or populations of organisms that inhabit a given area or region. Included at that level are studies of the roles that specific kinds of plants and animals play in the complex and self-perpetuating interrelationships that exist between the living and the non-living world, as well as studies of the built-in controls that maintain those relationships naturally. Those broadly based levels molecules, cells, whole organisms, and populations may be further subdivided for study, giving rise to specializations such as morphology, taxonomy, biophysics, biochemistry, genetics, epigenetics, and ecology. A field of biology may be especially concerned with the investigation of one kind of living thing for example, the study of birds in ornithology, the study of fishes in ichthyology, or the study of microorganisms in microbiology (Zeba and Sabbir 2019).

Teaching biology via ICT

The introduction of ICT in almost all the sectors of our lives have created a new global economy that is powered by technology, fuelled by information and driven by knowledge (US Department of Labour, 1999). Advent of the knowledge economy and global economic competition compel governments to prioritize educational quality, lifelong learning and the provision of educational opportunities for all. It is widely accepted that access to ICT in education can help individuals to compete in a global economy by creating a skilled work force and facilitating social mobility (Wallet & Melgar, 2014). Leaving the Least Developed Countries (LDC) category towards developing country, most countries are striving to improve their education system for the knowledge era (United Nations, 2018). These Governments are aiming to turn the huge number of its potential young intelligent populace into a resourceful one, have emphasized on ICT in education by introducing 'multimedia classrooms, teacher-led content development, e-learning module, interactive digital text etc in primary schools and secondary schools across the country.

As biology includes complex relationships of unfamiliar and abstract concepts, it is quite difficult to learn and teach. Students often experience difficulty in understanding certain biological subjects and try to learn them via memorization without understanding (Kilic & Salam, 2004). But the use of ICT can help understanding a difficult subject easily. A survey in Bangladesh has shown that learning becomes interesting and lively through using multimedia equipment in the classroom through active participation of learners in the learning process (PMID, 2013). It is especially important in biology as computers can present the information visually through well-prepared pictures, three-dimensional models, animations, interactive environments etc (Wang, 2017). Teachers play a crucial role in the adoption and implementation of new technologies in education. Their perceptions are an important aspect that influences their adoption of ICT in teaching and learning (Zhu, 2010), because teachers' educational beliefs are closely linked to their actual use of ICT in classrooms (Dwyer, Ringstaff, & Sandholtz, 1991) (Tondeur, Valcke, & Van Braak, 2008). The quality of teachers and their continuing professional education and training remain central to the achievement of quality education. Understanding this fact, most countries regularly arranges teachers' training on ICT (Mamataz, 2017) (PMID, 2013). Moreover, Digital Content Development has also been undertaken so that all teachers can collect subject based contents from a single source, for which an official web portal named Shikkhok Batayon (www.teachers.gov.bd) has been opened (Mamataz, 2017).

ICT teaching materials

ICT is a broad term. It stands for Information Communication Technology. ICT tools for teaching and learning cover everything from digital infrastructures such as printers, computers, laptops, tablets, etc., to software tools such as Google Meet, Google Spreadsheets, etc. The top 6 ICT Tools for Teaching and Learning

Blackboard

Blackboard is a popular teaching tool that comes with numerous capabilities. Teachers can easily administer tests, monitor performance, manage syllabus and even upload grades. This can save you from the hassle of writing everything on paper, and also from an aching wrist. Students can equally benefit from this tool because they can access all the information, including grades, assignments, attendance, that you upload on the platform. The best part is that all this comes in one platform. So, you won't need multiple applications to manage it all.

Google Classroom

Google Classroom, as the name suggests, is a virtual classroom that makes learning easy and fun. Teachers can integrate educational apps or websites and create interactive assignments. You can include a slideshow, a small game, or an entertaining YouTube video full of information. This way, kids learn better and enjoy their learning experience. Also, Google Classroom allows you to go paperless. You can easily create paperless assignments and grade students within a few minutes. This way, you can save time and focus more on improving the learning experience. Furthermore, you can create a separate drive folder for assignments, grade sheets, attendance sheets, etc. And you can access all this on the go, even from your mobile or laptop. What's more, Google Classroom allows virtual meetings. You can host parent-teacher meeting sessions online from your home. It's beneficial both for you and the parents, especially during the lockdowns. All in all, Google Classroom offers a complete solution for online teaching.

Trello

Trello is a collaborative tool that is used widely in IT companies with large teams. Fortunately, it has several applications for you educators as well. If you prefer project-based learning for students, Trello is for you. Trello has these digital boards. You can create different boards for assignments, test papers, etc. And in those boards, you can create cards. Furthermore, you can discuss a particular topic in that card. You can invite your students to view that card. And the students can put in comments, doubts, or ask questions and even

attach images, videos, etc. Also, students can easily look at their projects, set deadlines, and track progress online. In a nutshell, Trello takes a lot of burden off your shoulder while enriching the learning experience for kids.

Microsoft Teams

Microsoft Teams is another popular tool for IT professionals. And similar to Trello, it has several applications for teachers and educators. Microsoft Teams is a Microsoft Office 365 product. It simply means you can host meetings, chat, share files, and use every Microsoft Office app using Teams. One of the best features Teams comes with is the Class Notebooks from One Note. Class Notebooks resemble individual student notebooks(physical) but come with additional features and ease of use. Teachers can assign individual notebooks to students and provide them with real-time feedback. You can easily distribute exams, handouts, quizzes, and homework instantly to your students. Also, the students can use amazing tools within Teams for taking notes and highlighting important things. This helps the students engage more and enjoy learning. All in all, Teams can reduce the manpower and can completely replace the use of paper. It's yet another amazing tool that ensures effective education online.

Online Coding Websites such as DataCamp, HackerRank, Coderbyte

No minimum age exists when it comes to learning how to code. Mark Zuckerberg, the owner of Meta (formerly Facebook), said that his daughter, who's just three, has started coding already. Now, how can you beat that? If you want your students/kids to learn how to code, make sure it's practical. Practicing code on paper is simply a waste of time. And it also kills the creative talent of the students. This is where the websites such as DataCamp, HackerRank, Coderbyte, etc., come into play. Using such websites, your students can implement what they've learned instantly. Also, such websites feature several tricky problems that your students will enjoy. The best part is that most websites are free and accessible from any device. It simply means none of your students will need particular hardware(laptop/PC) to code. A normal PC or a mobile with an internet connection would do.

Subject Specific Tools

All of the above ICT tools for teaching and learning help in generalized learning. However, when it comes to specific subjects, special tools are required. Let's talk about them below:

ICT Tools for Teaching Geography

Google Maps: With Google Maps, kids can learn to find the distance between two places and look at 360-degree images of places. This can help your students become familiar

with multiple locations across the world. Google Earth: This tool shows the entire earth with every location and supports an amazing zoom feature. Kids can learn about different regions, landmasses, and water bodies in a fun way.

ICT Tools for Teaching Mathematics

CanFigureIt Geometry: This tool makes learning geometry pretty easy. You can teach kids about several mathematical proofs and theorems in an engaging way.

CueThink: You can use this tool to teach kids how to solve math problems in four steps: understand, plan, solve, and review.

ICT Tools for Teaching Biology

When it comes to Biology, you can take the help of Microsoft PowerPoint: You can use HD images and create slides to clear the biological concepts for the kids. Also, you can download templates from Slidesgo and make the job even easier. YouTube: What's better than using videos for explaining complex biological processes via YouTube videos. From digestion to excretion, you can find plenty of child-safe content on YouTube.

ICT Tools for Teaching History

Here again, you can use the above-listed tools but in a different manner: YouTube: You can find historical movies related to the chapter you're teaching for kids to remember. Microsoft PowerPoint: You can create slideshows with minimal details such as dates, names, locations, and events, etc. This way, kids can learn facts easily and for longer durations.

Teacher's ICT kills

Integration of ICT into pedagogical practices will seriously be compromised if teachers possess little or no knowledge of ICT. Kadel (2005) noted that regardless of the quantity and quality of technology available in classroom, the key to how ICTs are used is the teacher; therefore, teachers must have the competence and right attitude towards technology. ICT can do wonders in classroom if used wisely by well –trained teacher. According to Marija and Palmira (2007) ICT competencies can be classified into two: Basic and educational ICT competence. Competence can be said as having the necessary skills or knowledge or the ability to make use of relevant attributes to particular task. These attributes include; high levels of knowledge, values, skills, personal dispositions, sensitivities, capabilities and the ability to put these attributes into practice in an appropriate way (Commonwealth Department of Education, Science and Training, 2002)

The rise of Information and Communication Technologies (ICT) in the educational field led to a rethinking of the role of teachers in schools, and the need arose to further their

training in order to achieve a more effective education in the development of their students' skills (Satharasinghe, 2006). The use of ICT in education led UNESCO, together with companies such as CISCO, Intel, ISTE and Microsoft, to reflect on the skills teachers need in order to ensure an effective teaching and learning process in the classroom. They developed the third edition of the ICT Competency Framework for Teachers. The framework incorporates inclusive principles of non-discrimination and equality, and integrated recent technological advances: mobile technologies, open educational resources, artificial intelligence, and so on. ICT Competency Framework for Teachers is a tool aimed mainly at training teachers in the use of ICT in schools. It addresses teachers, education experts, providers of teacher training courses, etc. To achieve the implementation of ICT, it is necessary to have a favourable environment. According to Bhebhe (2016), this involves government, teacher training, and professional development of teachers and school principals. This Framework presents a total of 18 ICT competences structured into six dimensions:

Understanding the role of ICT in education policy

Understand the role of ICT in accordance with national education policies. Teachers need to consider and work towards the goals that should be achieved.

Curriculum and assessment

This approach involves considering the use of these digital tools, and the redefinition of specific objectives in the curriculum, as well as their related indicators and assessment proposals.

Teaching

Teachers are encouraged to use ICT to improve teaching and learning methods. Accordingly, they acquire skills and in, a final phase, implement alternative, student-focused teaching strategies based on solving problems in a collaborative way.

Application of digital skills

This involves integrating technology into teachers' tasks linked to collaboration with other teachers and to planning. The most important applications at this level are e-mail, social media and word processing and presentation programmes.

Organisation and administration

This aspect involves the management of digital tools in the school. It involves organising classrooms and the rest of the environment. The main objective is to build virtual environments to promote learning outside the classroom.

Professional learning of teachers

To develop teachers' digital literacy and train them professionally. By becoming producers of knowledge, they use ICT to enhance classroom practices. In turn, each of these aspects is divided into three levels of pedagogical use of these technologies by teachers in the classroom setting:

Knowledge acquisition

This enables teachers to help students use ICT to learn effectively. At this level, the classroom has technological resources and ICT laboratories, ensuring equal access. This is the first phase of digital literacy. Teachers who master the skills at this level can:

- Check whether their teaching practices are in line with national policies.
- Make pedagogical use of ICT in accordance with curricular standards.
- Choose the appropriate ICT for each of the teaching and learning methodologies.
- Define the functions of the technological tools to be used.
- Address inclusive learning through ICT
- Use technological tools for their own professional development.

Knowledge advancement

At this level the aim is to improve teachers' ability to help students. Teachers use ICT to work on curricular content. This approach allows students to acquire a broad knowledge of the subjects taught, and to apply what they have learned to collaborative problem solving in the real world. It is a project-based approach to teaching and learning. Teachers with skills at this level can:

- Implement teaching practices in accordance with education policies.
- Integrate ICT into the teaching and learning and assessment processes.
- Create project-based learning activities using ICT.
- Use the various technological tools and resources for problem solving.
- Use technology to facilitate collaborative learning.
- Interact with professional networks for the teacher's own development.

Knowledge creation

This enables teachers to create knowledge, to devise activities for the classroom and to develop programmes applicable outside the school in order to achieve the goals set. New knowledge is created in order to make societies thrive. At this level, teachers will be able to:

- Reflect on educational policies and contribute ideas for improvement.
- Establish the conditions for optimal student-focused collaborative learning.
- Use ICT to promote learning by creating communities for knowledge sharing.
- Develop a technological strategy for the school.
- Share best practices on an ongoing basis, so that ICT improves schools.

According to Novela (2022), other recently added skills that teachers are expected to have before indulging in teaching a subject using ICT are:

Open Educational Resources (OER):

Involving complete courses, videos, podcasts, course materials, etc. OER has been established as a tool that can lead to educational transformation. This is learning based on digitalised resources, easily shared and disseminated via the Internet.

Social Media:

Used to facilitate interactive learning, build communities and improve pedagogical communication.

Mobile technologies:

Learners make use of tablets and mobile devices to access learning platforms These devices promote productivity in the classroom and in distance learning.

The Internet of Things:

Involves all those applications and devices that affect the education sector, which can work in an interconnected way, serving the scholastic needs of the education community.

Artificial Intelligence (AI):

Used in the form of personalised content adapted to students using AI applications. Their biggest challenge is to adapt a learning sequence to a learner's particularities and possibilities.

Virtual Reality and Augmented Reality:

Using applications that simulate real learning environments. These provide an alternative to in-person classroom attendance.

Macrodata:

Showing the connections between people and devices, with the aim of improving learning opportunities.

Coding:

Allows the creation of applications and programmes through programming languages that foster the development of key competences.

Ethics and privacy protection:

As technology advances, so must the reflection on ethics and human rights. The use of ICT must take into account ethical values and safeguard users' rights, privacy and security.

According to Bransford, J.D., Brown, A.L. & Cocking, R. (1999), in order to facilitate the implementation of this Framework, thus supporting teachers in their professional development and in the application of new teaching and learning methodologies using ICT, in 2016 UNESCO created an open resource repository, the OER Commons. This is a search engine aimed mainly at fostering the improvement of teaching practices. It contains collections of Open Educational Resources (OER), aligned to the training needs set out in the Competency Framework. Teachers can use this tool to locate support content, as well as to connect with other educators who use ICT to improve their teaching practices. In short, the integration of ICT into learning environments requires the right balance of pedagogy and technology in the classroom. Consequently, teacher training is a process that must take place throughout a teacher's career, in a process commonly known as "lifelong learning".

Digital Library

A library is a collection of materials, books or media that are accessible for use and not just for display purposes. According to Howard (2019). A library provides physical (hard copies) or digital access (soft copies) materials, and may be a physical location or a virtual space, or both. A library's collection can include printed materials and other physical resources in many formats such as DVD, CD and cassette as well as access to information, music or other content held on bibliographic databases. A library, which may vary widely in size, may be organized for use and maintained by a public body such as a government; an institution such as a school or museum; a corporation; or a private individual. In addition to providing materials, libraries also provide the services of librarians who are trained and experts at finding, selecting, circulating and organizing information and at interpreting information needs, navigating and analyzing very large amounts of information with a variety of resources.

Library buildings often provide quiet areas for studying, as well as common areas for group study and collaboration, and may provide public facilities for access to their electronic resources; for instance: computers and access to the Internet (Howard (2019). The library's clientele and services offered vary depending on its type: users of a public library have different needs from those of a special library or academic library, for example. Libraries may also be community hubs, where programs are delivered and people engage in lifelong learning. Modern libraries extend their services beyond the physical walls of a building by providing material accessible by electronic means, including from home via the Internet. The

services the library offers are variously described as library services, information services, or the combination "library and information services", although different institutions and sources define such terminology differently.

Libraries may provide physical or digital access to material, and may be a physical location or a virtual space, or both. According to Marshall, et al. (2013), a library's collection can include books, periodicals, newspapers, manuscripts, films, maps, prints, documents, microform, CDs, cassettes, videotapes, DVDs, Blu-ray Discs, e-books, audiobooks, databases, table games, video games and other formats. Libraries range widely in size, up to millions of items. Libraries often provide quiet areas for studying, and they also often offer common areas to facilitate group study and collaboration. Libraries often provide public facilities for access to their electronic resources and the Internet. Public and institutional collections and services may be intended for use by people who choose not to—or cannot afford to purchase an extensive collection themselves, who need material no individual can reasonably be expected to have, or who require professional assistance with their research. Services offered by a library are variously described as library services, information services, or the combination "library and information services", although different institutions and sources define such terminology differently.

A digital library, also called an online library, an internet library, a digital repository, or a digital collection is an online database of digital objects that can include text, still images, audio, video, digital documents, or other digital media formats or a library accessible through the internet (Lenangan, 2012). Objects can consist of digitized content like print or photographs, as well as originally produced digital content like word processor files or social media posts. In addition to storing content, digital libraries provide means for organizing, searching, and retrieving the content contained in the collection. Digital libraries can vary immensely in size and scope, and can be maintained by individuals or organizations. According to written et al. (2009) The digital content may be stored locally, or accessed remotely via computer networks. These information retrieval systems are able to exchange information with each other through interoperability and sustainability.

Types of digital libraries

Institutional repositories

Many academic libraries are actively involved in building repositories of their institution's books, papers, theses, and other works that can be digitized or were 'born digital'. Many of these repositories are made available to the general public with few restrictions, in accordance with the goals of open access, in contrast to the publication of research in

commercial journals, where the publishers usually limit access rights. Irrespective of access rights, institutional, truly free, and corporate repositories can be referred to as digital libraries. Institutional repository software is designed for archiving, organizing, and searching a library's content. Popular open-source solutions include DSpace, Greenstone Digital Library (GSDL), EPrints, Digital Commons, and the Fedora Commons-based systems Islandora and Samvera, (Castagné, 2013).

National library collections

Legal deposit is often covered by copyright legislation and sometimes by laws specific to legal deposit, and requires that one or more copies of all material published in a country should be submitted for preservation in an institution, typically the national library. Since the advent of electronic documents, legislation has had to be amended to cover the new formats, such as the 2016 amendment to the Copyright Act 1968 in Australia. Since then various types of electronic depositories have been built. The British Library's Publisher Submission Portal and the German model at the Deutsche National bibliothek have one deposit point for a network of libraries, but public access is only available in the reading rooms in the libraries. The Australian National edeposit system has the same features, but also allows for remote access by the general public for most of the content (Lemon, et al. 2020).

Digital archives

Physical archives differ from physical libraries in several ways. Traditionally, archives are defined as:

- Containing primary sources of information (typically letters and papers directly produced by an individual or organization) rather than the secondary sources found in a library (books, periodicals, etc.).
- Having their contents organized in groups rather than individual items.
- Having unique contents.

The technology used to create digital libraries is even more revolutionary for archives since it breaks down the second and third of these general rules. In other words, "digital archives" or "online archives" will still generally contain primary sources, but they are likely to be described individually rather than (or in addition to) in groups or collections. Further, because they are digital, their contents are easily reproducible and may indeed have been reproduced from elsewhere. The Oxford Text Archive is generally considered to be the oldest digital archive of academic physical primary source materials (Pitti and Duff, 2010).

Archives differ from libraries in the nature of the materials held. Libraries collect individual published books and serials, or bounded sets of individual items. The books and journals held by libraries are not unique, since multiple copies exist and any given copy will generally prove as satisfactory as any other copy. The material in archives and manuscript libraries are "the unique records of corporate bodies and the papers of individuals and families". A fundamental characteristic of archives is that they have to keep the context in which their records have been created and the network of relationships between them in order to preserve their informative content and provide understandable and useful information over time. The fundamental characteristic of archives resides in their hierarchical organization expressing the context by means of the archival bond.

Archival descriptions are the fundamental means to describe, understand, retrieve and access archival material. At the digital level, archival descriptions are usually encoded by means of the Encoded Archival Description XML format. The EAD is a standardized electronic representation of archival description which makes it possible to provide union access to detailed archival descriptions and resources in repositories distributed throughout the world. Given the importance of archives, a dedicated formal model, called NEsted SeTs for Object Hierarchies (NESTOR), built around their peculiar constituents, has been defined. NESTOR is based on the idea of expressing the hierarchical relationships between objects through the inclusion property between sets, in contrast to the binary relation between nodes exploited by the tree. NESTOR has been used to formally extend the 5S model to define a digital archive as a specific case of digital library able to take into consideration the peculiar features of archives.

Computer assisted instructions

Teaching style of pedagogy remains the science and art of teaching (including evaluation). The fast changes in the society is imposing a need to relook at the teaching style in the respective schools. The technical colleges are expected to design inclusive, relative and innovative pedagogic practices that will warrant studying from a distance and acquire the required skills. The method of teaching in secondary colleges especially biology which is a science subject is expected to be peculiar as it has both theory and practice. Teaching is gradually escaping from the confines of a classroom to an open limitless space where in learners can access lessons at any given time. Therefore, the teaching style, needs to be relooked.

Pedagogy specifically, it is principally concerned with the teaching of teachers how to teach people effectively Nicodamus (2007). For every educational system to be effective and efficient, all the teachers have expertise in pedagogy and not just on their subject matter. This is because as Nicodemus (2007) says one cannot effectively separate the methods from the subject matter of teaching nor from the person involve and the environment. Teachers who do not master pedagogy simply transfer the knowledge to the extent at which they master the subject matter in a given subject or discipline.

To such teachers, they believe that teaching just entails pouring out knowledge as the expression goes to empty vessels (students). This is probably not a convenient knowledge transmission method. An effective teacher is knowledgeable in art of knowledge transfer with respect to inclusive nature of the class. They are aware that just talking or pouring out facts, ideas or principles to pupils is only a small part of teaching. Teaching means that the teachers organize the child's environment in such a way as to make it possible for the child to learn. This organization of the environment could be in the form of talking directly to the child, asking the child to find out things from people around him /her, encouraging the child to explore his/her environment, experimenting and so on Nicodamus (2007).

Research and observation have shown that most secondary education teachers in Cameroon are masters in their subject matter and not in the art of transmission. Some who gained employment through the contract employment policy of 25000 launched by the President of the Republic of Cameroon in 2011 take students for experiments. This lack of pedagogical knowledge amongst teachers greatly hampers the training of students in different skills that give them the possibility of responding to the question of, 'what can I do?' in the job market. The teachers transfer the same theories they have in store to the children even more narrowly and passively because of the lack of professional training programs and teachers quest for money from several institutions at the same time. Although it gives extra experience in their profession, it makes most teachers perpetual absent from school, rarely available for student's needs.

As Nicodemus (2007) affirms, the view that knowledge of subject matter (that is, if not all, a majority of teachers in the Cameroon Universities), is the most important factor in teacher's work has let many secondary schools in Cameroon into the mistake of recruiting people who appear to know a lot, but are in reality limited as teachers. With respect to the decision for 25000 employment of youths in Cameroon and the need to have skillful and effective teachers who can groom the students to meet their needs and fit in the job market in Cameroon. In Cameroon secondary schools apart from regurgitating knowledge, students

could be thought basic skills such as pedagogy, management, technology, problem solving, military skills and many others alongside the theories of subject of specialization so that they may have the skills to teach students effectively. For those who will be lucky to fall in the next collective employment decree and as well gain employments upon graduation.

The process of teaching and learning across secondary school institutions serves as a strategy of achieving quality, (UNESCO, 2018). For every educational system to be effective and efficient, its pedagogic practices must be up to accepted standards. The teaching staff must have been trained on the processes of teaching and learning and other flexible teaching strategies, creativity, adaptation, and not just based on the mastery of subject matter. The didactic materials put in place, and other environmental and infrastructural amenities put in the most recommended shape. The actors (teachers and students) must be ready and motivated both physically and psychologically. These actors exploit the respective components to enable the transformation of learners into skill human capital through theory and practice. A teacher could best master what he/she has, but the method of transmission inhibits the successful application and after the lesson students remains without a change in behavior. Moreover, teaching is not done in a vacuum; the learners must be present with their diverse characteristics like age, backgrounds, thoughts, objectives and visions and the lesson must be tailored to their level and most importantly to their interest. This is done from setting and announcing the objectives before the lesson, most learners show more interest when they are given a specific reason or their expectations are raised before the lesson is learned. It is the combination of these three and further creative abilities that could make the teaching-learning process successful.

According to Tchombe (2019, p. 168), the relationship between teaching and learning is an example of two processes embedded in a reciprocal act. This implies that during the transformation process, there is an active exchange of knowledge, ideas between the actors involved. The teacher (lesson conceiver) observes certain teaching techniques and gives opportunities for the learner to undergo different learning phases. Chombe (2019) outlined the recommended learning phases and teaching techniques thus:

Table 1 Presentation of Learning Phases (process) Within Lesson Structure and Teaching Technique

LESSON STRUCTURE	TEACHING TECHNICS	LEARNING PHRASES
Introduction	Highly directive	Motivation
Presentation	More interactive	Apprehension, acquisition, retention
Application	Individual/group interaction	Recall, generalisation, performance
Conclusion/Evaluation	Directive	Feedback

Source: Adopted from Chombe (2019) Psychology parameters in teaching. *An African perspective to learning as a process for cognitive enhancement.*

Table 1 presents the teaching-learning process involved in a lesson. It involves the various steps, the techniques and learning phases that enable a more active transformation of the learner to a more skillful human capital. All these occur successfully only when the teacher has undergone training and acquired specific cognitive behaviors that guide pedagogic activities and enhance student-centeredness in the process of transformation. During teaching, the focus is on enhancing and empowering the students as the primary target. Quality education is one that effects changes in the participants and therefore enhances them. It is based on this that the quality of teaching-learning is judged based on knowledge enhancement, abilities and skills acquired by the learner (Hervey & Knight, 1996).

According to the Cameroon Reference and Guidelines in Education (2018, p. 21) institutions ensure that programs are delivered based on student-centered learning and teaching, in a way that encourages students to play an active role in the learning process, including in its development and the evaluation of student's achievements reflect this. Student's centered learning strategy employs practices like stimulating, motivation, self-reflection, roll call, feedback in learning.

In Cameroon, a set of guidelines are given to orientate teaching-learning in schools. Teaching must respect and take into account the diversity of students and their needs, offering flexible employment pathways. This becomes most vital in education owing to the continuous homogenous organization made up of people from diver's origins, religion, and faith working towards different career visions. In teaching, emphasis is made on education planning which must be clear with the existence of coordinated progress in schools,

preparation sheet for the course (challenging situations, exercises, practice, case study) and details on the number of summative/formative evaluation per semester communicated to learners.

Learners' Competences

Competencies are combinations of attitudes, skills and knowledge that students develop and apply for successful learning, living and working. In school, competencies help students achieve learning outcomes and transfer their learning to new situations. The introductory biology courses have been "widely criticized for overemphasizing details and rote memorization of facts". This heavy emphasis on simply recalling facts lends support to the recommendations of the American Association for the Advancement of Science's Vision and Change report (2011), and the need to promote higher-order thinking in the courses we present. The Report found that the fact-heavy undergraduate biology curriculum would benefit from:

- Focusing on broader concepts (for example, evolution) and using facts to illustrate those concepts, providing a framework for the field of biology, and
- Ensuring students become capable biologists by providing them with authentic research experiences, thereby developing vocationally relevant skills.

There are specific competences that all biology students are expected to acquire, these six core competencies are:

- Ability to apply the process of science
- Ability to use quantitative reasoning
- Ability to use modelling and simulation
- Ability to tap into the interdisciplinary nature of science
- Ability to communicate and collaborate with others
- Ability to understand the relationship between science and society.

However, evidence of competency development is contextualized by subject-area learning content. Educators are not required to formally evaluate and report on competencies separately from students' progress in achieving learning outcomes. Educators are encouraged to give students feedback on competency development as it relates to specific learning outcomes and activities. From a larger educational perspective, some common competences cut across all the subjects and into our daily lives. Among them we have:

Critical Thinking in social studies involves using reasoning to explore topics, examine issues and develop informed positions. Students:

- Distinguish fact from opinion to identify bias in historical or contemporary sources; • make reasoned judgements based on historical or contemporary evidence to challenge or affirm thoughts, beliefs or actions;
- Determine relationships of cause and consequence to understand historical or contemporary events;
- Consider the ethics of decisions or actions that influence society; and • demonstrate integrity and open-mindedness when making reasoned decisions or forming opinions about topics and issues.

Problem Solving in social studies involves taking responsible action to implement solutions that address problems or issues in communities. Students:

- Identify dimensions or causes of historical or contemporary problems or issues;
- Examine societal issues from diverse perspectives to generate possible solutions;
- Evaluate the social, political, economic or environmental impacts of proposed solutions in order to select courses of action;
- Recognize that solutions to problems can create new challenges and may require alternative solutions; and
- Demonstrate flexibility, creativity and fairness when selecting courses of action.

Managing Information in social studies involves synthesizing information from a variety of sources to understand people, places, land, events or issues over time. Students:

- Use various methods and sources to explore historical or contemporary topics or issues;
- Evaluate the accuracy and relevance of information to clarify understandings of topics or issues;
- Synthesize information to determine points of view, perspectives, themes or trends; and
- interpret, organize and share social, historical, geographic, political, economic or environmental information in an ethical manner.

Creativity and Innovation in social studies involves envisioning possibilities and taking action to affect change. Students:

- Adapt existing or develop new approaches to address social, political, economic or environmental issues;
- Create opportunities or products to inform, persuade or inspire action on issues; and
- Demonstrate initiative and resourcefulness when taking action to address social, political, economic or environmental issues.

Communication in social studies involves exchanging ideas about historical or contemporary topics or issues while considering audience, points of view, perspectives and context. Students:

- Use language to express ideas or support their positions on topics or issues in an appropriate manner;
- Engage in dialogue, debate or presentations to construct and share understandings about historical or contemporary topics or issues;
- Consider how experiences, perspectives, points of view or contexts influence how messages are constructed and perceived;
- Use a variety of oral, written or visual modes of expression when exchanging ideas on topics or issues; and
- Respect cultures or protocols when sharing ideas about experiences, topics or issues.

Collaboration in social studies involves working with others to build and renew relationships. Students:

- negotiate to resolve conflict or build consensus when making decisions about topics or issues;
- consider needs, points of view or perspectives when setting and working towards common goals;
- Share roles and responsibilities among group members when working towards a common goal; and
- Nurture positive relationships within diverse communities by demonstrating empathy and respecting differences.

Personal worth and well-being in social studies involves developing a sense of identity as a valuable member of local or global communities. Students:

- Exercise their rights and responsibilities to develop healthy relationships and affirm their place in an inclusive, pluralistic and democratic society;
- Develop the ability to make informed choices to effect change as active and responsible citizens;
- Recognize the consequences and the interconnectedness of their choices on self and community;
- Appreciate how social, political, economic or legal institutions can promote and secure individual and collective well-being; and
- Demonstrate reflection, resilience and resourcefulness in fostering individual and collective well-being.

Theoretical Framework

Generally, when data is collected, analyses and interpretations follow. In pure or natural sciences, this exercise is carried out in the laboratory. But in human or social sciences, the situation is different; since the latter deals with human beings who are complex and whose behaviours, opinions, interactions, laws, beliefs, pasts (history), knowledge and/or cultures cannot be treated in the laboratory. In effect, social scientists have come up with their own mechanism of data analysis and interpretation which is usually with the help of what is known as the theoretical framework. This refers to a set of elements, traits, concepts or principles selected from a theory or a given number of theories and built in a certain manner by the researcher which in turn serves as an aid in the explanation of realities in a particular context.

We can therefore deduce from the above definitions that a theoretical framework is a construction of the researcher; that is, the latter is the author of the former. However, the researcher's choice of theory and principles depends on the nature of his topic and/or the angle he wants to take in the treatment of the phenomenon under study. So, a theoretical framework is not a theory or a set of theories per say. It is worthy to note here that it is with the help of a theoretical framework that the reader can determine the scientific discipline and scope that the writer fitted his work in; that is, whether sociological, psychological or educational. This is because social scientists nowadays treat similar and/or the same issues. What therefore differentiate, not to say oppose their respective findings is the paradigm of intelligibility that they employ in their analyses and interpretations.

Theories are therefore analytical tools for understanding, explaining, and making predictions in particular areas of study (Shafritz and Ott, 2000 p.1). Many theories exist in varied fields of study, including the arts and sciences. A formal theory is syntactic in nature and only makes meaning when given a semantic component by applying it to some content (that is, facts and relationships of the actual historical world as it is unfolding). Researchers have been able to develop a number of different theories to explain ICT involvement in teaching and competence acquisition. Each individual theory tends to be rather limited in scope. However, by looking at the key ideas behind each theory, one can gain a better understanding of assessment as a whole.

Constructivism and Social Constructivism by Jean Piaget (1896-1980)

Constructivism in education has roots in epistemology, which - in philosophy - is a theory of knowledge, which is concerned with the logical categories of knowledge and its

justification basis. According to Steffe and Gale (2012), epistemology also focuses on both the warranting of the subjective knowledge of a single knower and conventional knowledge. In constructivism, hence, it is recognized that the learner has prior knowledge and experiences, which are often determined by their social and cultural environment. Learning is therefore done by students' “constructing” knowledge out of their experiences. While the Behaviorist school of learning may help understand what students are doing, educators also need to know what students are thinking, and how to enrich what students are thinking, (Nola, Irzik, 2006). There are scholars who state that the constructivist view emerged as a reaction to the so-called "transmission model of education", including the realist philosophy that it is based on.

Constructivism can be traced back to educational psychology in the work of Jean Piaget (1896–1980) identified with Piaget's theory of cognitive development. Piaget focused on how humans make meaning in relation to the interaction between their experiences and their ideas. His views tended to focus on human development in relation to what is occurring with an individual as distinct from development influenced by other persons. According to Nola, Irzik, (2006), Lev Vygotsky's (1896-1934) theory of social constructivism emphasized the importance of sociocultural learning; how interactions with adults, more capable peers, and cognitive tools are internalized by learners to form mental constructs through the zone of proximal development. Expanding upon Vygotsky's theory Jerome Bruner and other educational psychologists developed the important concept of instructional scaffolding, whereby the social or informational environment offers supports (or scaffolds) for learning that are gradually withdrawn as they become internalized.

The concept of constructivism has influenced a number of disciplines, including psychology, sociology, education and the history of science. During its infancy, constructivism examined the interaction between human experiences and their reflexes or behavior-patterns. Piaget called these systems of knowledge "schemes. Schemes are not to be confused with schema, a term that comes from schema theory, which is from information-processing perspectives on human cognition. Whereas Piaget's schemes are content-free, schemata (the plural of schema) are concepts; for example, most humans have a schema for "grandmother", "egg", or "magnet." Constructivism does not refer to a specific pedagogy, although it is often confused with constructionism, an educational theory developed by Seymour Papert, inspired by constructivist and experiential learning ideas of Piaget.

In this study we have chosen the constructivist theory as one of the approaches to learning that will orient our work. To this effect we shall make reference to the works of;

Jerome Bruner, (1990), John Dewey (1933/1998), social constructivists; Bandura (1986), Piaget, (1972), and Vygosky, (1978). According to Tebogo M., (2014), constructivism is an epistemology (a theory of knowledge) which argues that humans generate knowledge and meaning from an interaction between their experiences and their ideas. Constructivism is a learning theory which holds that learning is a process of constructing meaning. Also, constructivism is seen as an approach to probe children's level of understanding and to show their level of thinking. Constructivism shows the way that learners can make sense of the materials and how the material can be taught effectively.

Social constructivism is a theory which developed from constructivism. This theory is seen as a transformation from constructivism and this explains why some advocates of constructivism like Dewey, Jerome Bruner, and Piaget, still appear to be advocate of social constructivism. Quoting Schwandt, (1994), Kathryn (1998), the claim of the social constructivists is that people perceive and describe the world using language and social artefacts. They believe that the process of knowledge construction is based on the social groups and the inter-subjectivity established through their interactions with the group. In a constructivist approach, the focus is on the sociocultural conventions of academic discourse such as citing evidence, hedging and boosting claims, interpreting the literature to back one's own claims, and addressing counter claims. These conventions are inherent to a constructivist approach as they place value on the communicative, interpersonal nature of academic writing with a strong focus on how the reader receives the message. The act of citing others' work is more than accurate attribution; it is an important exercise in critical thinking in the construction of an authorial self.

Studies on increasing the use of student discussion in the classroom both support and are grounded in theories of social constructivism. There is a full range of advantages that results from the implementation of discussion in the classroom. Participating in group discussion allows students to generalize and transfer their knowledge of classroom learning and builds a strong foundation for communicating ideas orally (Reznitskaya, 2007). Many studies argue that discussion plays a vital role in increasing student ability to test their ideas, synthesize the ideas of others, and build deeper understanding of what they are learning.

Significance of the theory to the study

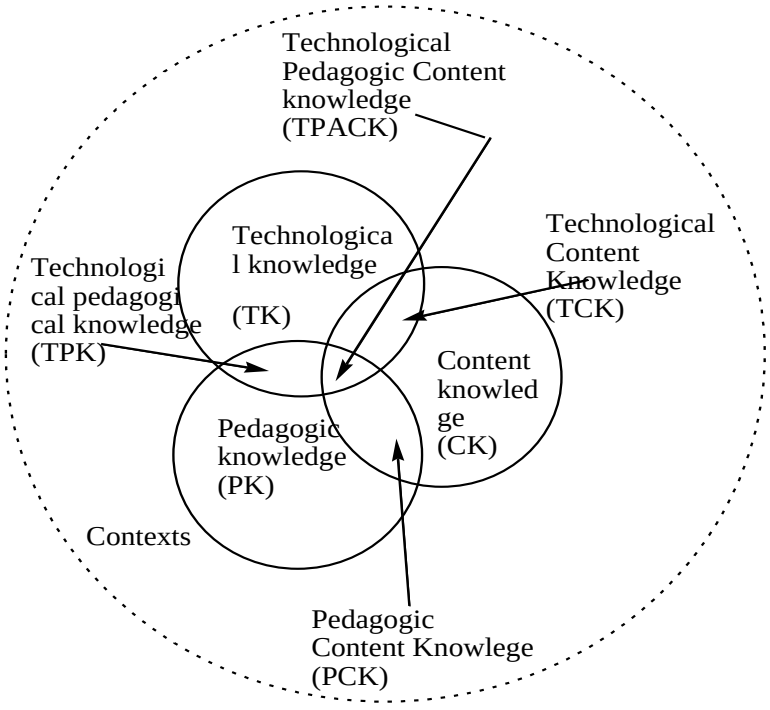
This theory is significant to this study because it explains the concept of ICT skills in teaching-learning. The benefits of this theory to this study include the accelerated rate of assisted learning as well as the ability to complete the complex task independently after being

assisted. As a result, whilst using social constructionism, teachers can take advantage of the group's diverse experience and skillset. Moreover, this theory leverage on the fact that students learn in groups. Especially in case of limited tools in the classroom. They get to learn from each other via exchange of ideas.

TECHNOLOGICAL PEDAGOGICAL AND CONTENT KNOWLEDGE (TPACK)

This model was proposed by Koehler and Mishra in (2006) and it identifies the knowledge teachers need to teach effectively with technology or for effective pedagogical practice in a technology enhance learning environment. It combines three main knowledge areas; technological knowledge (TK, content knowledge (CK and pedagogical knowledge (PK. An effective implementation of technology in classrooms requires acknowledgement of dynamic transactional relationship between content, pedagogy and incoming technology all within the unique contexts of different schools, classrooms and culture. Factors such as individual educator, the specific grade level and class demographics etc. will mean that every situation will demand a slightly different approach to the application of educational technology. No one monolithic combination of content, pedagogy and educational technology will be applicable for every situation. TK,CK and PK are thus combined and recombined in various ways in the intersections within the TPACK framework as shown below.

Figure 2 The TPACK Framework Illustration



According to TPACK framework, TK, CK and PK offers a productive approach to many of the dilemmas that teachers face in implementing educational technology in their classrooms because it further indicates that specific technological tools e.g. hardware's, software's, applications etc. can be best used to instruct and guide students towards a better understanding of subject matter. TPACK leaves room for researchers and practitioners to adapt its framework to different circumstances. This adaptability can be seen in the various intersections and relations embodied in the TPACK framework.

- **Content Knowledge:** This describes teachers own knowledge of the subject matter which may include knowledge of concepts, theories, evidence and organizational framework within a particular subject matter. CK will also differ according to discipline and class level. For example, junior secondary schools' science biology students like forms one and two requires less details and scope than senior secondary school's science biology students. So their various instructors as well as content each class impart to its students will differ.
- **Pedagogical Knowledge PK:** This describes teachers' knowledge of practices, processes and method regarding teaching and learning. PK also encompasses the purpose, values and aims of education. More specifically it may also include the understanding of students learning styles, classroom management skills, lesson planning, assessment etc.
- **Technological Knowledge TK:** This describes teachers' knowledge and ability to use various technologies, technological tools and associated resources. This concerns understanding educational technology considering its possibilities for a particular subjects' area or classroom learning. It is also important for teachers to recognize when it will assist or impede learning and continually adapting to new technology offerings.
- **Pedagogical content knowledge PCK:** PCK describes teachers' knowledge regarding fundamental areas of teaching and learning, including curriculum, students' assessments and reporting results. PCK seeks to improve teaching practices by creating stronger connections between the content and pedagogy. This occurs especially when the teacher interprets subject matter and finds different ways to represent it and make it accessible.
- **Technological content knowledge TCK:** TCK describes teacher understanding of how technology and content can both influence and push each other. It involves understanding of how subject matter can be communicated through different

educational technological offerings and considering which specific educational tools might be best suited for specific subject matter or classrooms.

- **Technological pedagogical knowledge TPK:** TPK describes teachers understanding of how particular technology can change both the teaching and learning experiences by introducing new pedagogical affordances. This concerns understanding of how technological tools can be deployed alongside pedagogy in ways that are appropriate to the discipline and the development of the lesson at hand

Significance of the Model to the Study.

Because TPACK considers the different type of knowledge needed and how teachers themselves could cultivate this type of knowledge, this framework thus become a productive way to consider how teachers could integrate educational technology into classroom. Teachers simply need to understand that instructional practices are best shaped by content-driven, pedagogically sound technologically forward thinking knowledge. As outlined by Mishla and Koehler. For teachers to make effective use of TPACK framework, they should be open to certain key ideas e.g.

- ✓ Concept from the content being taught can be represented using technology.
- ✓ Pedagogical techniques can communicate content in different ways using technology.
- ✓ Different contents concepts require different skills levels from students and educational technology can help address some of these requirements.
- ✓ Students come to the classroom with different backgrounds including pedagogical experiences and exposure to technology and lessons utilizing educational technology should account for this.
- ✓ Educational technologies can be used in tandem with students existing knowledge helping them to strengthen prior knowledge or to develop new ones.

TPACK is the type of knowledge that leads to quality teaching which requires a nuanced understanding of the complex relationship between technology, content and pedagogy, and using the understanding to develop appropriate context, specific strategies and representations (Mishla and Koehler 2006). This is considered the ultimate goal for the 21st century teacher but takes time to develop and become compatible with. However, the more conscious you are of this three important areas of teaching, the more likely you will be to succeed in this framework.

Social learning theory by Albert Bandura (1977)

In the 1941s, B. F. Skinner delivered a series of lectures on verbal behaviour, putting

forth a more empirical approach to the subject than existed in psychology at the time. In them, he proposed the use of stimulus-response theories to describe language use and development, and that all verbal behaviour was underpinned by operant conditioning. He did however mention that some forms of speech derived from words and sounds that had previously been heard (echoic response), and that reinforcement from parents allowed these 'echoic responses' to be pared down to that of understandable speech. While he denied that there was any "instinct or faculty of imitation", Skinner's behaviourist theories formed a basis for redevelopment into Social Learning Theory.

In the Social Learning Theory, Albert Bandura (1977) stated that behaviour is learned from the environment through the process of observational learning. This theory is based on the idea that we learn from our interactions with others in a social context. Separately, by observing the behaviours of others, people develop similar behaviours. After observing the behaviour of others, people assimilate and imitate that behaviour, especially if their observational experiences are positive ones or include rewards related to the observed behaviour. According to Bandura, imitation involves the actual reproduction of observed motor activities. (Bandura 1977). SLT has become perhaps the most influential theory of learning and development. This theory has often been called a bridge between behaviourist learning theories and cognitive learning theories because it encompasses attention, memory, and motivation. (Muro & Jeffrey2008). Bandura demonstrated that cognition plays a role in learning and over the last 30 years social learning theory has become increasingly cognitive in its interpretation of human learning; these points supported by (Newman B.M. & P.R, 2007).

Significance of the theory to the study

This theory is significant to this study as it explains vital proponent of the relationship between social environment and the individual learning process. It stipulates that learning is not purely behavioural; rather, it is a cognitive process that takes place in a social context, learning can occur by observing a behaviour and by observing the consequences of the behaviour (vicarious reinforcement), learning involves observation, extraction of information from those observations, and making decisions about the performance of the behaviour (observational learning or modelling). Thus, learning can occur without an observable change in behaviour. The learner is not a passive recipient of information. In the context of this study, it entails that learner should be a re doer, a participant in the teaching-learning process in order to acquire competences.

Theory of academic performance by Reynolds & Walberg, (1992).

Walberg's theory of academic achievement posits that psychological characteristics of individual students and their immediate psychological environments influence educational outcomes (cognitive, behavioural, and attitudinal) (Reynolds & Walberg, 1992). Walberg's theory talks about the influences on learning that affects the academic performance of a student. It is an exploration of academic achievement wherein Walberg used a variety of methods on how to identify the factors that affects the academic performance of a student. He analysed his theory with the help of different theorists and integrated his study with over 3000 studies. In his theory, he classified 11 influential domains of variables, 8 of them were affected by social-emotional influences namely, classroom management, parental support, student-teacher interactions, social-behavioural attributes, motivational-effective attributes, the peer. Academic achievement or academic performance is the extent to which a student, teacher or institution has attained their short or long-term educational goals. Completion of educational benchmarks such as secondary school diplomas and bachelor's degrees represent academic.

Significance of the theory to the study

This theory centres on academic performance which entails the acquisition of competences in that shows our performances in the digitalise new normal. The competences acquired give the teacher the possibility to judge or determine the best students.

Empirical literature review

Information Technology (IT) is the very essential for today as well as the tomorrow in education, economy, businesses etc. Education play the vital role in day today lifetime because it is the place that everyone's lifetime begins. Education is very efficient, valuable useful when it accumulated with information technology. Most of the schools around the world use Information Technology and Communication (ICT) integrated technologies in teaching and learning process such as video, audio and image projection, tablet usage, online learning, websites, mobile phone techniques etc. For identifying challenges, techniques, problems that arise with the new methodologies, most of the countries have conducted surveys and questionnaires. From that most of the countries give solutions for problems like IT centers, providing infrastructures, trainings for teachers, improving English capabilities. In the field of research, many earlier researchers have conducted related studies in this field.

Teaching materials / ICT tools and student's competence acquisition

A related study was conducted by Anne (2004). In this paper Anne present the rationale that motivates the study in an ongoing three-year project following students in school years 8 to 10. The aim is to develop the students' competence with use of ICT tools in Biology in such a way that they will be able to choose tools for themselves, not rely just on the teacher telling them what to use for a specific task. Experiences and results from research emerging after more than two years will be discussed.

Another related study was conducted by Simin et al. (2006). According to them, in this digital era, ICT use in the classroom is important for giving students opportunities to learn and apply the required 21st century skills. Hence studying the issues and challenges related to ICT use in teaching and learning can assist teachers in overcoming the obstacles and become successful technology users. Therefore, the main purpose of this study is to analyze teachers' perceptions of the challenges faced in using ICT tools in classrooms. A quantitative research design was used to collect the data randomly from a sample of 100 secondary school teachers in the state of Melaka, Malaysia. Evidence has been collected through distribution of a modified- adopted survey questionnaire. Overall, the key issues and challenges found to be significant in using ICT tools by teachers were: limited accessibility and network connection, limited technical support, lack of effective training, limited time and lack of teachers' competency. Moreover, the results from independent t- test show that use of ICT tools by male teachers (M =2.08, SD = .997) in the classroom is higher compared to female teachers (M = 2.04, SD = .992). It is hoped that the outcome of this research provides proper information and recommendation to those responsible for integrating new technologies into the school teaching and learning process.

Another study was conducted by Akugu (2014). Education is a fundamental human right, and a key input in production and development of an economy. This explains why countries worldwide plan for and increase budgetary allocations to fund various educational programs each financial year. There is however concern on the quality of education offered and performance of students in national examinations. The purpose of this study was to examine the influence of teaching and learning resources on students' performance in KCSE in FDSE in Embakasi district. Four objectives were formulated to guide the study; the objectives of the study were to determine how availability of teaching and learning materials used in FDSS affect students' performance, which was done by determining the availability of learning materials utilized in schools, the study also established how adequacy of physical facilities and human resources influence students' performance and also assessed the extent of resource utilization and its effect on students' performance in KCSE in FDSE in Embakasi

district, following provision of teaching and learning resources by the government to the public day secondary schools. The study used descriptive study design, and data was collected using three sets of questionnaires for the head teachers, teachers and students. The target population consisted of all the Free day secondary schools in the district, their head teachers, teachers and students. The sample consisted of 6 principals, 18 class teachers and 240 students. Data was analyzed using descriptive statistics, using Statistical Package for Social Sciences (SPSS), the analyzed data was then presented using frequency tables, means, percentages, pie charts and bar graphs. The study found out that teaching and learning materials were available and are utilized in schools, especially those used in classroom instruction, like chalks, dusters and charts except physical facilities are lacking and there's gross inadequacy of human resources. This resulted to overstretched resources with annual increase in enrolment rates thus compromising the quality of education. Therefore, the government should allocate more funds for TLR provision to improve the status and condition of physical facilities and employment of more teachers for the FDSE to be effective. Based on the study findings, it is recommended that similar research could be carried out in other parts of Kenya since different parts of the country have different characteristics. Further research could also include a study on Integration of ICT and e-learning to complement human resources.

Another study was conducted by Olayinka (2016). The aim of this paper is to highlight the contribution of instructional materials to the academic achievement of secondary school students in Social Studies in Ekiti State. The population for the study comprised of all Junior Secondary School Class II students from among which 180 were sampled. The instrument for the study is a 30 multiple-choice self- designed Social Studies Achievement Test (SSAT). The instrument was validated by specialists in Social Studies Test and Measurement and Educational Management. Test-re-test method and estimation of internal consistency was used to ascertain the reliability. The reliability co-efficient of 0.73 and 0.75 were obtained respectively. The study generated four hypotheses that were tested at the significance level of 0.05. ANOVA and ANCOVA statistical tools were used to analyze the data collected. The study found that there was a significant difference in the pre-test and post-test of students in the experimental group. The study also found that gender effect was not statistically significant in social studies. The study concluded that students who were taught with instructional materials performed better than those taught without. The study therefore recommended that teachers of Social Studies should employ the use of essential instructional materials for their teaching and also improvise where and when the materials are

not available. It therefore becomes imperative to have concerted efforts among parents, school and the government to make available important and necessary instructional materials to teachers of Social Studies for enhanced teaching and consequents improved achievement of students in the subject.

According to Josua in Abiodun-Oyebanji and Adu (2007), instructional materials are all things that are used to support, facilitate, influence or encourage acquisition of knowledge, competency and skills. Abdu-Raheem (2014) encouraged teachers to improvise teaching aids because they are in great measure enhance learners' full participation in the lesson, gives room for inquiry, problem-solving, discussion and clarification of issues and ideas among students and the teacher. Riveire (2006) noted that improvisation is a valuable teaching tool. Afolabi and Adeleke (2010) identified non-availability, inadequacy and non-utilization of learning materials as a result of teacher's poor knowledge as factors responsible for the use of lecture method. They recommended that both students, teachers, parents, Parents/Teacher Association, government and philanthropists should be involved in improvising instructional materials for the teaching and learning in schools.

Teachers ICT skills and student's competence acquisition

On this aspect, a related study was conducted by Enu et al. (2018). According to this study, the integration of ICT into pedagogical practices will seriously be compromised if teachers possess little or no knowledge of ICT. This paper reports on a study which sought to explore basic school teachers' ICT skills and ICT usage in the classroom. In all 20 basic school teachers took part in the study. Three instruments were used to gather data from teachers which include lesson observation, questionnaires, and interview. The study adopted survey research design. Qualitative analysis of the data collected revealed that teachers' ICT skills were at the moderate level. The study also revealed that teachers' uses ICT for general and personal purposes which includes chatting and communicating with friends as well as family members via WhatsApp, Facebook, WeChat. In terms of ICT integration in classroom lessons, it was found that, teachers hardly use technology in their lessons because of not having ICT integration skills as well as lack of resources in the Basic schools. The study recommends the need for regular in-service training programme for teachers with a direct focus on ICT integration and ICT usage for teaching and learning by Ghana Education Service.

Novela (2022) conducted another related study. This study determined the teachers' competency in Information and Communication Technology (ICT) in the new normal. The

descriptive correlational and quantitative method of research was utilized. The respondents of this study were the teachers from four Secondary Schools of Bulan 1 District, S.Y. 2021-2022. Findings revealed that teachers age 26-35 was dominant and female teachers have higher frequency than male. The married teachers were dominant than single. Most of the teachers were Bachelor's Degree holder and served 5 years and above in the institution. The level of competency of the teachers along Productivity Tools and Email Management was moderately competent. While, the level of competency of the teachers along Web Browsing, Video Conferencing, and Other Online Applications were all less competent. Lack of sufficient training was the most problem encountered by the teachers. Followed by lack of quality software and technical problems.

Another related study was conducted by Patankar and Jadhav, (2014). ICT is a well-known word to all fields. ICT shows its effectiveness in every field of mankind. The term ICT is used for information communication technology. ICT refers to technologies that provide access to information through telecommunications. It is similar to Information Technology (IT), but focuses primarily on communication technologies. This includes the Internet, wireless networks, cell phones, and other communication mediums. ICT may be defined, for the purposes of this primer, as a "diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information." These technologies include computers, the Internet, broadcasting technologies (radio and television), and telephony. A skill is the learned ability to carry out a task with pre-determined results often within a given amount of time, energy, or both. In other words, skill may be the abilities that one possesses. Teaching learning is the most important process in education. Teaching may be defined as the process to help learner to learn. The quality of Higher education depends on the quality of teaching-learning process. Higher education describes the rate of growth and development of Nation. Various researches' proved that the use of ICT is best tool for learning process. 21st century learner possesses the characteristics like self-directed and lifelong learners, visionary leaders, collaborative communicators, aware and adopt information manager, adopt and literate performers, healthy humans, caring global citizens, flexible critical thinkers, etc. To promote these characteristics of 21st century learner teacher must be familiar with ICT and also must be techno-savvy. The present paper describes the need of ICT skills of teacher for teaching learning process in higher education. And also find out the various ICT skills of teachers for teaching learning process.

Another related study was conducted by Awouh (2019). According to him, advances in Information and Communication Technologies (ICT's) are changing the way people share,

use, and process information. Overtime, students' academic performance had been used to determine excellence in teacher teaching. This study was conducted to investigate the relationship between teachers' ICT competency and students' performance in ICT in East Akim Municipality in the Eastern Region of Ghana. It also sought to find out whether availability of ICT resources have influence on students' performance. In the study, 19 public Junior High Schools were sampled from 67 schools. Questionnaire was employed for data collection from the total sample of 322 students and 19 teachers of ICT. Descriptive research design was selected for quantitative research approach. The findings on the academic performance of students revealed that only 7(2.2%) out of 322 students and 9(2.8%) had a mark above 80 for term 1 and term 2 respectively. Majority of the students also rated themselves as either poor or very poor in performing computer related tasks. Most students' performance in both practical and end of term examination were low due to the unavailability of computers in their schools. This reflected in a positive linear relationship between the availability of ICT resources (computers) and students' academic performance. The null hypothesis H0 was rejected at 0.05 level of significance with $p = 0.032$. The level of teachers' ICT competence on the six UNESCO standards generally recorded a low mean value of 3.77. It was recommended that teachers who do not have the required ICT qualification and practical skills in ICT usage should seek training to enable them competently and confidently use them in teaching the subject.

Another related study was conducted by Nor et al. (2019). The preliminary presumption is that academic teachers are competent in teaching based on the degree they graduated in. It is claimed that teachers with low quality competency in teaching are those who are not skilled and practice passive teaching method. Recent reviews on education mostly talk about creating 21st century teaching environments in schools therefore student-centered classroom approach for Malaysian students which is implemented with clarity and understanding that, can engage teachers and students in new ways should be studied. This paper seeks to determine the factors that contribute to excellent result achievement by students in relations to teachers' competency. The study employed a mixed-method approach using a quantitative technique of semi-questionnaire survey on teaching competencies for teachers from selected excellent religious secondary schools under BPI (Islamic Education Department, MOE) that underwent the Virtuous Student Character Program (SUMUR) and qualitative in the form of interview for Sic+, PPD excellent guide teachers from the selected SABK and SMKA secondary schools (School Improvement Specialist Coaches (SISC+) under the Malaysian Education Blueprint, PPPM 2013-2025.). The independent variable is

teacher competencies, the mediator is holistic centred learning and the dependent variable is student academic performance (based on Malaysian Education Certificate “SPM” 2015 result) as per specified in each instrument. The findings will contribute towards a better understanding on how teaching competency affects students’ academic performance in relations to Holistic Centred Learning and the SUMUR program. Keywords: Teachers’ Teaching Competency, Holistic centred Learning, Student Academic Performance, Multiple Intelligences Learning Style, SUMUR.

Akiri, (2013) conducted another study. This study determined the effects of teachers’ classroom effectiveness on student’s academic performance in public secondary schools in Delta State, Nigeria. The design was descriptive in nature and it involved 300 teachers, Academic performance records of 50 students per teacher, which is 1690 students’ scores were also used. Questionnaires and rating scale were used to collect data for the study. Three hypotheses were tested at the 0.05 level of significance using correlation, t-test, and single factor analysis of variance. The results showed that effective teachers produced better performing students. However, the observed differences in students’ performance were statistically not significant. This could be due to the influence of student and school environment related factors which were not included in this study. It was concluded that teachers’ effectiveness is not the only determinant of students’ academic achievement.

Digital library and student’s competence acquisition

A related study was conducted by Abbas et al. (2019). The purpose of the current study was to explore the effect of digital literacy on the academic performance of the students at the higher education level. The study was a mixed method and data were gathered with a questionnaire and semi-structured interviews. The validity and reliability of the scales were ensured through experts' opinion, pilot testing, and Cronbach Alpha score. The population comprised the students of M.S/M.Phil and Ph.D. A sample of 800 students was selected randomly from 10 Universities. The statistical tests like mean, standard deviation and correlation were used. Results revealed that digital literacy had significant effects on communication skills, research skills and confidence of the students and insignificant effect on students' CGPA.

Another related study was conducted by Rodrigue and Mandrekar (2020). According to this study, libraries play an important role as a reliable and beneficial information provider in the students’ academic success and performance. The aim of this study is to investigate the student’s satisfaction with library resources and services provided by the academic library. Random surveying was conducted to find out the problem and difficulties faced by the

students in accessing the library resources and its impact on their academic success and performance. The finding in the study showed that there is a significant and remarkable relationship between the library usage and the students' academic performance and success. the major finding of the study is to conduct the information literacy programme for the students to promote awareness about the resources, services and facilities available in the library so that the students can take maximum advantage of the benefits provided by the library. One way to overcome this problem is to encourage the students to embrace using the library in their academic studies and explain its benefits.

Another related study was conducted by Lim et al (n.d). A library is a collection of literary documents or records kept for reference or borrowing; many students regard the library as a place for researching and reading books. Many factors of library usage play an imperative part in determining students' performance at school; thus, it important to study and evaluate the impact for further understanding the relationship between the library and students. This research was undertaken because many researchers haven't focused on the library's role in developing countries. Subsequently, this research set out to examine the impact of the school library on student achievement at The University of Cambodia. Additionally, we also investigated the impact of library usage on students' academic performance as well as their approach to studying. The study used a questionnaire as a research tool for data collection. A total of one hundred copies of the questionnaire were given randomly to students who use the library at The University of Cambodia. The findings of the research showed that there is a notable association between library usage and students' academic performance. The results of our analysis further advocated the library provides several benefits to students and affects the way they approach their studies. Exploring this study of library is the first major step toward achieving further understanding of the overall impact of the library towards students as a whole, and helps make way for more comprehensive future research in this area.

Another related study was conducted by Jato, samule and peter (2014). The study was on study habits, use of libraries and students' academic performance in selected secondary schools in Ondo West Local Government Area of Ondo State. Survey technique was adopted for the study, and the instrument for data collection was questionnaire. Complete enumeration was the procedure used for the study. 296 copies of questionnaire were administered and retrieved but 14 copies were invalid. Thus, 284 (95%) copies were valid for analysis. Major findings of the study revealed among others that irregular use of school libraries by the students was one of the factors for poor scores in test and examination, many students did not

study outside the school, and academic performance of the students was poor in Mathematics and English Language. The study concluded that study habits of the students were bad and academic performance of the students was poor. Based on the findings, the study recommended among others that library study hours should be included on the school time table to allow students to have a specific time to use the school library on a regular basis; school libraries should open beyond school hours to enable the students the opportunity to study after school hours, students should find suitable and comfortable places to study outside the class each day, and amount of time used by the students for study must be increased both at school library and at home in order to devote quality time to study.

Adam and Blanfored conducted another study in 2022. Although web accessible digital libraries (DLs) have greatly increased potential information accessibility within academia, the use of these resources varies widely across disciplines. This study, within contrasting departments (Humanities, Computing and Business) of a London university, reviews the social and organizational impacts of DLs across these disciplines. In-depth interviews and focus groups were used to gather data from 25 lecturers and librarians, and results analyzed using the grounded theory method. Web-accessible DLs are identified as changing the roles and working patterns of academic staff (i.e. lecturers, librarians and computer support staff). However, poor accessibility due to inappropriate implementation strategies, access mechanisms, searching support & DL usability reduces the use of these resources. Consequently, web and personal collections without guarantees of quality are widely used as an accessible alternative. One conclusion is the importance of implementation strategies (e.g. giving feedback on document context, collection boundaries, ownership, accountability and support) in informing DL design.

Another related study was conducted by Vijeyaluxmy (2015). According to this study, academic libraries play an important role in the institutions they serve. The core objective of academic libraries is to support the parent institution to achieve its objectives. The purpose of the study was to identify the information needs of graduate students and assess the satisfaction level of the students towards the library services. Upon the basis of findings strong user oriented hands on training are recommended, as majority of the first year students from both faculties are lack of ICT skills. Better ICT skills are a must for effective handling of EIR, Therefore, in order to raise the awareness in accessing EIR, more vigorous campaigns are of dire necessity. It can be suggested to both libraries to revive modes and timing of providing access to EIR. Future research is required to identify particular group of students who are indeed in need of training, in order to improve ICT skills.

Another related study was conducted by Akande and Blemis (2017). The aim of this study is to evaluate the use of school library materials and services available in promoting students' academic motivation in selected Secondary Schools in Osun State, Nigeria. The study adopts multistage random sampling technique to choose the sample size from one senatorial district out of the three senatorial districts in Osun State. 240 students were randomly selected from the six secondary schools selected for the purpose of this study. A self-administered questionnaire was employed as the instrument for data collection. The questionnaires were distributed in the classrooms to those who agreed to participate in the study. There were 241 respondents; 120 males (49.8%) and 121 females (50.2%). Their ages ranged from 11 to 20 years. Majority of the respondents (53.5%) use the library weekly; 36.5% daily and 10.4% use the library monthly. The students that used the library daily were predominantly boys (49.2%) and most of those who used the library weekly were females (71.1%). On the main reason for using the school library; to study individually has the highest Variable Score (VS) of 3.61. The importance of some available library services to the students shows that "finding a place to do private study" has the highest VS of 2.6 while "finding electrical outlets in seating areas" has the lowest variable score of 1.49. The frequency of use of some available library resources shows that using the library textbooks has the highest VS of 2.92 while the use of CD-ROM has the lowest variable score of 1.54. "Finding relevant materials for better understanding of subjects", "reading and taking notes" have the highest VS of 2.88 while 2.85 respectively regarding what they enjoy in the library. "I can always go online and also check my email" has the lowest variable score of 2.32 among the factors that motivate the students in the library. The students used the school libraries on a slightly lower frequency daily. One of the reasons for visiting the library was significantly not to browse the internet despite the fact that this is important to them and the least factor that motivates them is their experience in online activities in the library. It is generally clear that a lot of funding still need to go into acquiring new technologies for use in Nigerian School libraries.

Another related study was conducted by Alham and Azza (2021). This study aimed to develop a model to examine how digital technology integration contributes to the enhancement of students' academic performance through project-based learning (PBL) amongst undergraduates in higher education. In this study, the technology acceptance model (TAM) was used as the basic model to explore the digital technology environment in terms of the perceived usefulness, perceived ease of use and attitude towards integrating digital technology and the influence of these factors on undergraduates' learning engagement and

academic performance within PBL. Therefore, this study proposed a model comprising factors that assist in addressing the study objective. As the main data collection method, a questionnaire was developed to obtain relevant information regarding digital technology acceptance, PBL, students' learning engagement and academic performance. The study sample comprised 185 undergraduate students who were enrolled in a course that utilised PBL. A quantitative research method via structural equation modelling (SEM) was used to analyse the data. The finding suggested that TAM-related factors and students' learning engagement positively affect their academic performance when digital technology is integrated into the PBL environment.

Another related study was conducted by Dukpe et al. (2018). School libraries are key agents in the educational system in Ghana. Therefore, this study sought to assess the impact of school libraries on students' academic success in Bunkpurugu Yunyoo District of Northern Ghana. The descriptive survey design was employed to determine the level of impact on the various variables deplored for the study. The population for this study was made up of Circuit Supervisors, teachers and students within the study area. Purposive sampling technique was employed to select three junior high schools with libraries and another set of three without libraries. Krejcie and Morgan (1970) table was used to select (150) students from a population of (240). Simple random sampling technique was used to proportionally select 25 respondents from each of the six schools. The instruments used for the study includes questionnaire, interviews, observation and existing document analysis. Key informants of 10 were interviewed and a visit to each of the schools included in this study was undertaken to observe how libraries utilisation could enhance students' academic achievement. Paired t-test calculated at ($p \leq 0.05$) was used to determine differences in students' academic achievement. The results indicated a positive significant difference in the academic achievement of students in schools with libraries and those without libraries in all the items that were investigated. The study recommends for a policy of 'one rural school, one library' stocked with relevant reading materials and the setting up of 'Reading Clubs' in rural schools in order to sustain students' interest in reading.

Summary of the review and examination of the knowledge Gap

A literature review is an overview of the previously published works on a topic. The term can refer to a full scholarly paper or a section of a scholarly work such as a book, or an article. Either way, a literature review is supposed to provide the researcher/author and the audiences with a general image of the existing knowledge on the topic under question. A

good literature review can ensure that a proper research question has been asked and a proper theoretical framework and/or research methodology have been chosen. To be precise, a literature review serves to situate the current study within the body of the relevant literature and to provide context for the reader. In such case, the review usually precedes the methodology and results sections of the work. The significance of this review is that it helps strengthen the views of your readers with the help of citations and references from other established sources. This also gives the impression that you have done your homework for your research study.

In the empirical review, the researcher deciphers that many earlier researchers have studied this domain extensively. However, that fact that ICT introduction is new in sub-Sahara African and Cameroon in particular makes this study different as it strives to bring in a new literature of the domain into the existing literature. Among the researchers, they focused their problem on academic performances, meanwhile this study is looking at competence acquisition. This demonstrates its novelty and originality.

CHAPTER THREE

RESEARCH METHODOLOGY

To examine the relationship that exist between the application of information and communication technology (ICT) in the teaching of Biology and learner's competence acquisition in some secondary schools in the Mfoundi division, this chapter is focused on the description of the methods and instruments used to collect information for this research work. It treats the following elements: research design, the area of study, population of study, target population, accessible population, the sample and sampling techniques, instruments used for data collection, techniques of analysing data, the variables, the indicators and recapitulative table.

Research Design

A research design is the procedures for collecting, analysing, interpreting and reporting data in research studies (Creswell & Clark, 2007). It sets the procedure on the required data, the methods to be applied to collect and analyse these data, and how all of this is going to answer the research question (Grey, 2014). This study adopts survey research design. A survey looks at the individual, groups, institutions, methods and materials to describe, compare, contrast, classify, analyse and interpret the entities and events in the field, (Cohen et al, 2007). The survey is employed in this study to enable the researcher study a large population and have a greater statistical power. Moreover, it gives the researcher the ability to collect a large amount of information and having the availability of validated models. The type of survey used in this study is descriptive. The descriptive survey is chosen because it enables the researcher to collect data at a particular point in time to describe the nature of the existing phenomenon; identify standards against which this existing phenomenon can be compared. It also helps us to scan a wide field of issues, population, institutions and programmes to describe or measure any generalised features. It further helps us to assure objectivity and generalization of findings.

Area of the study

This study is conducted in centre region of Cameroon. Specifically, the study was carried out in the Mfoundi division of the centre region of Cameroon. Mfoundi division covers an area of 297 km² and as of 2005 had a total population of about 1,881,876 and it is one of the 10 divisions that make up the Centre region. The division forms the Yaoundé

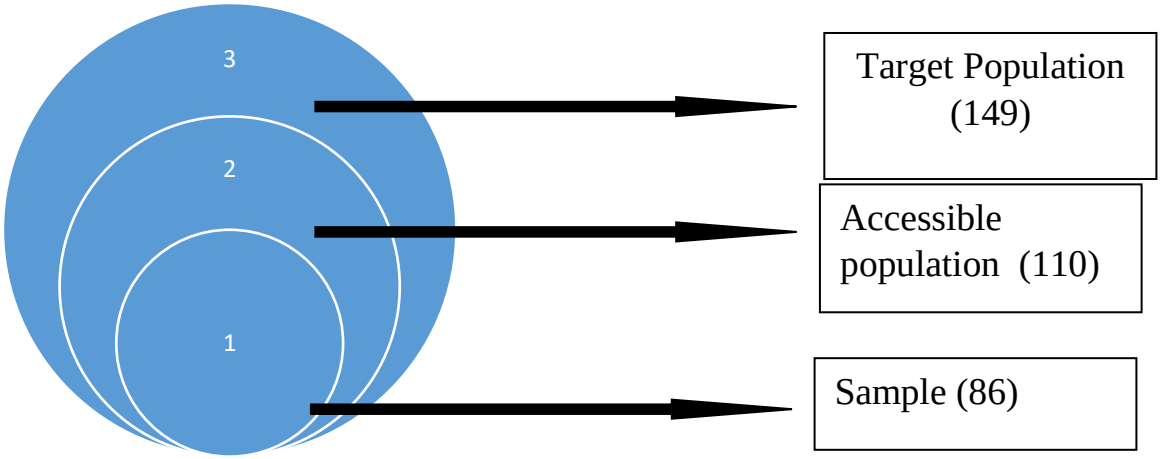
capital and cover greater area. The Centre Region occupies 69,000 km² of the central plains of the Republic of Cameroon. It is bordered to the north by the Adamawa Region, to the south by the South Region, to the east by the East Region, and to the West by the Littoral and West Regions. It is the second largest of Cameroon's regions in land area. Major ethnic groups include the Bassa, Ewondo, and Vute. Yaoundé, capital of Cameroon, is at the heart of the Centre, drawing people from the rest of the country to live and work there. The Centre's towns are also important industrial centres, especially for timber. Agriculture is another important economic factor, especially with regard to the region's most important cash crop like cocoa. Outside of the capital are the plantations zones, with most inhabitants being sustenance farmers.

This area was chosen for this study because it harbours a good number of secondary schools. ICT was first introduced in the secondary schools in the cities before going out words, meaning they have mastery of the procedure. Moreover, Cost considerations were made in line with the fact that a study of this type requires primary data and its collection requires a lot in terms of time and financial cost. The case with which data could be collected for the study in this area was not equally left out and the closeness of the researcher to the area was amongst the determinants of the choice of the study area.

Population of the study

According to Shukla, (2020), research population is a set of all the unites (people, events, things) that possess variable characteristics under study and for which the findings of the research can be generalised. The population of this study are all biology of both public and private secondary and high schools of Mfoundi Division which are about six hundred (600) in number. This study divides a research population into Target population, accessible population and the sample as presented on figure 3.

Figure 3 The Population Threshold



Source: Adapted from Amin (2005, p. 236)

Figure 3 is a demonstration of the respective population levels, sub-divided in order to make sure the right participants are met. These three levels are examined below.

Target population

Fraenkel and Wallen (2006) opined that the target population is the actual population to which the researcher would like to generalise its findings, (it is the researcher's ideal choice). The target population of the study was made up of all biology teachers of public secondary schools in Mfoundi division which are one hundred and forty-nine (149).

Since we could not be able to meet with each of the participants in this target group because of differences in schedules, absenteeism and unwillingness to participate, we exploited the accessible population.

Accessible population

According to Onen (2020), accessible population refers to the portion of the target population to which the researcher has reasonable access and from which sample can be drawn. It could be that portion of the population to which the researcher has reasonable access, may be a subset of the target population. The accessible population of the study was made up of all biology teachers in all bilingual public secondary schools in Mfoundi division. To acquire the sample, biology teachers were selected from six bilingual secondary schools in the Mfoundi division. These schools include GBHS Essos, GHS Nkol-Eton, GBHS Emana, GBHS Mendong, GBHS Ekounou, and GBHS Etouge-Ebe which gave us a total of one hundred and ten (110) biology teachers. Moreover, we used teachers of the same speciality

(biology) because of familiarity of the researcher with the subject area, so that they can effectively talk about introduction of ICT in the teaching and learning of Biology and how students acquire biological competence in the process.

Sample

Onen (2020), opined that a sample is the selected elements (people or objects) procedurally chosen for participation in a study to represent the target or accessible population). Hence it is the reduced number of biology teachers from the selected schools which form the accessible population for the current study. In this study, the researcher used the Krejcie and Morgan table to acquire a sample size of 86 from the 110 teachers from the six selected schools.

Table 2 Showing the sample size the study

Name of School	**Number of teachers**		
			Total
	Female	**Male**	
GBHS Essos	13	09	22
GBHS Nkol-Eton	12	07	19
GBHS Emana	11	10	21
GBHS Mendong	15	11	26
GBHS Ekounou	13	10	23
GBHS Etouge-Ebe	12	07	19
Total	**76**	**54**	**110**

Source: Field data (2023).

Sampling Technique

With consideration of the research objectives and the design used in this study, we adopted the simple random sampling technique. A simple random sample is a subset of individuals (a sample) chosen from a larger set (a population) in which a subset of individuals are chosen randomly, all with the same probability. In simple random sampling, each subset of individuals has the same probability of being chosen for the sample as any other subset of individuals. A simple random sample is an unbiased sampling technique. We used the simple random sampling because the principle of simple random sampling is that

every set of items has the same probability of being chosen, so there is no bias and more of objectivity in sampling procedure.

Sample Size

Table 3 Sample size (Krejcie and Morgan) with confidence level of 95% and error margin of 5.0%

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

Data Collection

Data here contained was got from different sources; categorized under primary and secondary data.

Primary data: Primary data here has to do with raw material got from research participants and through questionnaires administered to teachers in the above secondary schools. The data is primary because it is directly collected from the field.

Secondary data: Secondary data on its part is reviewed material related to the application of ICT in teaching biology as a subject in the digital age and how it effects learner's competency acquisition in one way or the other. This data is gotten from reviews of existing material,

from libraries, internet. It is called secondary because of the fact that it is got from pre-existing texts and research works.

Research Instruments

Every research project has as goal to gain knowledge. To arrive at this, investigations are to be made between variables. Hopkins (1998) holds that in educational settings, the purpose served by research instruments can be classified into four categories;

- The research instruments should provide a means of feedback to the instructor and the students. This helps the instructor to provide more appropriate guidance for individual students.
- It is used for research and evaluation. That is, tests are necessary to determine whether an innovative program is better than the conventional one in facilitating the attainment of specific curricular objectives.
- The instruments are used for guidance functions. That is, diagnosing an individual's aptitude and ability.
- The instruments are used for the administrative process that is, to facilitate better classification and placement decisions for instance, the groupings of children by their level.

Since it is complicated to measure directly, it is necessary to use indicators for our investigations.

For a good comprehension of this study, the instruments used to collect data, was questionnaire. The questionnaire is the main instrument of the study.

The questionnaire

A questionnaire is a set of questions on a topic or group of topics designed to be answered by the respondent. It is the vehicle used to pose the questions that the researcher wants respondents to answer (Ahmad, 2012). To add to this definition, a questionnaire can be typed or printed in a definite order or form and can be distributed directly or mailed to respondents who are expected to read, understand the questions, then write down the reply in the space meant for the purpose in the questionnaire itself. The questionnaire was designed to meet the demands of some of research questions underpinning this study. The tool was chosen in order to create room for the respondents (teachers) to express their opinions on how the application of ICT in the teaching of biology in this digitalise new normal enhance students' competence acquisition.

Description of the tool

In this study, we designed and administered 130 questionnaires. The 130 questionnaires contained 24 questions divided into the respective indicators. The questionnaire was measured using the 4-point Likert scale. We adopted 4 points Likert scale because it gives the exact results of every participant. Every questionnaire was made up of closed-ended questions and was anonymous. There were designed into five sections as follows: Section "A" was demographic information. Structured to collect general information about respondents such as: name though facultative; gender, age, level of education, date and place of interview. Section "B" was consisted as information on Teaching materials / ICT tools. Section "B1" is based on questions related to the teachers' ICT skills; section "B2" concerns itself with digital library, while section "C consisted of students' competence acquisition.

Table 4: Presentation of variables and corresponding items on the questionnaire

HYPOTHESES	**ITEMS**
Teaching materials / ICT	5-9
teachers' ICT skills Discipline	10-15
Digital library	16-20
Computer assisted instructions	
Students' competence acquisition	21-24

Source: *Field data (2022)*

Validation of the instrument

According to Amin (2005) validity means the instrument measures what is true, what is supposed to measure and the data collected honestly and accurately represents the respondent's opinion.

Face Validity

Face validity is the extent to which a tool appears to measure what it is supposed to measure. In this light, the researcher after constructing the tools (questionnaire guide), they were presented to senior students and research specialist in the department to cross examine the structure and number of items. They made some respective corrections. They were then taken to the supervisor for examination. He reconstructed some items and together with the researcher approve that the tool is well structured and fit for the purpose.

Content validity

This is to know if the questions match with the subject matter. E.g. asking questions in all the indicators. All questions were constructed following the subject matter and all indicators had almost equal representation in the questionnaire. They were given to the supervisor to verify if the various components of the study are covered. We used the expert judgmental test to measure the content validity of the tools.

Reliability of the instruments

Reliability refers to how consistently a method or an instrument measure something. If the same result can be consistently achieved by using the same methods under the same circumstances, the measurement is considered reliable and consistence.

The Pilot Test

A pilot study can be defined as a 'small study to test research protocols, data collection instruments, sample recruitment strategies, and other research techniques in preparation for a larger study' (Zailinawati, Schattner &Danielle, 2006). A pilot study is one of the important stages in a research project and is conducted to identify potential problem areas and deficiencies in the research instruments and protocol prior to implementation during the full study. It can also help members of the research team to become familiar with the procedures in the protocol, and can help them decide between two competing study methods, such as using interviews rather than a self-administered questionnaire. The pilot study can reveal the ambiguity, and poorly elaborated questions.

Questions that are not understood and unclear can indicate whether the instructions to the respondents are clear. The outcome of this pilot study enabled the researcher to eliminate and refine certain items in the questionnaire. A pilot test was carried out by the researcher using teachers and students of GBHS Mbankomo. The researcher obtained permission through an attestation of research from the head of department and the Dean of the Faculty before going to the field at the field. These students were chosen because they have nearly the same characteristics like the students in the sample. According to Saughmessy and Zechmeister (1990), an instrument is reliable when it measures what it is intended to measure consistently. Hence the reliability of the instrument was verified. The reliability is the degree to which the instrument consistently measures whatever it is supposed to measure. The advantages derived from the pilot test were that new insights were obtained, the errors pointed out were corrected and the total understand ability of the questionnaire was measured which assisted to enrich the final questionnaire, hence, the validity of the research instrument.

Results of the pilot testing

Administration of instruments

The research obtained the research authorization from the department, invited two other researchers and together, they concerted before going to the schools concerned. At the school, the researcher presented herself to the principal and presented her research authorization. From there the principal invited the vice principal and head of biology department concerned and got biology teachers into contact with the researcher. The researchers took schedule from the teachers on what time will the teachers schedule permit them to participate in the study. Following their time schedule, the teachers all answered the questionnaires and returned all because the head of biology teacher department was there and willing to assist.

Ethical Consideration

In contemporary education studies, all researchers are expected to apply, respect ethical principles and guidelines when research involves human subjects (international commission for world health organisation CIOMS 2002). This is because other researchers and those reviewing or supervising research would also find such helpful to themselves (Bailey, 1988). According to Gustafsson, Hermaren and Peterson (2005), areas of ethical concerns are lack of informed consent, plague with inversion of privacy, deception and harm to participants. Ethical issues have to do with respect for lives, persons, human dignity, beneficence and justice. According to (Amin, 2005),

> *Ethics refers to well based standards of right and wrong that prescribe what humans ought to do usually in terms of rights, obligations, benefits to society, fairness, or specific virtues… ethical standards support the virtue of honesty, compassion and loyalty and include standards relating to rights such as the right to life, the right to freedom from injury and the right to privacy (p. 28)*

This takes place in four different stages of the research process; the choice of the topic, data collection, analysis, interpretation and thesis writing. In this study, we ensure ethics in these four parts; in the research topic, all cautionary motives were taken into consideration, in order to avoid stumbling on a topic that could harm or put both the university community and research participants in any inconveniencies. In order to achieve this, an explorative study was conducted to test the suitability of the topic and to find out if it is sensitive to the

scientific world or not.

At the level of data collection, the methodology, techniques and tools used were chosen with reasons, and further pretested during the explorative study before they are finally employed in the study. This was purposefully to avoid straying into research participant's privacy in one way or the other. While in the field, the main instrument that was used to give every informant their rights in the informed concerned form. This form was presented in two parts, part A presented the information about the research work and B presented information on participant's engagement on the whole exercise. The document was handed to participants and some verbal explanations were made after which they fixed day and place for the interview according to their convenience. On data analysis, our tools did not give any gap for the participants to put their names, so all responses were unanimous.

Authentication of instruments

The validation process was done in two phases: the first phase sealed off the presentation of the questionnaires and the interview guide to the research supervisor. After a thorough inspection of this instrument, he brought in some corrections and modifications before giving his approval for them to be administered. The second phase of it consisted of doing the necessary corrections following the instructions of the research supervisor, that which was done, before they were ready to serve the purpose for which they were intended.

The data analysis technique

This work applies the survey research design which describes the extent to which the variables are interrelated. With correlation studies, the data collected is used to verify if there is a relationship between two or more variables. The Statistical Package for Social Sciences (SPSS) version 23.0 was used for data analysis. Both inferential and Descriptive statistics were used to analyse the data collected from the field with the use of questionnaires and interview guide. The descriptive data was applied using tables and chats. Concerning inferential statistics, the spearman correlation index was used to test research hypotheses. We used the statistics in order to ascertain the correlation between school environment and learner's academic performance. This description gave us the frequencies and the percentages while inferential data determined the nature of correlations and magnitudes of the relationship between the two variables.

Statistical Procedures Used

To measure the correlation between the two variables, the alpha and the standard error margin, the Spearman rank correlation index was used.

Table 5 Correlation value and interpretation

Correlation value	**Interpretation**
00	No relationship
0.01-0.19	Very low
0.2-0.39	Low
0.4-0.59	Moderate
0.6-0.79	High
0.8-0.99	Very high
1	Perfect

Source: Adapted from Chaffi (2018).

The variables of the study

A variable is a characteristic on which people differ from one another. The two main variables are the independent and dependent variables.

Independent variable

The independent variable of the study is introduction of ICT in teaching biology is the independent variable. The independent variable of a study is the presumed course of a phenomenon and also, it is known as the predictor. It is presumed that, this variable has an effect on the dependent.

The dependent variable

Dependent variables are the characteristics that are being studied when statements of hypotheses are made. The dependent variable in this study is students' competence acquisition.

Table 6 The recapitulative table of the hypotheses, variables, indicators, modalities, measurement scale and statistical test.

The General Hypothesis	The Research Hypotheses	The indicators	The modalities	The Dependent Variable	The indicators	The Measurement scale	Statistical test
Ha0: There is no relationship between the application of ICT in teaching Biology and learner's competence acquisition in some secondary schools in Mfoundi division	**Ha1:** There is a relationship between ICT teaching materials and learner's competence acquisition in some secondary schools in ,Mfoundi division	ICT teaching materials	printers, computers, laptops, tablets, etc., to software tools such as Google Meet, Google Spreadsheets.	Competence acquisition	Ability to apply the process of science - use quantitative reasoning -use modeling and simulation	4-points Likert scale	Pearson correlation
	Ha2: there is a relationship between teacher's ICT skills and learner's competence acquisition in some	teacher's ICT skills	Understanding the role of ICT in education policy, Application of digital skills,	Competence acquisition	Ability to apply the process of science - use quantitative reasoning -use modeling and simulation	4-points Likert scale	Pearson correlation

secondary schools in Mfoundi division	digital library	Digital archives, institutional repositories, national library collection,		4-points Likert scale	Pearson correlation
Ha3: There is a relationship between digital library and learner's competence acquisition in some secondary schools in Mfoundi.					
Ha4: There is a relationship between computer assisted instruction and learner's competence acquisition in some secondary schools in Mfoundi division	Computer assisted instruction	Adopt, Online, via zoom, lecture, projector, computer			

Source: This study (2023).

Conclusion This chapter presents the areas of the study, research design, population, instruments, validity and reliability and the dada analysis technique. This chapter presents the methodology that enables us conduct this research. It ushers us to chapter four.

CHAPTER FOUR

PRESENTATION OF RESULTS AND DATA ANALYSIS

This section presents the different results of our analysis. We will first of all present the descriptive statistics results, then, we are going to test our research hypothesis to see if there is a relationship between the variables of our study.

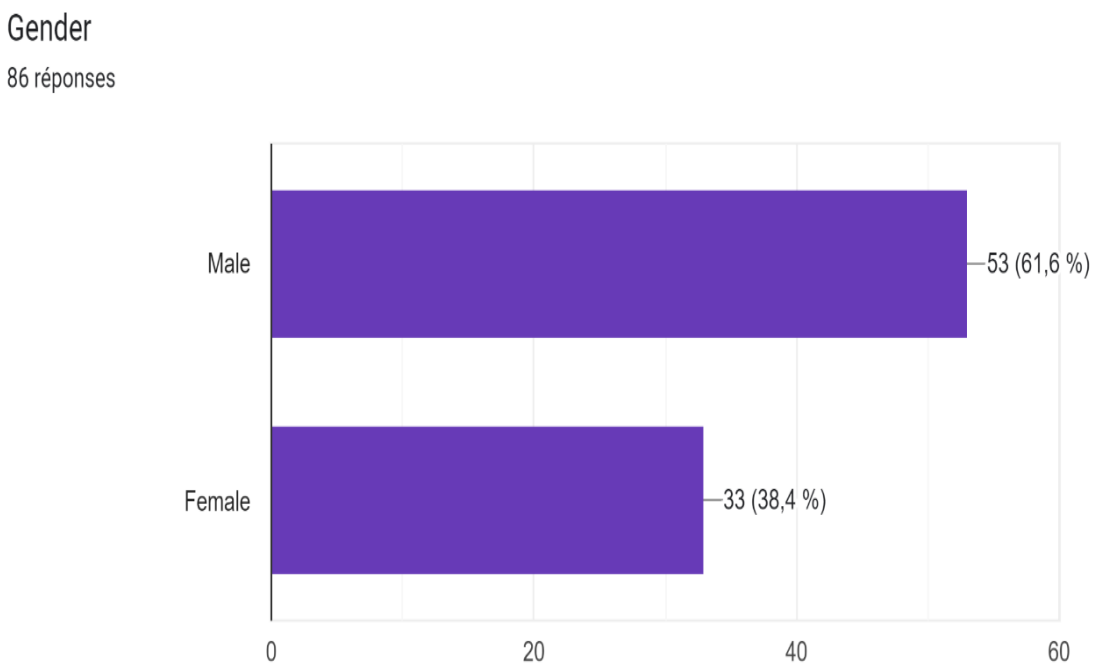
DESCRIPTIVE STATISTICS

Socio demographics information

Over the 86 biology secondary teachers who responded to the questionnaire, 53 are males (61,6%) and 33 are females (38,4%) as presented in the following table.

Presentation of Respondents' Personal Information

Figure 4 Percentage of respondents by Gender

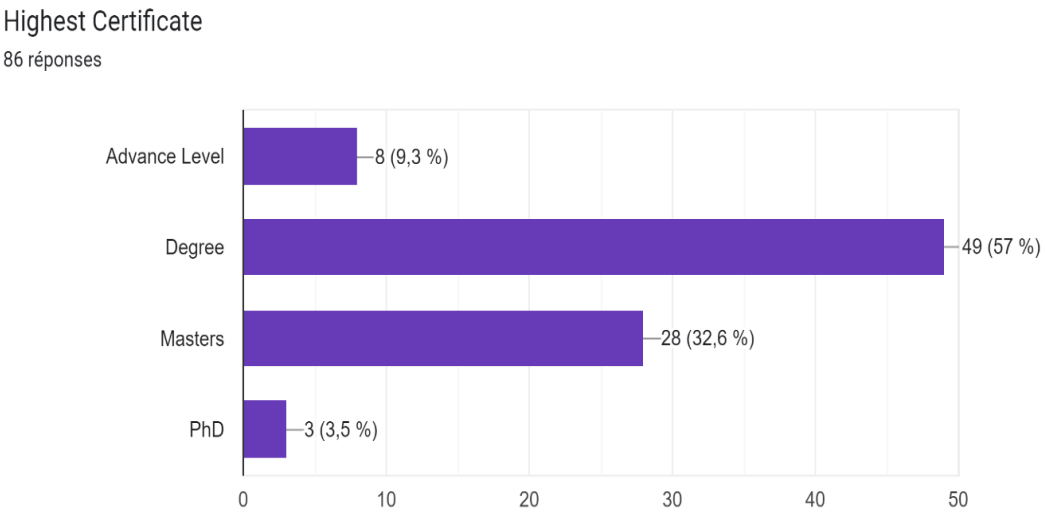


Source: Data from the field (2023)

According to this figure 4 above, 53 participants who participated in the study were male, making a percentage of 61.6%, and 33 participants were females, making a 33ss%. This gave a total of 86 participants, giving 100 percent participation of the sample size. Looking at the data, there are more male than female biology teachers in Mfoundi division,

we decided to find out why the difference on this study. according to the school administration, science subjects are mostly done by men that is why more men participated then female.

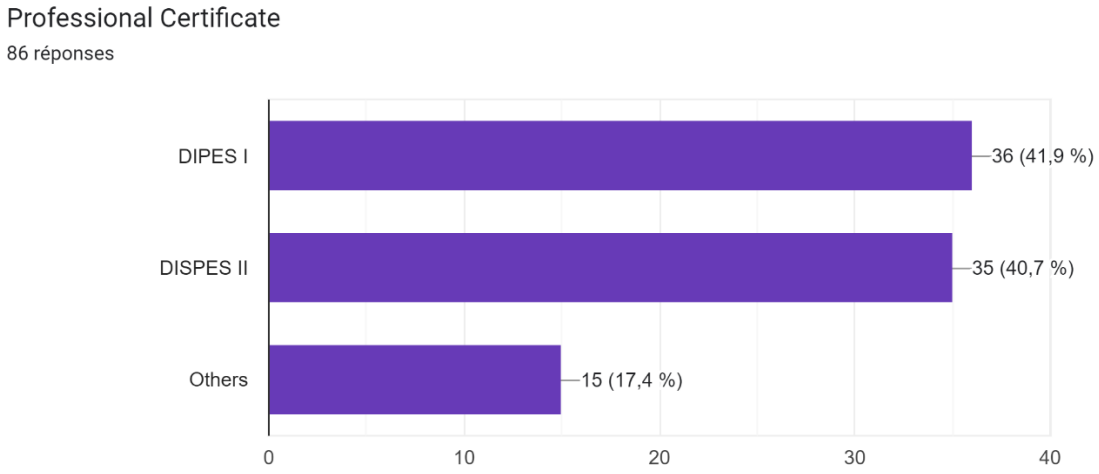
Figure 5 Percentage of Respondents by Qualification



Source: Data from the field (2023)

According to figure 5 above, 8 teachers are advanced level holders (9.3%), 49 teachers are teaching with a degree (57%), 28 teachers are masters degree holders (32,6%) and 3 are PhD holders (3.5%)

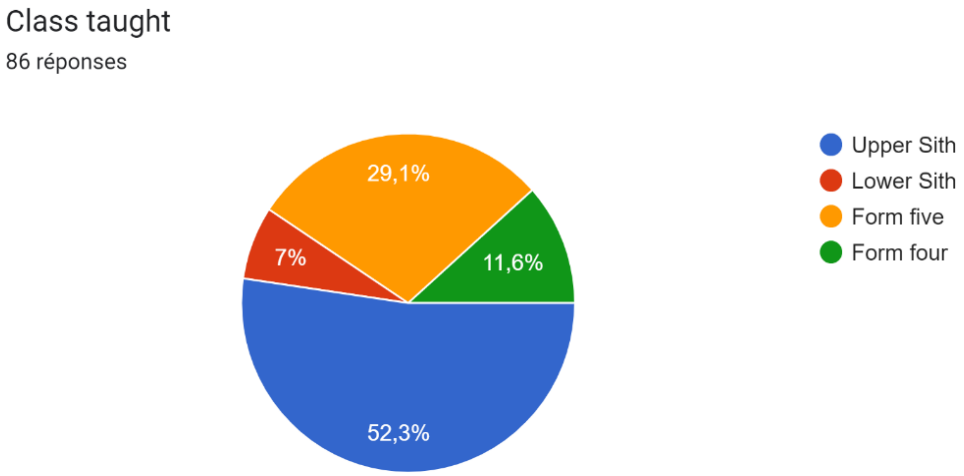
Figure 6 Percentage of respondents according to professional certificate



Source: Data from the field (2023)

According to figure 6, biology teachers teaching with DIPES I are 36, representing (41,9%), 35 are teaching with DIPES II, representing 40,7% and 15 are teaching with other certificates (17,4%).

Figure 7 Percentages of classes taught by respondents



Source: Data from the field (2023)

The results of figure 7 above reveals that 52% of biology teachers are teaching in Upper sixth, 29,1% are teaching in form five, 11,6 % teach in form four and 7% teach in lower sixth.

Presentation of the results according to the different modalities of the questionnaire

In analysing table 7, the mean value greater than 3 is considered high impact of ICT while teaching Biology, and a mean value less than 3 is considered low impact of ICT while teaching biology given the fact that we are using a 4 Likert scale analysis

Table 7 Research hypothesis 1: Teaching materials

Descriptive Statistics

Items	SD	D	A	SA	Mean	Sdt deviation
1 I project all my biology lessons in the class for my students	31 (36%)	39 (45,3%)	12 (14%)	0 (0%)	1,8721	,82314
2. I have my personal computer which I use in class when teaching	20 (23,3%)	31 (36%)	24 (27,9%)	11 (12,8%)	2,3023	,97099
3. I sometimes organize video conferencing and use to teach my students	26 (30,2%)	33 (38,4%)	20 (23,3%)	7 (8,1%)	2,0930	,92835
4. My classrooms are design such that I use ICT tools during teaching	37 (43%)	31 (36%)	14 (16,3%)	4 (4,7%)	1,8256	,87032
5. I use my phone in class to send notes to student's devices	22 (25,6%)	36 (41,9%)	24 (27,9%)	4 (4,7%)	2,1163	,84601
Over all Mean					2,0418	,88776

Source: Data from the field (2023)

Table 9 above shows that the overall Mean of teaching materials on competence acquisition is low (M=2.0418, SD=.88776). Among the 5 items that were designed to measure the influence of teaching materials, none of the elements has a mean of 3 which is the cut-off mean. This shows that the influence of teaching materials is low partly due to the lack of ICT teaching materials in some schools.

Table 8 Research hypothesis 2: Teacher's ICT skills

Descriptive Statistics

	SD	D	A	SA	Mean	Std deviation
10. I have mastery of word processing which I use to write my lessons	6 (7%)	21 (24,4%)	41 (47,7%)	18 (20,9%)	2,8256	,84285
11. I always use spread sheet to present my notes and diagrams to learners	17 (19,8%)	40 (46,5%)	22 (25,6%)	7 (8,1%)	2,2209	,85956
12. I am able to create and use all electronic presentations when teaching	15 (17,4%)	42 (48,8%)	20 (23,3%)	9 (10,5%)	2,2674	,87346
13. I have the ability to use computer and all ICT tools during teaching	14 (16,3%)	28 (32,6%)	33 (38,4%)	11 (12,8%)	2,4767	,91686
14. I have understood web navigation (online search) and always use it to modify my notes and thus teaching	8 (9,3%)	14 (16,3%)	42 (48,8%)	22 26,6%)	2,9070	,88952
Over all Mean					2,5395	,87645

Source: Data from the field (2023)

Table 8 above shows that the overall Mean of teacher's ICT skills on competence acquisition is low (M=2.5395, SD=.87645). Among the 5 items that were designed to measure the influence of teacher's ICT skills, none of the elements has a mean of 3 which is the cut-off mean. This shows that the influence of teacher's ICT skills is low partly due to the lack of training of some biology teachers.

Table 9 Research hypothesis 3: Multimedia library

Descriptive Statistics

	SD	D	A	SA	Mean	Std deviation
15. My school has an updated library where I usually get physical books to prepare my lessons	19 (22,1%)	33 (38,4%)	26 (30,2%)	8 (9,3%)	2,2674	,91297
16. I also have access to document from my school library online which help me to prepare my lesson	38 (44,2%)	35 (40,7%)	9 (10,5%)	4 (4,7%)	1,7558	,82514
17. I have physical devices like DVD that helps to save notes and question for other use.	21 (24,4%)	29 (33,7%)	28 (32,6%)	8 (9,3%)	2,2674	,93839
18. In my school library, each student has access to notes and other data using a single password	39 (45,3%)	40 (46,5%)	6 (7%)	1 (1,2%)	1,6395	,66709
19. My school library has free and highly performant internet service which I constantly use to access material for lessons	47 (54,7%)	24 (27,9%)	12 (14%)	3 (3,5%)	1,6628	,84867
Over all Mean					1,9185	,83755

Source: Data from the field (2023)

Table 9 above shows that the overall Mean of multimedia library on competence acquisition is low (M=1,9185, SD=.83755). Among the 5 items that were designed to measure the influence of multimedia library, none of the elements has a mean of 3 which is the cut-off mean. This shows that the influence of multimedia library is low partly due to the lack multimedia library in some schools.

Table 10 Research hypothesis 4: Computer assisted instructions

Descriptive Statistics

Items	SD	D	A	SA	Mean	Std Deviation
6. I turn my teaching into problem oriented to ease students understanding	1 (1,2%)	5 (5,8%)	53 (61,6%)	27 (31,4%)	3,2326	,60730
7. I start my lessons by giving learners a task to resolve at the end of the lesson	1 (1,2%)	18 (20,9%)	51 (59,3%)	16 (18,6%)	2,9535	,66699
8. My teaching is application-oriented students learn to apply skills immediately	22 (25,6%)	56 (65,1%)	0 (0%)	8 (9,3%)	2,8372	,57108
9. I usually blend my teaching method, i.e using traditional explanatory method and modern ICT teaching method at the same time to facilitate learning.	3 (3,5%)	17 (19,8%)	49 (57%)	17 (19,8%)	2,9302	,73229
Over all Mean					2,9883	0,64441

Source: Data from the field (2023)

Table 10 above shows that the overall Mean of computer assisted instructions on competence acquisition is low (M=2.9883, SD=.64441). Among the 4 items that were designed to measure the influence of computer assisted instructions, only item 6 has a mean of 3 which is the cut-off mean, the others items are lower than 3. This shows that the influence of computer assisted instructions is low partly due to the lack of mastering teaching methods using ICT by certain biology teachers.

Table 11 Competence acquisition

Descriptive Statistics

	SD	D	A	SA	Mean	Std deviation
20. Through ICT methods, students quickly develop knowledge and experiences in biology	6 (7%)	8 (9,3%)	54 (62,8%)	18 (20,9%)	2,9767	,76661
21. Through ICT methods, students have developed the ability to design good diagrams in biology	10 (11,6%)	30 (34,9%)	38 (44,2%)	8 (9,3%)	2,5116	,82240
22. The multimedia library helps students to have access to all information and facilitate competence acquisition	11 (12,8%)	21 (24,4%)	42 (48,8%)	12 (14%)	2,6395	,88001
23. ICT tools are easy to use and demonstrate lessons that enhance student's competence acquisition	0 (0%)	13 (15,1%)	50 (58,1%)	23 (26,7%)	3,1163	,64019
Over all Mean	86				2,2488	,77717

Source: Data from the field (2023)

Table 11 above shows that the overall Mean of competence acquisition is low (M=2.2488, SD=.77717). Among the 4 items that were designed to measure if learners have acquired competences, only item 23 has a mean of 3 which is the cut-off mean, the mean of the others items is lower than 3. This shows that competence acquisition is low partly due to the fact that some learners didn't learn well with ICT tools.

HYPOTHESIS TESTING

In this section of the work, we are going to analyse if there is a relationship between the different modalities of the study and the dependent variable by proceeding with hypothesis testing. The two variables of the study are: teaching of Biology for the independent variable and learner's competence acquisition for the dependent variable. The Pearson Moment correlation has been used and it's important to remember some assumptions of this test. The correlation coefficient value is noted ***(r***) and this varies from -1 to 1 where:

-1: indicates a perfect negative correlation among the two variables

0: indicates that there is no relationship between the two variables

1: indicates a perfect positive correlation between the two variables

Furthermore, to determine the p value associated to the correlation coefficient, we calculate a t value using the following formula.

$$t = \frac{r}{\sqrt{(1 - r^2)/(N - 2)}}$$

To verify the existence of a link or not between teaching of Biology and learner's competence acquisition, let's formulate the hypothesis of the study.

H0: There is no relationship between the application of information and communication technology (ICT) in the teaching of Biology

Ha: There is a relationship between the application of information and communication technology (ICT) in the teaching of Biology

Verification of Research Hypotheses.

Research hypothesis 1: ICT teaching materials

HR1: ICT Teaching materials have a significant impact on the development of competences

Ha: There is a strong correlation between ICT teaching materials and the development of competences

Ho: There is a weak correlation between ICT teaching materials and the development of competences

Table 12 Correlation between teaching materials and competence acquisition

Correlations

		TEACHING MATERIALS	COMPETENCE AQCUISITION
TEACHING MATERIALS	Pearson Correlation	1	,265*
	Sig. (2-tailed)		,014
	N	86	86
COMPETENCE AQCUISITION	Pearson Correlation	,265*	1
	Sig. (2-tailed)	,014	
	N	86	86

*. Correlation is significant at level 0,05 (2-tailed).

Table 12 above presents the data of the first modality of our research. It establishes the correlation that exist between teaching materials and competence acquisition. According to the results, there is a positive moderate correlation between teaching materials and competence acquisition. Also, the result of the Pearson moment correlation is the following: **(r=0,265, p= 0,014 <0,05)**. We reject the null hypothesis and validate the alternative hypothesis due to the fact that the Pearson correlation is statistically significant and lower than 0.05

Research hypothesis 2: Teachers ICT skills

HR3: There is a significant relationship between teachers ICT skills and the development of competences

H0: There is a weak correlation between teachers ICT skills and learner's competences development

Ha: There is a strong correlation between teachers ICT skills and learner's competences development**.**

Table 13 Correlation between teachers ICT skills and competence acquisition

Correlations

		TEACHEARS ICT SKILLS	COMPETENCE AQCUISITION
TEACHERS ICT SKILLS	Pearson Correlation	1	,143*
	Sig. (2-tailed)		,191
	N	86	86
COMPETENCE AQCUISITION	Pearson Correlation	,143*	1
	Sig. (2-tailed)	,191	
	N	86	86

*. Correlation is significant at level 0,05 (2-tailed).

Table 13 above present the data of the second modality of our research. It establishes the correlation that exist between biology teachers ICT skills and competence acquisition. According to the results, there is no correlation between biology teachers ICT skills and competence acquisition. Also, the result of the Pearson moment correlation is the following: **(r=0,143, p= 0,191 >0,05)**. We reject the alternative hypothesis and validate the null hypothesis due to the fact that the Pearson correlation is not statistically significant and greater than 0.05. An addition to this result is that some of the biology teachers don't have good ICT skills in teaching biology.

Research hypothesis 3: Multimedia Library

There is a significant relationship between multimedia library and learners competences development

H0: There is a weak correlation between multimedia library and learner's competences development

Ha: There is a strong correlation between multimedia library and learner's competence development

Research hypothesis 4: Computer assisted instructions:

HR4: There is a significant relationship between computer assisted instructions and the development of competences

H0: There is a weak correlation between computer assisted instructions and the development of competences

Ha: There is a strong correlation between computer assisted instructions and the development of competences.

Table 14 Correlation between computer assisted instructions and competence acquisition

Correlations

		COMPUTER ASSISTED INSTRUCTIONS	COMPETENCE AQCUISITION
COMPUTER ASSISTED I	Pearson Correlation	1	,281*
	Sig. (2-tailed)		,009
	N	86	86
COMPETENCE AQCUISITION	Pearson Correlation	,281*	1
	Sig. (2-tailed)	,009	
	N	86	86

*. Correlation is significant at level 0,05 (2-tailed).

Table 14 above presents the data of the fourth modality of our research. It establishes the correlation that exist between computer assisted instructions and competence acquisition. According to the results, there is a positive moderate correlation between computer assisted instructions and competence acquisition. Also, the result of the Pearson moment correlation is the following: **(r=0,281, p= 0,009 <0,05)**. We reject the null hypothesis and validate the alternative hypothesis due to the fact that the Pearson correlation is statistically significant and lower than 0.05.

Table 15 Correlation between multimedia library and competence acquisition

Correlations

		MULTIMEDIA LIBRARY	COMPETENCE AQCUISITION
MULTIMEDIA LIBRARY	Pearson Correlation	1	,361*
	Sig. (2-tailed)		,001
	N	86	86
COMPETENCE AQCUISITION	Pearson Correlation	,361*	1
	Sig. (2-tailed)	,001	
	N	86	86

*. Correlation is significant at level 0,05 (2-tailed).

Table 15 above present the data of the third modality of our research. It establishes the correlation that exist between multimedia library and competence acquisition. According to the results, there is a positive moderate correlation between multimedia library and

competence acquisition. Also, the result of the Pearson moment correlation is the following: **(r=0,361, p= 0,001 <0,05)**. We reject the null hypothesis and validate the alternative hypothesis due to the fact that the Pearson correlation is statistically significant and lower than 0.05.

Let's now summarize the findings in a table

Table 16 Summary of the correlations and decisions

Hypothesis	**Correlation coefficient**	**Significance**	**Decision**
RH1	,265	.014	Ho rejected Ha retained
RH2	,143*	.191	Ho retained Ha rejected
RH3	,361**	0.001	Ho rejected
RH4	,281	.009	Ho rejected Ha retained

According to table 16 Research hypothesis number 1,3 and 4 have been retained, only research hypothesis 4 has been rejected. That means some teachers still lack the competence of teaching using ICT tools.

CHAPTER FIVE

DISCUSSION OF FINDINGS, RECOMMENDATIONS AND PROPOSALS FOR FURTHER STUDIES

This section is based on the description of each hypothesis based on findings which is backed by the views of other authors with respect to the relevant theories and the researcher's perception. The findings shall gain grounds based on results from research instruments.

Summary of the Findings

This study was conducted to examine the influence of the application of ICT in teaching Biology and learner's competence acquisition in some secondary schools in Mfoundi Division. Four research hypotheses were drawn which help to guide this research work. After the analysis, all the four research hypotheses were validated and are presented as follows:

RHa1: There is a strong correlation between ICT Teaching Materials in Biology and Competences development in some secondary schools in Mfoundi. Division

RHa2: There is a significant relationship between teachers ICT skills in Biology and Learners' Competences development in some secondary schools in Mfoundi Division

RHa3: There is a significant relationship between multimedia library in Biology and the development of competences in some secondary schools in Mfoundi Division.

RHa4: There is a significant relationship between computer assisted instructions in Biology and the development of competences in some secondary schools in Mfoundi division.

Presentation of findings on frequencies and tables

Discussion of Findings according to the Demographic information

During the field work, the researcher found out that there were more male than female teachers who participated in the study. According to figure 4, 53 participants who participated in the study were male, making a percentage of 61.6%, and 33 participants were females, making a 38.4%. Giving a total of 86 participants and 100 percent participation of the sample size. Looking at the data, more 20 male teachers participated in the study than female, given that there are more female than male teachers in Cameroon, we decided to find out why the difference on this study. According to the school administration, science subjects

are mostly done by men that is why more men participated then female. Some principals told us that most women are into ARTS subjects like Languages and Literature.

Moreover, we examine figure 5 titled highest certificate. According to this figure, 8 participants had advance level, making 9.3%, 49 had bachelor's degree, making 57%, 28 participants had master's degree making 32.6% and 3 had a doctorate degree, making 03.5%. These make up 86 participants, therefore 100% participation. About 28 chemistry teachers had master's degree and were teaching in secondary schools. This was very significant in the study as it indicates that the participants understood the study very well before presenting their responses. Many participants, especially the individual with a doctorate degree had much to recommend during the field work. And they are also expecting feedback to help them enhance their application of ICT in teaching chemistry.

The teachers were further questioned on their professional certification. Looking at figure 6, titled professional certificate, 36 participants had DIPES I certificate making 41.9%, 35 participants had DIPES 2 certificate, making 40.7% and 15 participants had other certificates, making 17.4 % participation. These make up 86 participants and therefore, 100% participation of the sample size. The strength of the chemistry teachers who participated in the study convinced the research team that they mastered their field or expertise. More than 50% of the participants had graduates ENS level and most with DIPESS II certificate. This implies that they have mastery of their work.

The research also examined the classes they taught so far from the day they got posted. Figure 7 is titled classes taught. According to table 9,52 % of Biology teachers are teaching in upper sixth, 7 percent teach in lower sixth, 29.1% are teaching in form five while 11.6 percent are teaching in form four. All these make up 86 participants and a 100% participation by the sample. This indicates that all the participants have been teaching effectively and were still teaching during the period of the study. It enabled the participants to give the exact fresh knowledge or responses according to their day-to-day experiences. Therefore, the above demographic background of the participants gave these findings a strong base making the findings could be convincing and trust worthy.

Table 17 Presentation of summary discussion of findings

Variable	Indicator	Hypothesis	Confirmation of findings from the questionnaire	Relevant theory
There is no relationship between the application of ICT in teaching Biology and competence development in some secondary schools in Mfoundi division.	ICT teaching materials	Ha1: There is a relationship between ICT teaching materials and the development of competence in some secondary schools in Mfoundi Division.	Ha retained and Ho rejected. There is a significant relationship	Social learning theory by Albert Bandura (1977)
	Teachers' ICT skills	Ha2: There is no relationship between teachers ICT skills and the development of competence in some secondary schools in Mfoundi Division.	Ho retained and Ha rejected. There is a significant relationship	Constructivism by Jean Piaget (1896-1980) and TPACK model
	Digital library	Ha3: There is a relationship between digital library and the development of competence in some secondary schools in Mfoundi division.	Ha retained and Ho rejected. There is a significant relationship	Constructivism by Jean Piaget (1896-1980).
	Computer assisted instruction	Ha4: There is a relationship between computer assisted instructions and the development of competence in some secondary schools in Mfoundi Division	Ha retained and Ho rejected. There is a significant relationship	TPACK model by Mishra and Koehler and constrictivism by Jean Piaget 1896 to 1980/

Source: Researcher (2023).

Discussion Of Findings

The influence of ICT teaching materials in teaching Biology and the development of competence in some secondary schools in Mfoundi Division.

The first objective sought to find out the influence of ICT teaching materials in teaching Biology and the development of competence in some secondary schools. After the data analysis, Ha was confirmed while Ho was rejected. According to the correlation table 18 the Pearson correlation value $r = 0.265$, which indicates a moderate correlation between ICT Teaching Materials and Learners' Competences development. This is equally based on the fact that the level of significance is 0.013 which is largely less than 0.05, (alpha) which is the standard error margin: $r = 0.265$, $P = 0.014 \leq 0{,}05$. The correlation falls within the range of a strong correlation since it is high and moves towards 1. This permits us to confirm Ha: There is a strong correlation between ICT Teaching Materials and Learners' Competences development, while Ho is rejected. Thus, at an error margin of 5%, HR1 is confirmed. Therefore, the unsatisfying Learners' Competences development event observed is strongly blamed on ICT Teaching Materials. This implies that the relative lack of competences among secondary schools' leavers experience in the Mfoundi Division communities as one of the causes is as a result of the lack of digital teaching material for teachers use in secondary schools.

Based on the above findings, we affirm that ICT teaching material significantly influenced learner's competence acquisition in Biology. The finding is positive and however does not occur in isolation, many earlier researchers have conducted studies and also confirm; for instance, a study conducted by Simin et al. (2006) has related findings. According to them, in this digital era, ICT use in the classroom is important for giving students opportunities to learn and apply the required 21st century competences. Hence studying the issues and challenges related to ICT use in teaching and learning can assist teachers in overcoming the obstacles and become successful technology users. Anne (2004) presents the rationale that motivates the study in an ongoing three-year project following students in school years 8 to 10. The aim is to develop the students' competence with use of ICT tools in Biology in such a way that they will be able to choose tools for themselves, not rely just on the teacher telling them what to use for a specific task. Olayinka (2016). The aim of this paper is to highlight the contribution of instructional materials to the academic achievement of secondary school students in Social Studies in Ekiti State. The study concluded that students who were taught with instructional materials performed better than those taught

without. The study therefore recommended that teachers of Social Studies should employ the use of essential instructional materials for their teaching and also improvise where and when the materials are not available.

The theory that explains this finding was social learning theory by Albert Bandura (1977) In the Social Learning Theory, Albert Bandura (1977) stated that behaviour is learned from the environment through the process of observational learning. This theory is based on the idea that we learn from our interactions with others people and things in a social context. Separately, by observing the behaviours of others, people develop similar behaviours. After observing the behaviour of others, people assimilate and imitate that behaviour, especially if their observational experiences are positive ones or include rewards related to the observed behaviour. The observation process in class is enhanced by the used of ICT didactic material employ to demonstrate and edify understanding of reasons for which things occur differently and why people behave differently. The findings connote that the application of the ICT teaching material positively influence learner's competence development which implies the learners from secondary schools could be short of competences if theses ICT tools are not properly used in the 21st century.

The present situation of Cameroon society presents a decry of the youths and parents on the emptiness and inability of secondary school graduates to exploit its competences and skills to makes changes in the community. They cannot even provide for themselves because the job market keeps rejecting them from their different specialties. This has increasingly brought forth high dependency ration on parents, it has lured most youths into illegal practices for survival and has thereby affecting the country's gross domestic product and economic growth. The undulating struggle is how could education become an antidote to the prevailing situation in Cameroon community.

The influence of teacher's ICT skills on teaching Biology and competences development in some secondary schools in Mfoundi division.

The second objective sought to find out the influence of teacher's ICT skills on teaching Biology and competences development in some secondary schools in Mfoundi division.

After the data analysis, it was realised that the Pearson correlation value r = 0.143, which indicates a very low correlation between Teachers ICT Skills and Learners' Competences development. This is equally based on the fact that the level of significance is 0.191 which is largely more than 0.05, (alpha) which is the standard error margin: r = 0.143, P= 0.191 > 0,05. The correlation falls within the range of a very low correlation since its low and moves

towards 0. This permits us to confirm H0: There is a no correlation between Teachers ICT Skills and Learners' Competences development, while Ha is rejected. This permits us to accepts that teachers' ICT skills could positively influence the way learners acquire competences but the fact that most teachers lack ICT skills greatly affect learners competence development.

This finding was positive, yet not in isolation. This is based on the fact that other earlier researchers have equally conducted studies in this field and have realised closely the same findings. A case in point is Enu et al. (2018). According to this study, the integration of ICT into pedagogical practices will seriously be compromised if teachers possess little or no knowledge of ICT. This paper reports on a study which sought to explore basic school teachers' ICT skills and ICT usage in the classroom. However, there was a little digression on the course of the study as the researcher focused more on the state of integration of ICT in classroom teaching by the teachers. In terms of ICT integration in classroom lessons, it was found that, teachers hardly use technology in their lessons because of not having ICT integration skills as well as lack of resources in the schools. The study recommends the need for regular in-service training programme for teachers with a direct focus on ICT integration and ICT usage for teaching and learning by Ghana Education Service. The same applies to our reality and the observed lack of competencies by learners could partly be blamed on the lack of their teacher's ICT skills.

Moreover, Novela (2022) conducted another related study. This study determined the teachers' competency in Information and Communication Technology (ICT) in the new normal. The findings showed that most teachers could manipulate some basic ICT tools with the little skills they had. However, the crux of the issue was the relative lack of sufficient training of teachers as the most problem encountered by the teachers. Followed by lack of quality software and technical problems. Furthermore, Awouh (2019), advances in Information and Communication Technologies (ICT's) are changing the way people share, use, and process information. Overtime, students' academic performance had been used to determine excellence in teacher teaching. The findings on the academic performance of students revealed that only 7(2.2%) out of 322 students and 9(2.8%) had a mark above 80 for term 1 and term 2 respectively. Majority of the students also rated themselves as either poor or very poor in performing computer related tasks. It was recommended that teachers who do not have the required ICT qualification and practical skills in ICT usage should seek training to enable them competently and confidently use them in teaching the subject. These related studies all cantered on ICT skills of the teachers in the activation of learners' competences.

We however observe minor differences on the direct influence of the ICT skills in integrating the competences in learners to the lack of such skills by the teachers. These have the same signification as teachers are expected to possess the skills before teaching the learners.

The theory that explains this objective is Constructivism by Jean Piaget (1896-1980). Constructivism is a learning theory which holds that learning is a process of constructing meaning. Also, constructivism is seen as an approach to probe children's level of understanding and to show their level of thinking. Constructivism shows the way that learners can make sense of the materials and how the material can be taught effectively. The benefits of this theory to this study include the accelerated rate of assisted learning as well as the ability to complete the complex task independently after being assisted. As a result, whilst using social constructionism, teachers can take advantage of the group's diverse experience and skillset. Moreover, this theory leverage on the fact that students learn in groups. Especially when the teachers are guiding them with the skills in the classroom. They get to learn from him/her via exchange of ideas. We however, observed that in most deplorable cases, the teachers lack the ICT skills needed to even guide the student through the process of learner or competence development.

Teachers' ICT skills deficiently cannot be over emphasized in the present-day educational system. ICT has infested the educational system deeply that all teachers irrespective of subjects are expected to master ICT skills in order to be able to apply in their lessons. Cameroon through the ministry of secondary education in the academic year 2022/2023 launched the digital school year. This rekindles the adaptation of lessons into digital lessons and present them digitally. Although this is a beholden technique of integrating technology into Cameroon secondary schools, many teachers lack what it takes to effectively implement the digitalisation drive. The ministry has however employ pedagogic inspectors from divers fields to school the teachers in the application of digital lessons. However, these came after the launching and teachers had not had enough of the training and today, many are still in the dark as far as the digital lessons are concern. It will therefore take a longer period for all teachers to acquire the expected ICT skills and employ in the class to help students acquire competencies.

The influence of digital library in teaching Biology and learner's competence acquisition in some secondary schools in Mfoundi division.

The third objective was to find out the influence of digital library in teaching Biology and learner's competence acquisition in some secondary schools in Mfoundi division. After the analysis was done, it was found out that the Pearson correlation value r = 0.361, which indicates a low correlation between Multimedia Library and Learners' Competences Acquisition. This is equally based on the fact that the level of significance is 0.001 which is less than 0.05, (alpha) which is the standard error margin: r = 0.361, P= 0.001 ≤ 0,05. The correlation falls within the range of a low correlation since its low and moves towards 1. This permits us to confirm Ha: There is a low correlation between Multimedia Library and Learners' Competences Acquisition, while Ho is rejected. It was based on the above fact that we affirmed that multimedia library positively influenced learner competences acquisition in biology.

This finding is positive, yet does not exist in isolation. It encores on the findings presented by earlier researchers in the domain. A case in point is the study conducted by Rodrigue and Mandrekar (2020). According to this study, libraries play an important role as a reliable and beneficial information provider in the students' academic success and performance. The finding in the study showed that there is a significant and remarkable relationship between the library usage and the students' academic performance and success. The major finding of the study is to conduct the information literacy programme for the students to promote awareness about the resources, services and facilities available in the library so that the students can take maximum advantage of the benefits provided by the library. The researcher opined that one way to overcome this problem is to encourage the students to embrace using the library in their academic studies and explain its benefits. To buttress the fact, Lim et al (n.d). explains that a library is a collection of literary documents or records kept for reference or borrowing; many students regard the library as a place for researching and reading books. Many factors of library usage play an imperative part in determining students' performance at school; thus, it important to study and evaluate the impact for further understanding the relationship between the library and students.

Furthermore, Jato, samule and peter (2014). The study was on study habits, use of libraries and students' academic performance in selected secondary schools in Ondo West Local Government Area of Ondo State. Major findings of the study revealed among others that irregular use of school libraries by the students was one of the factors for poor scores in test and examination, many students did not study outside the school, and academic

performance of the students was poor in Mathematics and English Language. Based on the findings, the study recommended among others that library study hours should be included on the school time table to allow students to have a specific time to use the school library on a regular basis; school libraries should open beyond school hours to enable the students the opportunity to study after school hours, students should find suitable and comfortable places to study outside the class each day, and amount of time used by the students for study must be increased both at school library and at home in order to devote quality time to study. According to Adam and Blanford (2022, although web accessible digital libraries (DLs) have greatly increased potential information accessibility within academia, the use of these resources varies widely across disciplines. Vijeyaluxmy (2015), further affirms that academic libraries play an important role in the institutions they serve.

In the same light, Akande and Blemis (2017). The aim of this study is to evaluate the use of school library materials and services available in promoting students' academic motivation in selected Secondary Schools in Osun State. The students used the school libraries on a slightly lower frequency daily. One of the reasons for visiting the library was significantly not to browse the internet despite the fact that this is important to them and the least factor that motivates them is their experience in online activities in the library. These results presented by earlier researchers are varied in context and period. However, in all they appreciate the role of libraries in students learning which goes with the finding of our study. This makes the findings of this study relevant and convincing as it has a based on which it stands and therefore, brings in great contribution in the literature of Cameroon.

The theory that expatriates on this idea is the theory of Constructivism by Jean Piaget (1896-1980). the claim of the social constructivists is that people perceive and describe the world using language and social artefacts. They believe that the process of knowledge construction is based on the social groups and the inter-subjectivity established through their interactions with the group. In the context of this study the constructivism theory is adopted to explain the teaching process involving the use of ICT. The social constructivism could help in examining the teaching process that involves the media which has strengthened the social interaction among learners. In the connection with this study, it is agreed that social interaction today is largely on the digital tools and knowledge. The digital library has become a great avenue for students to exploit and also interact alongside with their peers and their teachers. However, most schools do not have such libraries and students do not have the chance to experience any improvement in their competences. This is why in as much as the digital library is inexistent, most secondary school still record poor results.

According to Howard (2019). A library provides physical (hard copies) or digital access (soft copies) materials, and may be a physical location or a virtual space, or both. A library's collection can include printed materials and other physical resources in many formats such as DVD, CD and cassette as well as access to information, music or other content held on bibliographic databases. A library, which may vary widely in size, may be organized for use and maintained by a public body such as a government; an institution such as a school or museum; a corporation; or a private individual. In addition to providing materials, libraries also provide the services of librarians who are trained and experts at finding, selecting, circulating and organizing information and at interpreting information needs, navigating and analyzing very large amounts of information with a variety of resources.

The Cameroon government is on the move to embrace digitalisation for all secondary schools. These efforts have been on ground for a couple of years, mostly in the ministries and has gradually been extended to the teachers and will eventually reach the learners. The process started with the introduction of computer as a common subject to all students in secondary schools, and today all teachers are expected to possess basic digital skills that permit them to deliver digital lessons. It should be noted that the efforts of the state are not completed as they keep preparing the teachers and the learners without preparing a good breathing ground for them at schools. They have totally neglected the digital libraries where students and teachers should have and live the reality of digitalisation in schools.

The effects of computer assisted instructions in biology and competence development in some secondary schools in Mfoundi division.

The fourth objective was to find out the effect of computer assisted instructions in biology and competence development in some secondary schools in Mfoundi division. After the data was analysed, the finding shows the Pearson correlation value r = 0.281, which indicates a moderate correlation between computer assisted instructions and Learners' Competences development. This is equally based on the fact that the level of significance is 0.009 which is largely less than 0.05, (alpha) which is the standard error margin: r = 0.281, P= 0.009 ≤ 0,05. The correlation falls within the range of a moderate correlation since it's moderate and moves towards 1. This permits us to confirm Ha: There is a moderate correlation between computer assisted instructions using ICT and Learners' Competences Acquisition while Ho is rejected. Thus, at an error margin of 5%, HR4 is confirmed. It is based on the above fact that we

accept that computer assisted instruction has a positive influence on learner's competence development.

This finding is positive, but does not exist in isolation. This is based on the findings presented by earlier researchers. For instance, Keshavarz et al. (2013) concluded that computer assisted instruction has a positive impact on academic achievements of students. ZarieZavaraki& Rezaei (2011) in their study at the pedagogic center in Khaje Nasir Toosi University concludes found that the use of e-learning significantly improved students' attitude, motivation and academic achievement. Mahmoodi et al. (2015) found that the use of online teaching-learning process improves students learning and creativity. Zare et al. (2015), also found that learning and recollection of students who were educated to multimedia methods, is more than learning and recollection of students who were educated in the traditional methods.

The theoretical perspective employ for this study is Constructivism by Jean Piaget (1896-1980). In the context of this study, the Piaget's ideology holds that from the way others behave or act, another person can learn from them. When the teachers uses different teaching methods to demonstrate a lesson, the learners interact with him/her and eventually register something that was formerly absent. The teaching method used in teaching in today secondary schools has evidently moved from the traditional classroom to the media. It has brought in the online learning via different platforms like google meet, zoom, WhatsApp among others. This depends on the readiness of the teachers and the students.

In this light, science students and biology students in particular are not left out, they are increasingly possessing android telephone, have excellent mastery. They access information everywhere even at the comforts of their home even with a data as low as 50frs. Unfortunately, they are not free to use these telephones in the school campus, where as it has become indispensable in other countries. In order to prepare the learners for tomorrows job market, there is a need for the systems to preview the undeniable usage of telephones and other media devices in schools, in classes during lesson. Moreover, it is envisaged that learners may turn to learn via these devices from the comforts of their homes, without the need of coming to the class everyday as it is done in developed nations. Learning strategy today has moved from taking handwritten notes of all subjects and drawing by hand from blackboard and master classes, to hardly take any notes and have a large number of references, books and documents posted on the web to consult.

If today, the student has seen no need to take notes in class giving that they are confident that at home they will have the possibility to download some perfect notes from the

web, then there is a need to plan for such realities in Cameroon secondary schools. But all the teaching staff still remain in the old traditional teacher centered method, they have to meet in large classrooms even in the midst of deadly disease (Covid-19, cough, catarrh) in order to learn. According to Jose Campo et al. (2012). If virtual classrooms are the winners then we possibly will face a future of distance learning in which classrooms as such will disappear, and teachers will summon students to virtual classrooms, such as those provided in other countries in order to conduct classes. This will allow the student to have a more flexible schedule than currently and to obtain more free time, as student will avoid having to commute to the college premises. Student will attend remotely to virtual labs and simulators.

Recommendations

To MINESEC

Based on the objectives of this stud, the researcher therefore recommends that the state should consider organising effectives digital or ICT training for the teachers. This is largely because it has been found out that ICT positively influence students learning and competency acquisition. But unfortunately, we have also seen that many teachers do not have these skills especially with the recent operation digitalisation enacted in secondary schools in 2022/2023 school year.

To the teachers

Based on the objectives of the study, we recommend that teachers should take upon themselves to learn ICT skills and effectively use them in class. ICT skills are the most influential skills in teaching today.

Suggestions for further studies

We suggest that a further study could be conducted with the same objective in the higher education in Cameroon

We also suggest that another researcher could conduct a study with the same topic on a different subject since all the teachers and different speciality are called upon to use ICT

We also recommend further research could be conducted using only the qualitative approach so that we get to unravel the teacher’s perception on ICT in teaching.

General Conclusion

The application of information and communication technology (ICT) in the teaching and learning of Biology and learner’s competence acquisition in some secondary presents an

interesting reality in the Cameroon secondary education. It holds that the use of ICT in teaching could enhance the way learners learn and acquire competencies. We however, have seen that in as much as ICT improves the learning process and competency acquisition, many Cameroonian teachers are still left wanting with the ICT skills. The idea is not tied to Cameroon alone but it cuts across sub-Saharan African countries. The recent outrage of digitalization in the world of industries and subsequently in education cannot be over emphasized. The rapid progress of information and communication technologies has been combined with different aspects of life, including its effect on education, health, research and communications. Progress and development in information and communication technology are considered as positive elements of change in secondary education, and internet and network technology are used extensively in educational fields on the Earth.

The main impact of ICT in education can be seen in improving the capabilities of instructors, changing the educational structure, creating opportunities for greater and more comprehensive learning, enhancing educational quality and improving teaching skills. In this light, the academic year 2022/2023, the ministry of secondary education in Cameroon instituted and unconditional use of digitalization in the teaching learning process. this entails, all secondary school teachers have to begin employing ICT in the teaching of respective subjects. This goes in collaboration with the already existing competency-based approach (CBA) as the pedagogic technique in use in the secondary school. This study sets to examine how the inculcation of implementation of ICT in the teaching of biology as a subject could influence the student's ability in acquiring competencies.

The introduction of ICT in almost all the sectors of our lives have created a new global economy that is powered by technology, fuelled by information and driven by knowledge (US Department of Labour, 1999). Advent of the knowledge economy and global economic competition compel governments to prioritize educational quality, lifelong learning and the provision of educational opportunities for all. It is widely accepted that access to ICT in education can help individuals to compete in a global economy by creating a skilled work force and facilitating social mobility (Wallet & Melgar, 2014). Leaving the Least Developed Countries (LDC) category towards developing country, most countries are striving to improve their education system for the knowledge era (United Nations, 2018). These Governments are aiming to turn the huge number of its potential young intelligent populace into a resourceful one, have emphasized on ICT in education by introducing 'multimedia classrooms, teacher-led content development, e-learning module, interactive digital text etc. in primary schools and secondary schools across the country.

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APPENDICES.

Appendix A: Questionnaire

RÉPUBLIQUE DU CAMEROUN
PAIX-TRAVAIL-PATRIE
****
UNIVERSITÉ DE YAOUNDE I
****
FACULTÉ DES SCIENCES DE L'EDUCATION
****
DÉPARTEMENT DE CURRICULA ET EVALUATION
******

QUESTIONNAIRE FOR TEACHERS

REPUBLIC OF CAMEROON
PEACE-WORK-FATHERLAND
****
THE UNIVERSITY OF YAOUNDE I
****
FACULTY OF EDUCATION
****
DEPARTMENT OF CURRICULUM AND EVALUATION
******

SECTION A : GENERAL INFORMATION

Dear Respondent

I am a master's student from faculty of Education of the University of Yaoundé 1, I am conducting a research to examine the application of information and communication technology (ICT) in the teaching and learning of Biology and learner's competence acquisition in some secondary schools in Yaoundé V. The answers you provide will be used strictly for this master's research and your privacy will be highly protected**. Thanks for your participation**

Informant' information

Instructions: ***kindly place a tick (√) on the box that best describes your opinion.***

1. Gender: Male ☐ Female ☐
2. Highest certificate: Advance ☐ Degree ☐ Masters ☐ PhD ☐
3. Professional certificate: DIPES I ☐ DIPES II ☐
4. Classes taught: upper sixth ☐ Lower sixth ☐ Form five ☐ Form four

SECTION B:

Instruction: Thick **(√)** in one of the boxes labeled (**SD, D, A, SA)** that best suits your opinion
KEY: SD= strongly disagree, D=disagree, A=Agree, SA= Strongly Agree

SN	I) Teaching materials / ICT tools	SD	D	A	SA
1	I project all my biology lessons in the class for my students				
2	I have my personal computer which I use in class when teaching				
3	I sometimes organize video conferencing and use to teach my students				
4	My classrooms are design such that I use ICT tools during teaching				

5	I use my phone in class to send notes to students' devices				
	Computer Assisted Instructions	**SD**	**D**	**A**	**SA**
6	I turn my teaching into problem oriented to ease students understanding				
7	I start my lessons by given learners a task to resolve at the end of the lesson				
8	My teaching is application-oriented students learn to apply skills immediately				
9	I usually blend my teaching method, using traditional at ICT at the same time to facilitate learning				
	Teachers ICT Skills	**SD**	**D**	**A**	**SA**
11	I have mastery of word processing which I use to write my lessons				
12	I always use spread sheet to present my notes and diagrams to learners				
13	I am able to create and used all electronic presentations when teaching				
14	I have the ability to use computer and all ICT tools during teaching				
15	I have understanding web navigation and have been using it to teaching.				
	Multimedia library	**SD**	**D**	**A**	**SA**
16	My school has an updated library where I usually get physical books to prepare my lessons				
17	I also have access to document from my school library online which help me to prepare my lesson				
18	I have physical devices like DVD that helps to save notes and question for other use.				
19	In my school library, each student has access to notes and other data using a single password				
20	My school library has free and highly performance internet service which I constantly use to access material for lessons				
	Competence acquisition	**SD**	**D**	**A**	**SA**
21	Through ICT methods, students quickly develop knowledge and				

	experiences in biology				
22	Through ICT methods, students have developed the ability to design good diagrams in biology				
23	The multimedia library helps students to have access to all information and facilitate competence acquisition				
24	ICT tools are easy to use and demonstrate lessons that enhance students' competence acquisition				

Thank you for your collaboration

Appendix B: 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
****
UNIVERSITY OF YAOUNDE I
****
FACULTY OF EDUCATION
****
DEPARTEMENT OF CURRILUM AND EVALUATION
****

The Dean

N° 040 /21/UY1/FSE/VDSSE

AUTHORISATION FOR RESEARCH

I the undersigned, **Professor MOUPOU Moïse,** Dean of the Faculty of Education, University of Yaoundé I, hereby certify that **BERINYUY Evangeline WIRNGO,** Matricule **19P3662,** is a student in Masters II in the Faculty of Education, Department: **Curriculum and Evaluation**, Specialty: **Curriculum Developer and Evaluator.**

The concerned is carrying out a research work in view of preparing a Master's Degree, under the supervision of **DR. KIBINKIRI Eric LEN (CC).** Her work titled: **"THE IMPACT OF INSTRUCTIONAL MATERIALS IN THE TEACHING AND LEARNING OF BIOLOGY IN SENIOR SECONDARY SCHOOLS: THE CASE OF SOME SELECTED HIGH SCHOOLS IN THE MFOUNDI DIVISION".** I would be grateful if you provide her with every information that can be helpful in the realization of her research work.

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

Done in Yaoundé 2 2021

For the Dean, by order

Le Vice-Doyen
DONGO Etienne
Professeur