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Curriculum Innovation and Effective Implementation of STEM Subjects in Government Technical Secondary Schools in Buea Municipality

A Dissertation submitted in partial fulfillment of the requirements for the award of a Masters' Degree in Curriculum Development and Evaluation

Specialty: Curriculum Developer and Evaluator

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DECLARATION

The project titled "***Curriculum Innovation and Effective Implementation of Stem Subjects in Government Technical Secondary Schools in Buea Municipality***" has been written by MBEH YVETTE (Matricule) 19Y3624.

This project is my endeavor and borrowed ideas have been acknowledged and referenced.

Signature ___________________________________

CERTIFICATION

This is to certify that the dissertation entitled ***Curriculum Innovation and Effective Implementation of Stem Subjects in Government Technical Secondary Schools in Buea Municipality*** and submitted by Mbeh Yvette is the original research project for an award of a master's in curriculum and evaluation in the department of Curriculum and Evaluation, Faculty of Education at the University of Yaoundé I. Also, it is certified that the dissertation represents an independent research work of the student and has not been submitted for an award of any other degree.

Supervisor
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Date……………………………………….

To my parents

Mr. and Mrs. Anang Zacharia

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SUMMARY

LIST OF TABLES

LIST OF FIGURES/GRAPHS

Figures

Graphs

ABBREVIATIONS

CESA: Continental Education Strategy for Africa

GESP: Growth and Employment Strategic Paper

ICTS: Information and communication technologies

MDGs: Millennium Development Goals

NDS: National development strategy

NQFs: National Qualification Frameworks

OSE: Open System Environment

RQFs: Regional Qualification Frameworks

SCT: Scientific Creativity Test

SDG: Sustainable Development Goals

STEM: Science Technology Engineering and Mathematics

STEAM: Science Technology Engineering, the Arts and Mathematics

SWSE: Sector Wide Strategy for Education

ABSTRACT

The main objective of this study is to examine the impact of curriculum innovation on effective implementation of STEM subjects (Science, Technology, Engineering and Mathematics) in government technical secondary schools in Buea municipality. The study adopted concepts such as: curriculum innovation - information and communication technologies, personalisation/personalised learning, outdoor learning, creative/innovative thinking and effective implementation of STEM subjects. The study employed diffusion innovation theory, social cognitive learning theory, experiential learning theory and national innovation system theory to explain the phenomenon. Methodological we used a quantitative approach with a survey research design. A close ended questionnaire was used as instrument of data collection. The instrument was constructed and tested following scientific procedure. With sample size of 126 respondents from two government technical school in the Buea municipality. The data was analysed using descriptive and inferential statistics- the descriptive statistics tables and graphs were used to present the data while multiple linear regression was to test the four research hypotheses. The findings revealed that, the first three hypotheses where highly predictive while the last hypothesis did not make significant contribution to model. The overall results show that curriculum innovation has significant statistical influence on the effective implementation of STEM subject in Buea municipality. We then concluded that curriculum innovation indications are indispensable elements in the effective development of STEM Curriculum in the Cameroon technical secondary education.

Key word: curriculum innovation, integration of information and communication technologies, personalisation/personalised learning, outdoor learning, creative/innovative thinking, and effective implementation of STEM subjects

RÉSUMÉ

L'objectif principal de cette étude est d'examiner l'impact de l'innovation des programmes d'études sur la mise en œuvre effective des matières STEM (Science, Technology, Engineering and Mathematics) dans les écoles secondaires techniques dominantes de la municipalité de Buea.

Méthodologiquement, nous avons utilisé une approche quantitative avec une conception par sondage, un questionnaire à réponses fermées a été utilisé comme instrument de collecte de données. L'instrument a été construire et testes en suivant une procédure scientifique. Les données ont été analysées à l'aide de statistiques descriptive et inferentielles- Les statistique descriptives, les tableaux et les graphiques ont été utilisés pour présenter les données, tandis que la régression linéaire multiple a été utilisée pour tester les quatre hypothèses de recherche. Les résultats ont révélé que les trois premières hypothèses ont été hautement productives, tandis que la dernière hypothèse n'a pas apporté de contribution significative au modelé. Les résultats globaux montrent que l'innovation dans les programmes scolaires a une influence statistique significative sur la mise en œuvre effective des disciplines STEM dans la municipalité de Buea. Nous concluons donc que les indications relative a l'innovation des programmes sont des éléments indispensables au développement efficace des programmes STEM dans l'enseignement secondaire techniques au Cameroun.

Mots clé : Innovation curriculaire, intégration des technologies de l'information et de la communication, apprentissage personnalisé, apprentissage en plein air, la pensée créative/innovante et la mise en œuvre efficace de matières STEM

CHAPTER ONE INTRODUCTION

1.1. BACKGROUND TO THE STUDY

Educational achievement and quality are driven by curriculum innovation. The implementation of the STEM curriculum in technical educational system in Cameroon is built on harnessing of information and communication technologies, personalisation learning, outdoor learning, and innovative thinking are critical in the transformation of the Cameroonian society. Curriculum innovation also requires effective professional development of the teaching and administrative staff. The effectiveness of the teaching staffs is the central human capital that its recognition and valorisation are significant in enhancing institutional competiveness and relevance. Therefore, technical education administrators in Cameroon must work to improve this area.

1.1.1. Historical background of secondary education in Cameroon

At the dawn of independence, two parts of Cameroon adopted two colonial educational systems that is Francophone subsystem in the French Cameroon in 1960 and an Anglo-Saxon sub system: in the British southern Cameroon in 1961. In the quest for the best itinerary of action to which served a means of responding to important national and international educational relevance, the Cameroonian nation opted for a continuous secondary school education curriculum and programmes that will bring the best out of both secondary education subsystems. These policy orientations were to ensure that the curriculum and programmes were built out of the realities of the Cameroon society. (Atemnge, 2021)

The reunification of the two Cameroons gave birth to the Federal Republic in 1961 which later became the United Republic of 1972 and to the Republic in 1982. These political transitions also influenced educational policies evolution. The efforts have been on-going to realize the objective of harmonising the secondary school programmes (Ngalim, 214). However, as these political processes continued to evolve the content of curriculum programmes and teaching materials incessantly deteriorated throughout the country causing a general out burse from all education various stake holders for the system to be adequately reviewed. (NUFFIC 2016)

This cause the government to organise a national Education in 1995 which all stake holders were called upon to and charged with the responsibility to make necessary proposals to government which **No table of figures entries found.** go a long way to address the awaited educational reforms. This national educational Forum met and made proposals to government addressing all aspects of the national education system (NUFFIC 2016). The recommendations made by the national Forum taken into consideration leading to the publication of the National Education Policy, embodied in the 1998 education law: Laying down the implementation guidelines for Education in Cameroon. These guidelines concerned all the sub sectors of education, but more emphasis was given to the primary and secondary sub sectors (Atemnge, 2021)

Nevertheless, the long-awaited reform leading to the new and harmonisation secondary schools' curriculum and programmes found expression within the general reform movement (GESP, 2010, pp. 4). This was a strategic document whose objectives were to transform the national economy from producing and commercialising primary products to an emergent one by 2035. The document advocated effectiveness, efficiency, and quality education. Therefore, innovation and technological development could only emerge if the necessary curriculum implementation approaches were put in place for better school system (Atemnge, 2021)

. The transformation of local primary products will add value to its products by transforming them into finished or semi-finished good before commercialisation. To this end, the new curriculum are guided by the desire to produce the human resources that will be imbued, with the required skills, knowledge, attitudes and creativity to be able to transform the society to achieve emergence by 2035 (GESP, 2010, pp. 4). Therefore, the introduction STEM curriculum is to engender this spirit of economic transformation

1.1.2. Contextual background to the study

The contextual background examines the global, regional, and national contextual of secondary education sub sector. The essence is to establish both the international and national trends that influence technical education policies across the world and place this work in the context of curriculum innovation and the implementation of STEM curriculum in Cameroon secondary education.

1.1.2.1 The global context of secondary education

Educational policies and the curriculum development or innovation have undergone grand changes since the 1990s with No table of figures entries found**.** The organization of different international conference ranging from the Justine 1990, the Dakar 2000 and the Incheon 2015 declarations. These international conferences or frameworks have reshaped the future of education systems across the world in terms of access, quality and equity, content, and teaching techniques, especially the technical education sector. These characteristic variables of global education strategies objectives help in the transformation of the global knowledge society governed innovation and disruptive technologies. Investing in technical education especially in the STEM subjects will be veritable breakthrough for the developing countries, especially integrating digital innovations into the curriculum (OECD, 2016). Therefore, Professional development of teachers' competence and knowledge in curriculum innovation is central to improve quality and ensuring better educational outcomes in the technical education system in Cameroon. This development will equally facilitate and link up the inadequacies of the secondary technical education sector in the various countries of the world to be more competitive (Wang, 2020).

The global agenda on education for sustainable development is critical wherein curriculum innovation in the educational sector across the world is continually a cycle which will maintain productivity and relevance. The integration of information and communication technologies improves teachers' effectiveness in fine-tuning pedagogic approaches and skill acquisitions especially in the implementation of STEM curriculum (SDGs 4 2015). Education in the 21st century is marked by major developmental dimensions which are relevant to contextual realities (OECD, 2016). These dimensions are building socio-economic and environmental paradigms where there is need for sustainability. Capacity building in the ICTs is important professional development strategies which help in improve teachers' creative skills in innovation and thinking which go a long way to enhance the teaching-learning processes in the STEM subjects (Ossomo & Foretia, 2013).

However, it is still a serious challenge in our technical schools today because technologies integration and innovations in the STEM subjects is still far from the reality. Education can be understood as a universal principle of human rights which the various countries of the world must ensure its universal implementation in the terms of access (enrolment), quality, equity and inclusion as given internal and external motivation for students (Wang, 2020). For these human principles to be a reality every country of the globe the government and educational institutional especially at the secondary level must determine the potential of innovations which will contributes teachers' development from the policy perspective and fields operation programmes in this direction (Alberta Education 2006). Teachers are the main human resource which forms the human capital of the educational section. Therefore, curriculum innovation is double fold that is improving on their professional competence is ensuring a sustainable development and building human capital for the new economic and promoting universal coverage that will solve the problem of inequalities (SDGs 4 2015). Technical education in Cameroon is more promising because it instills in students more practical skills which enable them to solve the daily problem of their communities (Ossomo & Foretia, 2013).

Also, the concept of lifelong learning is crucial to education for sustainable development in the sense that for teachers to be effective, they must continually improve on their teaching competences approaches and environment to enable the students to perform well. The reason is to ensure continuous lifelong learning and equal opportunities for all throughout their careers:

> SDG4-Education (2030) Aims to ensure equitable opportunities to education in a holistic and lifelong learning perspective. It aims to ensure universal pre- primary and secondary education leading to effective and relevant learning outcomes for all children, youth, and adults as a foundation for lifelong and life- wide learning. In addition, SDG4 also aims to ensure equal opportunity in access to further learning opportunities for youth and adults throughout life.

This global agenda is evident of the fact that, incentive and collaboration among education stakeholders is indispensable in improving the potential of teachers at the school level. This collaboration can help generate innovative thinking ideas and improve on the knowledge and skill transmission in the STEM curriculum. This can actually contribute greatly to local communities that are quite deplorable like in the sub–Saharan African and in Cameroon particular where there are inequalities or disparities in the provision of technical education and where there are conspicuous limitations of training due to the lack of limited resources. Provision of workshop materials and information laboratories is still a serious challenge in our content. Therefore, school administrators in technical school must work to improve this situation and learning opportunities can be improved through lifelong means of professional development in unlocking graduate employability through technical education.

In this way, effective personalisation learning can be ensured through effective and sustainable teacher professional innovation in the technical education sector as means of effective implementation of the STEM curriculum and making it relevant in our context (Williamson & Payton, 2009). This also entail the deployment of managerial and governance frameworks, in teacher training and continually development in the career path. These educational management strategies will enhance effective learning and the acquisition of relevant knowledge, skills and competencies for the 21st century. This is the main form of global agenda that will ensure prosperity. This is indicators for measuring the performance of primary education across the world (OECD, 2016).

New focus on relevance of learning is a criterion for technical education curriculum innovation in the 21st century. Question of relevant knowledge transmitted to students at various stages of the education system is always a serious challenge to school heads who struggle with policy implementation which may not be suitable to contextual reality. Therefore, SDG4-Education 2030 focuses (SDG4-Education. 2030).

Global education perspective is also based on Collaborative leaning, cooperation and partnerships, these institutional indicators that will boost innovative and critical thinking of teachers and school administration must be significantly integrated in the school system (Williamson & Payton, 2009). International Collaboration and partnership between government, non-governmental organisations, civil societies organisational and other educational stakeholders can contribute greatly to improve the quality learning and teaching approaches in the world secondary technical schools by providing infrastructures and better learning equipment that prepare students for the contemporary world challenges (OECD, 2016). This goes in line with the universal relevant agenda, SDG 4-Education 2030 which is to ensure collective commitment of all countries regardless of their level of development to improve quality education for all especially at the technical education level which is also supported by (Williamson & Payton, 2009).

> Recognition, validation, and accreditation of learning: A lifelong learning approach requires a system of recognition, validation, and accreditation (RVA) of learning and competencies acquired outside formal education and training institutions. RVA is essential for the establishment and facilitation of pathways between formal and less formal learning opportunities, as well as between education, training, and work. (SDG4-Education 2030)

This system will permit the already trained teachers to go for further studies and outdoor learning will be an innovative strategy that will better the knowledge and competences acquisition (Williamson & Payton, 2009). These studies will improve their teaching approaches and make more effective on their job. Providing these opportunities both the teaching and school management will improve the quality education, equity and productive outcome of the student and this will go a long to improve on the living conditions as well as social mobility (OECD, 2016).

The development of innovation Monitoring mechanisms can or will help improve teacher's effectiveness in the implementation of STEM curriculum in the technical education section. In

Cameroon, innovation monitoring is still ineffective in the educational section. This explains why some teachers or administrators are not committed to improving the quality and performance. Most of the technological innovations will work to enhance qualitative skills and knowledge transmission in the technical education (OECD, 2016). This disengagement by some teacher turns to affect their effectiveness in the curriculum implementation. This has serious consequences on the learners who are not taught what intent was. Consequently, falling standards in the innovation Monitoring system in STEM courses which could be a professional development strategy that can ensure quality teaching-learning processes. it will contribute to achieving the progress towards which is the commitments of the member's states to ensure sustainable education. From an equity lens it will require having access to more reliable, timely and aggregated data. It will also require strengthened capacity to analyse data on participation and learning outcomes at all levels. This involves state and non-state actor in sourcing data for planning and policy development in the technical education educational section SDG4-Education 2030

Teachers' Professional development focuses on the constant innovation of the Curriculum and teacher training: the objective of effective and relevant learning will require a continuous review of existing curricula structure; teaching and learning contents, pedagogical approaches, materials and classroom teaching practice; assessment structures; as well as teacher training and professional development. A holistic and coherent curricular approach will demand congruence between curriculum content, assessment, teacher training, as well as school leadership and management. These indicators will go long way to improve quality education (Ofsted, 2008)

> Assessment of learning outcomes: Focus on effective and relevant learning requires fairer and more balanced mechanisms for measuring and validating knowledge, skills and competencies across a broader spectrum of users and of competences and thus greater flexibility in assessment practice Focus on the effective acquisition of competencies and the relevance of learning for the world of work and civic life requires the establishment or the strengthening of national quality assurance and qualification frameworks. (SDG4-Education, 2030)

These will be effective and efficient strategies through continuous curriculum innovation in the technical education section. Education today is not education for education's sake but creating skills and competences that are ready to respond to the need of the job market or that of the economic therefore, teachers who are the guarantors of this knowledge should be professionally And innovatively equipped to transmit relevant knowledge to the students. When they fail to do so, they society has failed, and we will continue in the cycle of underdevelopment. To change the status quo, we have to improve on teacher quality through curriculum innovation. This improvement is based on professional development and consequent teachers' effectiveness in the implementation of STEM subjects which will be replicated on the need of the students (Ofsted, 2008).

Public funding for education oriented towards the deployment of resources for innovation development will enhance the quality of teaching and learning as well as the satisfaction outcome to stakeholders: This calls diversification or outsourcing new sources of funding, widening subvention schemes, preventing tax evasion, and increasing the share of the national budget allocated to technical education which can propel the materialisation of the untapped human capital skills. (SDG4-Education 2030)

Quality education can also be improving at the technical education sector through the Improvement of aid effectiveness, through harmonisation and better coordination of educational programmes and activities and creating partnership and cooperation among stakeholders: the Donors agencies can engage themselves in innovations and professional development of teachers in middle income countries by monitoring innovation growth and financing educational projects in this light. The commitment to improve teacher capacity and priorities depends on countries reality but developing countries still face a lot of challenges in this direction as there is lack of available resources both human and material to address the impending techno-innovative and entrepreneurial situation. The challenge of seeking to leverage domestic and external finance is also evident. Therefore, strategizing through diversification and positioning of educational programmes to mitigation this professional is key to the impending quality (OECD, 2016).

- **Regional context of secondary education in African**

National education vision documents in sub–Saharan Africa were mainly produced in the 1990s and early 2000s, focused on industrialisation and diversification as means to achieving middle-income status. These priorities both depend on improving STEM knowledge, which is also vital to responding to the challenges produced by climate change (Tikly, Jounet, Barret, Bainton, Cameron & Doyle, 2018). Curriculum innovation is therefore indispensable in the effective implementation of STEM, especially in the technical secondary schools.
Innovative thinking which creates avenue for education for sustainable development in African the African Union, through Agenda 2063, has responded to the SDG goals by setting

out a vision of a continent with a diversified and industrialised economy which is environmentally sustainable and has good governance (CASA, 2016). National education policies value STEM education in that it plays a significant role in developing human capital to achieve these goals and it is postulated that the general education provided at secondary level will lay the foundations for STEM education at the tertiary level (CASA, 2016). Lower secondary education is now considered to be part of the basic education that all children are entitled to, under SDG 4. In this light the curriculum that will develop system thinking competency will generate the spirit of innovation and invention the STEM fields. As such, it should be free and compulsory. In sub–Saharan African, it often takes the form of general education in which it is structured into subject disciplines that are taught differently (Tikly, Jounet, Barret, Bainton, Cameron & Doyle, 2018). This approach still lacks serious innovation orientation in terms of technologies and teaching approaches that better provide practical knowledge to students in current societal problem.

African countries are struggling to provide Students with varied ways of accessing quality and equity in technical education, but this is still confronted with a good number of challenges, for instance students who may not want to or cannot access this. There is often vocational provision (either formal or informal) which develops skills for artisan trades such as building or tailoring. Upper secondary education usually permits students to specialise, at least to some extent, and choose between academic and vocational training (Tikly, Jounet, Barret, Bainton, Cameron & Doyle, 2018). Both lower and upper secondary education is viewed as preparation for training or an apprenticeship leading into the world of work (CASA, 2016). There appears to be no real idea of STEM as a subject or disciplinary area (SWSE 2013). To achieve economic, social and environmental development, the notion of ‘sustainable work’ adopted by the United Nations is used. Here, work is about more than jobs/employment, but includes unpaid care work, voluntary work, and creative expression. STEM education has a role to play in all these areas (Tikly, Jounet, Barret, Bainton, Cameron & Doyle, 2018).

In as much as there is limited data on learning performances at the secondary education level Africa, the available data such as completion rates and examination results indicate that quality and performance is serious challenge. “*In low-income African countries, the completion rates for lower and secondary education are very low as only 29.5% and 13.9% of those accessing. The lower and upper secondary level respectively completes them.” (CASA, 2016)* The poor percentage cannot guarantee technical education as tool of education for sustainable development therefore, reflecting on critical thinking and strategic thinking as innovative approaches will provide new method for the effective implementation of STEM curriculum

The pertinence of technical secondary education remains a preoccupying situation when crossing the social reality of employability, technical and vocational training and orientation of higher education are still to inform innovative paradigms that can up economic growth as well as ensure social efficiency in more uncertain context. Math and science at this level are critical to the development of a well-equipped human capital capable of competing in increasingly science and technology driven world as well as the foundation for knowledge-based economies (CASA, 2016).

- **National context of secondary in Cameroon**

An assessment of the teacher pedagogic professional productivity at the end of each term brings serious problem at the level of teacher's competence and teaching-learning process in Cameroon. The implementation of teacher professional development policy at the school plant is still serious challenge to many school heads in Cameroon. Especially at private sector where most of the proprietors and school management run school with little or no understanding of government policy vision as it concerns professional development and teachers' effectiveness (SWSE 2013).

Technical secondary education is the third level of formal education. The duration of this cycle is seven years which substantial skills are to be developed at this level. The statutory admission is based on the success in the common entrance examination, and this is the only admission requirement, regardless of whether the child attended nursery school or not Growth and Employment Strategy Paper (GESP 2010-2020), (SWSE 2013)

In technical education government adopts economic policy that can promote strong growth, source of job and wealth-creation and as prerequisite to income redistribution and poverty reduction. Also, the Training of human capital that can respond the challenges and demands of the business and industrial community in a more holistic approach is crucial to the proponents of the STEM curriculum. This is realised through continuous professional innovation and development. Curriculum innovation in is the effective implementation of STEM will be the gateway to building competencies and knowledge that contribute to economic development.
Quality may be analysed in an initial approach via teaching and training resources made available to a school. An additional perspective considers the type of organisation and how available resources are used. However, both approaches are inadequate since some schools with

moderate means compared to others, perform better. This performance does not mean that professional development ensures teachers' effectiveness in the implementation of the STEM curriculum. There is need to build capacity, offer incentive and ensure information flow to determine quality and equity in technical education training in Cameroon (SWSE 2013)

Therefore, an assessment of resources and how these are used should be supplemented by another approach which measures learning, cognizant that whereas many itineraries may lead to the same result, the best route cannot be determined from the outset. Assessing resource should also go along with more allocation to performance at all levels. "It should also be noted that student results depend primarily on their inherent capabilities and their socio-economic and family settings. School environmental variables which we examine here are only an addition to this parameter." (GESP 2010-2020) Therefore, to boost these capacities teachers have also to be reinforced in this direction for them to have understanding on how to improve on students' autonomous learning competences (GESP 2010-2020).

Some resources used by a school may have an impact on teaching or training quality. Among factors which may influence student performance, we shall focus on those of them which officials can act upon learning environment logistics (quality of the buildings, availability of water, electricity, and latrines), availability of a school canteen and teaching tools. The table below presents some of these factors for primary and secondary school. The focus on these in neglect on the resources for the development of teacher competence is failure in the side of policymakers. The development of human resources is a key to the development of in education.

Equity Resources allocation in education is crucial to teachers' effectiveness in the technical education sector of education in Cameroon. Many schools especially in the private sector face this challenge. Government policies identify the law on orientation of education which was enacted in 1998. This law prescribes the degree of involvement of the education community in managing education to that effect, in 2001/2002, Government introduced school council. The school council supervises, advises, controls, and monitors the running of the school. These educational actors can help improve on professional innovation and development of teachers especially the STEM subjects. This development will go a long way to improve on quality teaching and learning methods and techniques. But we notice there is little involvement of community in educational management in Cameroon especially in the private school. The community seems sometimes not even to understand the role it has to play in this light in providing necessary resources that enable teachers to creative.

The purpose of schools is to transform the resources at their disposal into results for students and learners. These resources can only be effective transformed when effective professional development in terms of capacity building in resource management at the school level is assured. This is taking concrete actions and programmes that enhance efficiency in resources allocation and management. In fact, there is the lack of pedagogical management of schools yet; there are significant differences in the situations when comes to performances you will note that Some schools and training facilities with only limited resources perform well, whereas others which are allocated many resources, perform poorly. Therefore, the problems are at level of the resources allocation where some educational actors lack the competences there are necessary to ensure performance at the school plant. With the prevalence of this challenge, policymakers think that "A broad-based overhauling is needed to increase both the efficiency and efficacy of schools." They believe that to attain this, there are two avenues to be explored***:***

> social development, with the participation of relevant national structures and socio professional milieu, regarding the designing of courses and organisation of theoretical lessons, tutorials, conferences, seminars, and internships. Wishing to create a more conducive incentives-based environment, the Government will forge wider, effective, and better-organized partnerships with stakeholders and partners, including local/regional authorities, religious bodies, local communities, NGOs, businesses, private individuals and TFPs. (SWSE 2013).

These initiatives can be achieved when schools become involve in the looking of partnerships and the state follow up activities of the educational actors. Some of these educational stakeholders do have the competences that enable them to search for collaboration with others. A decentralised national structure integrating all stakeholders will facilitate the implementation of this policy.

The Government has taken the option to establish "quality core teaching covering the se cycle and the first cycle of secondary education open to the greatest number of children aged 6 to 15 years and making it possible to carry the average level of instruction along a path consistent with Cameroon's emergence by 2035."11 In fact, the demand for enrolment of adolescents aged 12 to 16 years is high and this is desirable. There are projections that this demand will grow in the coming years due to lesser technical school completion rates and high and rapid urbanisation of the country. This exponential increase in the social demand for enrolments is consistent with Cameroon's Growth and Employment Strategy (SWSE 2013). This strategy, based on industrial production, generates significant needs in terms of level of qualification that a mere completion of primary school by the greatest number can no longer satisfy; hence, the option for core teaching.

To support efforts centred on textbooks, schools and teachers will be granted core teaching aids which will be managed by school councils using procedures manual prepared for that purpose. Furthermore, textbooks will be bought on a competitive basis for the primary cycle (three books per child in reading, calculation, and science) and placed at the disposal of schools. School councils will make local arrangements for the management of these allotments. (SWSE 2013). The provision of these resources will also enhance professional development of teachers and in turn their effectiveness will increase. This effectiveness is significant in quality education pupils' performance. These will also prepare for the society where the knowledge acquired relevant to their daily situations.

Also, with the advent of information and communication technologies, there is great need for professional development in education. Teachers have to adapt their teaching approaches and method to the modern technologies. The development of distance learning at the basic level of education also demands professional development for teachers this will keep them abreast with technological innovations in education.

Pedagogic supervision structures are responsible for reawakening teaching practice to further professional development in teaching and improve the learning of pupils. Among novelties to be introduced, the following are prioritised: the use of ICTs and analysis of class practice. The government focuses on apprenticeship and on pedagogy of success that will strive to consolidate achievements and consider error as a factor of learning. Teachers must make evaluation work for learning. New practices are encouraging the learner's autonomy since he is the centre of the learning process. This is competency-based approach. But these teachers who are expected to adopt this do not actually have professional competences to guide students in the area. They expected to better prepare children for practical life, activities which focus more on problem situations, not leaving out fundamental learning. The Government struggle to equip specialized rooms (data-processing, laboratory) and mobilize for practical training (office automation, science experiments).

Building the capacities of teachers and supervisory staff focus on the use of computer hardware and digital pedagogic resources; the Promotion of new opportunities and training tools (E-learning, distance education, didactic software, etc.); the government is lagging in this area as most of the teachers have insufficient computers especially in their areas of study. The state has to step up and improve in this dimension in order to better ensure quality teaching and learning in our primary school. It also focuses on improving the learning environment in schools (multimedia centres, providing schools with computers, etc.) Setting up an operational system for preventive and curative maintenance of computers. At the level of the primary school this inexistent. Therefore, you can talk of teacher professional development in the 21st century without talking about the ICTs. The government has to improve on the provision of ICTs infrastructures at the primary sector to boost the development in teacher quality and quality education in Cameroon. This also make the Cameroonian pupil to be competitive with the global ones.

Government at the policy level ensures the actor in the sector that it will implement an effective training policy that meets institutional, collective, and individual needs. But the present challenges indicate that government's efforts are far from improving the situation on the ground. The identified weaknesses have been handled thoroughly and compiled and consolidated at school, sub-divisional inspectorate, divisional delegation, regional inspectorate, regional delegation, central services) and finally fed into a general information system to facilitate the drafting and implementation of national and devolved training plans. There is still ineffectiveness in the development of information system. This hinder information flows. Therefore, professional development cannot be effective without effect access and flow of information.

> Curriculum reform and preparation and delivery of core education will culminate in widespread upgrading. Supervisory staff (head teachers, pedagogic advisers, and inspectors) will identify training needs thanks to an ascending approach documented by field observation during pedagogic visits and class observation. This field data will inform the management of the sector. All stakeholders will work to encourage and multiply a variety of training types to broaden the training response (auto-training, presence-based, devolved training, distance learning, mentoring). Special attention will be paid to the poor (school-leavers, isolated teachers). Sector ministries will create education synergy (initial and continuing) through collective/joint management of all actors and partners to decide more consistent, complementary and efficient. (SWSE, 2013)

The need for educational relevance even at basic level needs professional development. Also, the foundation for quality in vocational training is built at the primary level. This consists forging multiple collaborative strategies and incentive mechanisms between the public authorities and actors of the productive private sector. The Government can develop partnership

Approach as a central instrument of education training policy but there are still very limited as they still far from meeting the need of the targeted pupil in real time. The Prime Minister's Office has a Partnerships Support Council (CARPA) whose mission is to support sector ministries to implement public-private partnerships. Support council help improve quality education is still a serious problem How this contribute to curriculum innovation is that Professional development of teachers at this level will ensure quality training for teachers (CEPS, 2013-2020) Cameroon 2035 development vision demands for a major redefinition of the programmes and activities assigned to educational institutions as well as the adoption of fundamental principles of governance. Institutional programmes require innovation to attain this strategic policy objective in technical education in Cameroon. Curriculum innovation is one of the major transformation mechanisms in responding to the development demands. Schools remain responsible for developing citizens, fostering individuality, economic understanding, collective responsibility, moral values, intellectual ability, political and civic understanding. All these values can be achieved through collective interaction between are stakeholders' structures for the better implementation of school programmes (Ossono & Foretia, 2013).

The development of consultation frameworks in bringing together curriculum experts from all sub-sectors of the education system will revise all the technical curricula of STEM for an effective implementation. The major objective of this review will be placed on strengthening innovative and creative thinking, citizenship and environmental education and the integration ICTs in the STEM (Solidarity and Development Initiative, 2021). The 21st century education demands knowledge, skills, and competencies in digital technologies. Promoting innovative teaching methods: stimulating pedagogical practices should be used to promote teacher professionalism and improve student learning. Teachers must receive more training in the ICTs skills. There will be a focus on the use of ICT and the analysis of class practices (Ossono & Foretia, 2013). Technological innovation can only be reality if the teachers and students from the curriculum development are provided the necessary technological tools that will boost their creativity and innovation in the respective fields.

The Expansion of the use of ICT in technical education and training programmes is imperative. Technical education and training will be modernised through the integration of ICT. The ICTs are the today's indisputable working tools. Information and communication technologies will strengthen the capacity of teachers and support staff to use computer tools and digital teaching resources; it will Promote and facilitate new opportunities and new training tools such as e-learning, distance learning, tutorials etc.; as well as Improving the teaching- learning environment in technical schools in Cameroon (Solidarity and Development Initiative, 2021).

1.1.3. Conceptual background to the study

1.1.3.1. Curriculum innovation

The idea of curriculum innovation is not new. Long before the establishment of a centrally prescribed National Curriculum, technical schools had been involved in innovating with their structures, hierarchies, and the content of their teaching" (Williamson & Payton, 2009, p. 19). Innovation has also seemed to be a transgressed work to most traditionalists who will want the norms to be maintained. However, new approaches are developed as result of innovative thinking. Curriculum innovation is crucial to STEM subjects. Industrial and technical development in the developing countries can only be achieved through technological innovation. The curriculum is key to promoting these innovative drives.

In the 1960s and 70s, for example, some teachers recognised that the formal offer made to children through a taught curriculum of academic subjects as an insufficient incentive for many. The subjects mirrored particularly strong and powerful views of the world that were related to class, gender, and ethnicity, which some young people actively resisted (Meena, 2009). Consequently, these teachers sought to engage more closely with the popular cultures, class cultures, and contextual experiences of the children in their schools" (Williamson & Payton, 2009, pp. 19) these were innovative approaches in responding to the challenges of the time. Curriculum innovation takes place in contextualised situations and engages teachers in authentic, complex teaching and learning problems (Tan, Koh, Lee, Letchmi Devi Ponnusamy, & Tan, 2017)

> Curriculum innovation means redesigning the curriculum to adapt it to current requirements. These changes may have different perspectives. In higher education, curricular innovation aims to modify one or more curricular components, through changes regarding the content of education, teaching methods, teacher-student interaction, and the organisation of activities. Curricular innovation involves reconceptualising, modernising, and optimising the university curriculum. This is referring to the organisational, methodological, and content side of the educational process (Gonta &Tripon, 2020).

In technical education in Cameroon, there is need for reconceptualization and redesigning, structuring the STEM subjects through curriculum innovation for better knowledge and skills transmission.

1.1.3.2. Integration Technologies (ICTs)

The ICTs are curriculum innovative techniques that will inform and facilitate the effective implementation of STEM in technical education in Cameroon. The aim of strategy is to create an "e-confident" system that is "intelligent and agile". This strategy will permit teachers and learners access learning resources and support at any time and from anywhere technology-supported learning helps build higher order skills for competiveness in technological engineering. Information technology helps deliver more personalised services for learners. Personalised learning in technical education development creative competencies in the students such that they generate inventions and reinvent of models and products. All students gain value including disadvantaged and vulnerable groups."(Williamson & Payton, 2009,).

The strategy stresses the place of ICT as a core tool in a modern education and skills system, with the capacity to link schools with learners' homes, to enhance personalised learning, and to contribute to flexible skills development. ICT is seen as providing the tools for both innovative professional practices in the classroom and to enhance children's innovative mind-sets." (Williamson & Payton, 2009, pp. 13)

Computers and the Internet are increasingly part of the teaching and learning environment in which young adults grow and learn. Technical education functions to create more of these technologies. Therefore, developing innovative and creative thinking abilities will through curriculum innovation can guarantee a gateway to the country's technological independent the future. Technical Schools and education systems therefore need to reap the educational benefits of information and communications technology (ICT). Co-ordinated ICT policies are common at the school, regional or national level (OECD, 2016)

Information and communication technology can support and enhance learning. With access to computers and the Internet, students can search for information and acquire knowledge beyond what is available through teachers and textbooks. ICT also provide students with new ways to practise their skills – such as maintaining a personal webpage or online publication, programming computers, talking, and listening to native speakers when learning a second language, and/or preparing a multimedia presentation, whether alone or as part of a remotely connected team. ICT devices bring together traditionally separated education media (books, writing, audio recordings, video recordings, databases, games, etc.), thus extending or integrating the range of time and places where learning can take place (Livingstone, 2011) in (OECD, 2016).

1.1.3.3. Personalisation/personalised learning

"*Taking a highly structured and responsive approach to each child's and young person's* *learning, in order that all are able to progress, achieve and participate. It means strengthening the link between learning and teaching by engaging pupils - and their parents - as partners in learning*." (Williamson & Payton, 2009, pp. 13). In terms of curriculum innovation, it suggests building "flexibility into curriculum organisation and delivery to ensure greater coherence from the pupils' perspective". The document provides a personalisation framework based on nine targeted areas for school improvement, as the boxed text on the next page shows." (Williamson & Payton, 2009, pp. 15). Innovative approaches to the curriculum at the present time have shifted some of the stress from subject knowledge to the acquisition of '21st century skills' and 'personalisation' which are seen as essential both for individuals' personal successes in learning and adult life, and for national economic development" (Williamson & Payton, 2009, p. 13).

1.1.3.4. Outdooring learning

Learning outdoors can be the educational context which encourages children and young people to make connections experientially, leading to deeper understanding within and between curriculum areas and meeting learner needs, learning and developing new technical in knowledge production (Teaching Scotland, 2010). Outdoor learning, used in a range of ways, will enrich the curriculum, and make learning fun, meaningful and relevant for students and young people. Outdoor learning can deliver sustainable development education through initiatives such as working to improve biodiversity in the school grounds, visiting the local woods, exploring and engaging with the local community and developing a school travel plan (Teaching Scotland, 2010).

With Technical education, outdoor learning will permit students to visit production industrial, engineering companies, biotechnology centres which can help to get first-hand information on their subject area. In curriculum development and innovation, Curriculum developers must work to provide outdoor learning as teaching-learning approach that will better the knowledge and competency development in learning. This approach will contribute to sustainability in technical education.

1.1.3.5. Innovative and Creative Thinking

Innovation and creativity are as old as human society. Innovation and creativity are the engines of the scientific progress which are broadening perspective and reversals of thinking (Roberta, 2015) .These concepts have receives great attention in the scholarly world give their frequency in relation to human civilisation and the social challenges (Tatiana et al, 2019). Knowledge transmission and acquisition also require a degree of innovation and creativity. There various disruptive changes in human society from agrarian, industrial and the knowledge societies are the outcomes of innovative and creative thinking (Gafour & Gafour, 2020). Curriculum innovation is all creating new patterns, methods, contents, and approaches to better implement educational policies in any one country. Technical education requires a lot of innovative and creative thinking to better invent or ameliorate processes, methods, tools and products.

Innovative thinking is the ability of a person to generate ideas, create innovative knowledge, i.e., to open their sense based on self-cognition and self-perfection. It is an innovative-strategic vector of humanitarian system of the innovative education, defining freedom of every person in his/her life of the ground of designing of innovative traditions with the peculiarity of mentality, that allows to construct an innovative paradigm of management forming its new content (Tatiana et al, 2019) In the educational sectors, innovative and creative thinking skills will help students as well as teachers to exchange and build new knowledge and competencies. (Yudha, Dafik & Yuliati, 2018) ACER (2020, p. 2) defines creative thinking as: "*the capacity to generate many different kinds of ideas, manipulate ideas in unusual ways and make unconventional connections in order to outline novel possibilities that have the potential to elegantly meet a given purpose*" (Gafour & Gafour , 2020) built on experience and knowledge, including Steve Jobs: Creativity is just concerning things. When you ask creative people how they did something, they feel a little guilty because they did not really do it, they just saw something. It seemed obvious to them after a while. That is because they were able to connect experiences they have had and synthesis new things. Moreover, the reason they were able to do that was that they had had more experiences, or they have thought more about their experiences than other people have. After that, we must understand that creative thinking is a skill we need to improve primary on.

1.1.3.6. Implementation of STEM subjects

The increasing interest and attention in science, technology, engineering, and mathematics (STEM) in global education has been the catalyst for this research. Exploring ways of curriculum innovation can better create awareness of this interdisciplinary field of study. There has been a global trend in focusing on the teaching and development of STEM education across all sectors of the education system, and this is evidenced by the geographical spread of literature in the STEM education (Jorgensen & Larkin, 2018). The initial intent of STEM education was to build strengths in science, technology, engineering, and mathematics due to the declining number of students undertaking these courses of study in high school or at university, a perceived decline in the quality of teaching, and an increased recognition that STEM is a key driver in advancing societies (see Han et al. 2015). Most countries have taken the boarder urgency to develop STEM curriculum in their education system and in their economic very seriously, with many nations developing productive strategies to boost STEM in schools and in the workplace (Jorgensen & Larkin, 2018)

STEM Education: Education in the subjects of science, technology, engineering, and mathematics, including computer science (Wang, 2020). These subjects in technical schools need curriculum innovation at the national level in Cameroon. This will give a holistic insight into the expectation of the government and the demand of the sustainable development. Industrialisation in Cameroon can only be achieved through curriculum revolutionisation (Ossono & Foretia, 2013). STEM subjects are full semester classes in science, technology, engineering, and mathematics that have a lectures, workshops, or laboratory part (Wang, 2020). This approach is still developing in Cameroon. "*STEM education, an acronym used to refer to a focus on Science, Technology, Engineering, and Mathematics encompasses a vast array of disciplines which include engineering, computer sciences, mathematical biology, physics, and robotics, among others. As evidenced in the multitude of disciplines, STEM fields affect virtually every component of everyday life"* (Ossono & Foretia, 2013, p. 5). Therefore, curriculum developers and planners in this respect must ensure innovations as an effective strategic in the implementation of STEM education in Cameroon.

1.1.4.Theoretical background

Theory is derived generally from a Greek word "theoria" which means 'a look at'. Theory is defined as a set of interrelated concepts, assumptions and generalisation that systematically explains and describes regularities in behaviour.

The theories selected for this study are diffusion of innovation, social cognitive learning theory and national innovation theory. These will help explain the curriculum innovation and the implementation of STEM subjects in Cameroon secondary schools.

1.1.4.1. Diffusion of Innovation Theory

Diffusion of innovation theory was introduced by the American sociologist Everret Rogers

1962 in his book; *Diffusion of Innovation* states that innovation is a "process by which innovation is communicated through certain channels over a period of time among the members of social system." He outlined four elements affecting the dissemination of ideas. These four elements are: a) invention b) channels of communication, c) time and d) the social system. He held that innovation diffusion depends on the human resources. The identified five categories of innovation: innovator, adaptors, innovators, early adapters, early majority, late majority, and laggard. (Naqshnandi& Singh 2015). This was one of the prolific theories of innovation, but it has its own limitations which led to the development of other models.

1.1.4.2. Social Cognitive Learning Theory

Social cognitive learning theory is an educational learning theory was developed Albert bandura in the 1989. "*Social cognitive theory favours a model of causation involving triadic reciprocal determinism. In this model of reciprocal causation, behaviour, cognition and other personal factors, and environmental influences all operate as interacting determinants that influence each other bidirectionally*" (Bandura, 1989, p. 2). The major principles of this theory as postulated by Bandura are: Symbolizing Capability, Vicarious Capability, Forethought Capability, Self-Regulatory Capabilities and Self-Reflective Capability. This theory since the last decades of the 20^{th} century and the early decades of the 21st century has been used by educational sciences, especially in teaching and learning. This theory has a great deal to influence curriculum innovation and implementation in the 21^{st} century. School system mark rapid technological development and innovations which demands a more holistic approaches to teaching learning (Bandura, 2002). This theory can better explain personalised learning in STEM subjects as innovative strategy in curriculum implementation.

1.1.4.3. National Innovation System Theory

National innovation theory is a multi-model theory of economic development which has received great scholarly attention over the years, theory was developed the in the 1980s. In OECD (1997) national innovation system has perceived by different authors in different ways. "The *network of institutions in the public and private sectors, whose activities and interactions initiate, import, modify and diffuse new technologies*." (Freeman, 1987) • cited in (OECD 1997). This author sees the system at the interactions of institutions in the diffusion of technologies. This technological diffusion is defined in clears, but the most important interactions is the dissemination of innovation.

National innovation system is also seen as “. *The elements and relationships which interact in the production, diffusion, and use of new, and economically useful, knowledge ... and are either located within or rooted inside the borders of a nation state.”* (Lundvall, 1992) • cited in (OECD 1997, p. 2) this definition goes ahead to support Freeman 1987) view by insisting on production diffusion which are grounded in the nation system. This explains an internal innovation system of innovation “*... a set of institutions whose interactions determine the innovative performance ... of national firms*.” (Nelson, 1993) • cited in (OECD 1997, p.2) this view emphasises on the performance of innovation system. The effective implementation of the STEM subjects in technical schools demands an effective development of national innovation system that permit students to be performant. “ *.. the national institutions, their incentive structures, and their competencies, that determine the rate and direction of technological learning (or the volume and composition of change generating activities) in a country*.” (Patel and Pavitt, 1994) • cited in (OECD 1997, p.2). This perspective of national innovation system for incentive structure and competencies in ensure technological learning. This implies that curriculum innovation in technical education must consider the innovation system landscape of the country in relation to its implementation “*That set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies, and which provides the framework within which governments form and implement policies to influence the innovation process*.” (Metcalfe, 1995) cited in (OECD 1997, p. 2). National innovation system is an interconnection of structures the boost innovation processes. STEM subjects is a an innovative and technological orientated learning and teaching in secondary schools can be inspired from the national innovation system theory approach to curriculum innovation impact on implementation of the curriculum in technical secondary schools.

1.2. RESEARCH PROBLEM AND HYPOTHESIS

The policy orientations demand in education at all sectors a continuous curriculum innovation for effective transmission of knowledge, skills, and competences to the students at all levels of levels of the education, specifically in the technical education. A special attention must be given so to build these competences and knowledge are replicated in the countries socio-economic development. Also, Classroom teaching has undergone several stages of innovation aimed at transforming teaching methods for efficiency to facilitate sound educational development. Innovations in teaching strategies which attracted a lot of previous research have not significantly led to the improvement in educational standards as students’ performance over the years keeps fluctuating as data on students' consecutive performance in class and national exams call for a review of curriculum innovation and the implementation of STEM curriculum technical schools in Buea municipality. The quality and achievement challenge are real in our education system and need redress (Ossono & Foretia, 2013).

Curriculum innovation is determined by a cross-section of strategic indicators. These are integration of the technologies into the learning processes, personalised learning, innovative thinking, and outdoor learning are strategies and methods that must be adopted by the actors to ensure effective skills, knowledge and competencies transmission in technical secondary schools to make it relevant to the context. The collaboration and mentoring are also some significant expectations that will greatly improve on teacher quality and effectiveness in the teaching-learning process the STEM subject. The effective realisation of these factors at the school level depends on school management and governance structures wherein the school administrators have to work serious to match up to the realities Ossono & Foretia, 2013).

However, the technical sub sector of education in Cameroon especially in the Buea municipality experience serious innovation inadequacies and challenges when it comes to the effective implementation of STEM curriculum (Ossono & Foretia, 2013). These challenges turn to affect students' learning abilities, teaching approaches, infective or conducive learning environment which turn to demotivate and creates disagreement between teachers due to absence of effective professional development that can enable the teachers to carry curriculum innovation at the school level which is a common phenomenon in the technical education sector especially lay privates' technical schools. Some of the proprietors and administrators lack educational management competences when comes to mentoring other teachers, creating collaboration frameworks that can boost teacher's confidence innovation and curriculum implementation. The lack of effective incentive and norms in ensuring accountability and transparency is also evident.

The limitations of capacity building in terms of conference, seminars, and professional coaching turn to affect teacher's effectiveness in the implementation of STEM curriculum in

Cameroon technical secondary schools. Schools do not organise these programme regulars. If they do organise them regular, they will stimulate professional engagement in the innovative approaches which will boost learning. This engagement is needed in efficient and quality learning. But institutions turn to neglect these because of limited resources or escaped of expenditure. The consequences of this neglect turn to affect students' performance.

The unpreparedness of teachers for the challenges of ICTs applications in this ICTs age is a serious challenge in our schools today. This means must teachers lack competences in the ICTs which are the determining indicators for knowledge society. Building teachers' capacity in this area will enhance their effectiveness in the implementation of STEM subjects. There also poor communication within school and staff in terms modes and channels. It seems that in most schools the channels do not exist at all. This discrepancy creates distortion of information flow between administration and teachers. The inadequacy of information tools such computers, projector and teaching material turn to make teachers to be ineffective in their practices. It is evident that the provision and capacity building of teachers in information and communication technologies at the primary school will boost their effectiveness 9Ossono & Foretia, 2013).

The continuous declining in academic performance and fall standards in the Cameroonians secondary technical education has generated much interest among stakeholders in the education sector to question teachers' effectiveness in terms innovative technical teacher training and continuous professional development through their career for a better curriculum implementation. This Poor academic performance of students in Cameroon has been linked to poor teachers' performance in terms of accomplishing the teaching task, negative attitude to work and poor teaching habits which have been attributed to poor motivation.

Therefore, this study seeks to understand to what extent can curriculum innovation, in terms ICTs, personalised learning, outdoor learning and innovative thinking influence the implementation of STEM subjects as means of ensure quality and equitable teaching and learning in the Cameroon technical secondary schools.

1.2.1. Research objectives

This study will centre on the following general and specific objectives. These objectives help to give the orientations the conceptualisation of the concept of curriculum innovation and the effective implementation in the STEM subjects.

1.2.1.1. General research objective

The main objective of this study is to examine the impact of curriculum innovation on effective implementation of STEM subjects in government technical secondary schools in Buea municipality.

1.2.1.2. Specific research objectives

i) To examine the influence of technology (ICTs) on effective implementation of STEM subjects in government technical secondary schools in Buea municipality.

ii) To examine the influence of Personalisation learning on effective implementation of STEM subjects in government technical secondary schools in Buea municipality.

iii) To examine the influence of Outdoor learning on effective implementation of STEM subjects in government technical secondary schools in Buea municipality.

iv) To examine the influence of Innovative thinking on effective implementation of STEM subjects in government technical secondary schools in Buea municipality.

1.2.2. Research questions

The research question constructed for this study consist of the reflections on the research objectives which equally gives direction to the methods and analysis of curriculum innovation and effective implementation of STEM subjects in government technical secondary schools Buea municipality

1.2.2.1. General research question

What influenced does curriculum innovation has on effective implementation of STEM subjects in government technical secondary schools in Buea municipality?

1.2.2.2. Specific research questions

i) How does technology (ICTs) influence effective implementation of STEM subjects in government technical secondary schools in Buea municipality?

ii) What is the influence of Personalised learning on effective implementation of STEM subjects in government technical secondary schools in Buea municipality?

iii) To what extent does outdoor learning influence effective implementation of STEM subjects in government technical secondary schools in Buea municipality?

iv) Does Innovative thinking have an influence on effective implementation of STEM subjects in government technical secondary schools in Buea municipality?

1.2.3. Research hypotheses

Based on this objectives and research questions tentative responses will be given to above research question. These hypotheses will enable to verify the degree of predictability of the variables on the effective implementation of STEM subjects in Cameroon technical secondary school

1.2.3.1. General research hypotheses

H_0: curriculum innovation has no significant influence on the effective implementation of STEM subjects in government technical secondary schools in Buea municipality.

H_A: curriculum innovation has a significant influence on effective implementation of STEM subjects in government technical secondary schools in Buea municipality

1.2.3.2. Specific Hypotheses

H_{10}: The integration Technology (ICTs) as curriculum strategies has no significant impact on effective implementation of STEM subjects in government technical secondary schools in Buea municipality.

H_{1A}: The integration Technology (ICTs) as curriculum strategies has significant impact on effective implementation of STEM subjects in government technical secondary schools in Buea municipality.

H_{20}: Personalisation/personalised learning has no significant influence on effective implementation of STEM subjects in government technical secondary schools in Buea municipality.

H_{2A}: Personalisation learning has significant influence on effective implementation of STEM subjects in government technical secondary schools in Buea municipality.
H_{30}: Outdooring learning as a teacher approach has no significant impact on effective implementation of STEM subjects in government technical secondary schools in Buea municipality.

H_{3A}: Outdooring learning as a teacher approach has significant impact on effective implementation of STEM subjects in government technical secondary schools in Buea municipality

H_{40}: Innovative thinking as curriculum innovative strategies does not have any significant influence on effective implementation of STEM subjects in government technical secondary schools in Buea municipality.

H_{4A}: Innovative thinking as curriculum innovative strategies does have any significant influence on effective implementation of STEM curriculum in government technical secondary schools in Buea municipality.

1.3. JUSTIFICATION OF THE STUDY

The study is motivation of the research experience in the field where there are some discrepancies and challenge when it comes to the lack of curriculum innovation and in the implementation of STEM subjects in technical secondary schools in Cameroon. This aspect is highly neglected in this light maybe due to the lack of attention. This approach can go a long way to boost the socio-economic development of the Cameroon (Ossono & Foretia, 2013)

This work is also to fill the gap of limited literature on curriculum innovation and the implementation of STEM subjects in technical secondary school in Cameroon and specifically in which Buea municipality in the southwest region which seems inexistent. In this light, the conceptualisation of the curriculum innovation in terms of Technology (ICTs), Personalisation learning, Outdoor learning and Innovative thinking are the veritable strategies in improving the technical education in these subjects. The Cameroon nation needs industrial transformation and integration in the global knowledge economy where critical thinking skills and technological knowledge is primordial. This will go a long way to improve quality education and equity in this sector of education (Ossono & Foretia, 2013)

More to this, generating theoretical perspectives for STEM curriculum in the technical education through curriculum innovation will be in response to the demands of the contemporary needs and basis for this investigation. Curriculum innovation will lens more impetus into the perspective of STEM education as way of ensuring education for sustainable development at the national level and will turn to replicate in the secondary sector and a great contribution to societal development (Ossono & Foretia, 2013).

This will help to bring better understanding to curriculum innovation through the development of learning approaches in the terms of human resource development and material investments that will enhance quality technical education which in the development of educational resources. The integration of these concepts will create a better environment and conditions for students and teacher and ascertain educational achievement at the school level and provide skills for the students to face real life challenge in the innovation in the 21^{st} century.

1.3.1. Significance of the study

Scientific: this work will contribute to limited scholarly research in curriculum innovation particularly in the implementation of STEM curriculum in Cameroon technical secondary wherein the perspective of innovation of the programmes and the teaching methods are still under researched. In this way, the study will give full understanding conceptualisation and theoretical grounding adopted to explain the phenomenon.

Teachers: curriculum innovation in terms of technological integration personalisation learning, outdoor learning and innovative thinking are indicators which make teachers more as felicitators than instructors. Curriculum innovation concept aligns with secondary education policy of competency-based approach. This constructivist approach can help boost teachers' professional development. The teachers who will integrate the above-mentioned innovation indicators contribute greatly to effective knowledge and practical competency transmission in STEM curriculum. This is already established that teachers are indispensable actors or human resource in education. The students' performance and achievement depend on the effectiveness of teacher's innovation abilities. This study will provide a guide for teacher on how to build innovative curriculum in the implementation of the STEM subjects in government technical secondary school in Cameroon. In order to ensure effectiveness in the teaching process, innovations approach should be at heart of the teachers' pedagogic strategies. It will give strategies on improve on their teacher method and quality education. The best way to effective innovation is through teachers' professional development which is crucial aspect of human resource management in any organisation whether in business or education. They can reinforce the capacities of each other at the school plant.

Schools' administration: It outlines the role of school administrators in curriculum innovation and how they contribute to effective implementation of STEM curriculum in secondary technical school in Cameroon. The school administrator is charge of translating national educational policy into action at level of the school. Therefore, their administrative strategies will determine the innovative performance of their teacher in competencies development in the STEM. The failure or the success of each educational system depends on their managerial governance skills and competences. Therefore, this work will provide indicators for school administrators to ensure continuous innovation professional indicators that will lead to the amelioration of the teaching and learning process.

Pedagogic inspectors: This work create awareness and help the national and regional inspectors on the current challenges and discrepancies in the technical education curriculum in Cameroon and how to tackle them as the way to ameliorate quality and equity of knowledge and skills transmission at this sector of education. This will enable them to see how they can intervene help school administrators and teachers in ensure effective technological deployment and outdoor learning which approaches to improve the STEM subjects through continuous professional development.

Policymakers: This work will give policy orientation curriculum innovation in technical education system to revisit programmes and frameworks of professional development in terms of planning, implementation, monitoring and evaluation of teachers' effectiveness in the implementation of STEM curriculum. The work will help them redesigning capacity building strategies and methods as well as the flow of information. Revisit the efficiency or resources allocation as means teachers effectiveness; incentive and norms as ways improving quality and efficiency technical education in the STEM subjects

Curriculum Planners: curriculum innovation and effective implementation of the STEM in Cameron technical education is depends on the role of the education planes. Conceptors and evaluators of the education programme. Planners as the vision bearers of the education system need skills and more knowledge on curriculum development and innovation which help them design plan that will contribute knowledge and skill development as well as to socio-economic of Cameroon and that of Africa in at large**.**

Economic Development: It is evident that the innovation in the technical field such a science technologies, engineering and mathematics will usher many students into the into knowledge economy which is the determinant of socio-economic development through human capital development. Competencies, skills, and knowledge are elements of human which can help the national and regional economies flourish in the face of global competition.

1.4. DELIMITATION OF THE STUDY

Contextual/ Geographical Delimitation: this study was carried in government technical schools in the Buea municipality of the southwest region of Cameroon. It the headquarter of the southwest region and has host a few secondary education institutions which both general and technical.

Thematic/Conceptual Delimitation: this study is limited to the conception of curriculum innovation, ICT, personalisation learning, outdoor learning, innovative thinking, and STEM curriculum in the secondary technical school in Buea municipality.

Theoretical Delimitation: this work is circumvented within four theories. These theories include diffusion of innovation, experiential learning theory, social cognitive theory, and national innovation system theory.

Methodological Delimitation: The study is a mono-quantitative analysis and data sources is limited to questionnaire survey operationalized using four independent specific latent constructs relating to curriculum innovation and effective implementation of STEM curriculum in government technical schools in Buea municipality. The process and measured using the four Likert scales ranging from strongly disagree to strongly disagree. The philosophical underpinnings supporting this analysis are limited to positivism epistemology, objectivism ontology, biased-free axiology, and deductive approach. Developed hypotheses will be tested based on the goodness fit for structural of the regression model analysis. Descriptive analysis will be used for demographic data.

1.5. ASSUMPTIONS OF THE STUDY

-This study is of the assumption that curriculum innovation will have significant impact in the effective implementation of STEM curriculum in Cameroon secondary technical schools.

-This study also assumes that effective implementation of STEM curriculum through innovative strategies will spur competency development and lead to sustainable socio-economic development of the Cameroon society and the African region at large.

1.6. STRUCTURE OF THE WORK

This work is made up of five chapters: Chapter one is the introduction to work containing contextual background, conceptual and theoretical backgrounds, justification, and statement of the research problem, significance delimitation and summary of the methodology; Chapter two deals with literature review- conceptual literature, theoretical literature and empirical literature; Chapter three is the research methodology, handles the research approach , research design, area of the study, population sampling and sampling techniques, validity and reliability, data collection, data analysis, ethical consideration operationalization of the variables; Chapter four presentation and interpretation of results; Chapter five discussion of findings. Recommendation, suggestion for further research, limitation of the study and educational implication of the overall results of the study.

This chapter handled the overall background (contextual, theoretical, and conceptual) to the, the statement of the research problem justification, significance, and delimitation of the study. This lays groundwork for the proceeding chapters. It conceptualised the problem within the field of curriculum and evaluation and the education sciences in general. The next chapter will present the literature review which constitutes the conceptual framework, the theoretical framework, and the empirical literature. These elements will establish the gaps and orientations the present study will in response to curriculum innovation and effective implementation of STEM in Cameroon technical school, specifically in Buea municipality.

CHAPTER TWO REVIEW LITERATURE

The main objective of this study is to examine the impact of curriculum innovation on effective implementation of STEM subjects in technical secondary schools in Buea municipality. This chapter focuses on the presentation of conceptual framework, theoretical framework and related empirical literature review. This is to establish a clear understanding of various concepts and identify the research gap and the discrepancies in the literature. The theoretical framework is used for the explanation and discussion of curriculum innovation and effective implementation of stem subjects in the Buea municipality, Cameroon. The empirical literature gives an insight into the scientific development debates and perspectives in the STEM paradigm. The literature places the work into perspective of curriculum innovation and evaluation. Empirical literature provides current debates, controversies and perspectives in curriculum innovation and STEM education nationally and globally.

2.1. CONCEPTUAL FRAMEWORK

This section presents the conceptualisation of curriculum innovation in relation the STEM. These concepts provide innovative way of approach to curriculum as an important aspect of an educational system**.** These concepts include curriculum innovation, personalisation/personalised learning (PL), innovative/ creative thinking (ICTh), outdoor learning(OL), ICTs and STEM subjects

2.1.1. Curriculum innovation

Tanner and Tanner (1980) in Asebiomo (2015, pp. 27) defined the curriculum as “planned and guided learning experiences and intended learning outcomes formulated through or symmetric reconstruction of knowledge and experience under the auspices of a school for learners continuous and willful growth in social competence**.”** (Sylvester, 2017) A school curriculum is intended to provide children and young people with the knowledge and skills required to lead successful lives. Today in most technical school as well general school, there is an increasing need to improve curriculum needs. The reconsidering and redesigning the curriculum demand innovative approaches in the implementation especially in the technical schools where a lot of learning demands practices on the side of students. Technical schools still receive limited practical and inconsistent content that do not respond to students’ needs and the needs of the society. (Williamson & Payton, 2009).

Adedeji et al (2013) think that Curriculum planners must be aware of the globalisation in the advancement of science and technology. In this light curriculum development has to capture to effective innovative means in overall teaching and learning and more specifically in the STEM where tremendous inventions and discoveries can emerge for quality education and socio-economic development.

> "Curriculum innovation may imply meaningful shifts in teaching and learning processes. Careful planning and management of curriculum change are keys to successful implementation. Innovation in curriculum requires a lot of meticulous planning and efforts must be made to prevent a natural death. Curriculum includes content, objectives pursued and structure. Content relates to areas of knowledge and disciplines. Objectives include purpose of programme, knowledge, and skills to be acquired by students, while structure relates to years of study, pattern of study and arrangement of units of study" **(**Dorgu 2020, p.99)**.**

In this definition and analysis, there is emphasis on shifts/change in the teaching and learning process. This beginning with curriculum developers or curriculum planners who have considered all the contexts demands of the curriculum. Relevant innovation will be considering sociological and anthropological variable that contribute to quality education. Technical education in developing countries and in Cameroon must focus on continue innovation of the curriculum taking stock of the environment and societal demand. Students needs in terms of skills, knowledge and competencies must be address according for effective implementation of STEM curriculum in Cameroon

Tan, Koh, Lee, Letchmi Devi Ponnusamy, & Tan, 2017)

> Curriculum innovation means redesigning the curriculum in order to adapt it to current requirements. These changes may have different perspectives. In higher education, curricular innovation aims to modify one or more curricular components, through changes regarding the content of education, teaching methods, teacher-student interaction, and the organisation of activities. Curricular innovation involves reconceptualising, modernising, and optimising the university curriculum. This is referring to the organisational, methodological, and content side of the educational process (Gonta & Tripon, 2020).

In technical education in Cameroon, there is need for reconceptualization and redesigning, structuring the STEM subjects through curriculum innovation for better knowledge and skills transmission.)

2.1.2. Information and communication technologies (ICTs)

In contemporary education technologies especially the ICTs and indispensable learning and teaching. These technologies facility the transmission of knowledge and competencies to learning. Information and communication technologies in technical education as innovation of the curriculum provide open space for research and more opportunities teachers and learners to access new knowledge and acquire innovative skill that led to innovation explosion and diffusion in science and technology. Technical education in Cameroon is still in need of serious improvement technical innovations in the STEM subjects for effective curriculum implement.

> "It refers to any product that stores, retrieves, manipulates, transmits, or receives information in a digital form (cellular phones, computer hardware and software, satellite systems) and to associated services and applications (video conferencing, distance learning) ICT skills" (Kogiso et al 2017, p. 9)

This technology is either considered: A Basic and applied skills or advanced ICT skills (Kogiso et al 2017). Each of the skills are employ depending on the needs and usage. Curriculum development through innovation engender all of these skill in technical education. Digitalisation or digital literary is fundamental requirement for industrial and economic development where industrial operations and designs are becoming more increasing digital. Integrating ICTs skill, knowledge into the STEM stream will promote effective knowledge skill diffusion (Kogiso et al, 2017).

These require school administration to develop effective communication channels and innovative decision support system which are adequate and adapted to the needs of the students. Teachers' capacities in the manipulation of the ICTs tools in the effective implementation of STEM curriculum will facility understanding and skill development

The information and communication technologies strategy in technical education create an "e-confident" system provide "intelligent and agile" virtual learning space and interaction for learners to access learning resources and support at any time and from anywhere technology supported learning helps build higher order skills technology helps deliver more personalised services for students. This personalisation learning is innovative in competency-based skill development. All student gain creative value in an inclusive manner (Alghamdi, 2018).

The digital strategy underlines the place of ICT as a fundamental tool in a modern technical education and skills system, which has the capacity to connect schools with students' homes, to enhance autonomous or personalised learning, and to contribute to flexibility and agility in skills development. ICT is perceived as a means of providing tools for both innovative professional and capacity building practices in the classroom instructions and to enhance student's workshop creative and innovative intellectual development. Curriculum Innovation and Information and Communication Technology are veritable 21st century factor t that cannot be ignore in curriculum development and planning **(**Alghamdi, 2018)

2.1.3. Personalisation/personalised learning

Personalisation/personalised learning refers to varying concepts over time and from one context to another. Personalised learning is known elsewhere in different names which include learner-*centred instruction, differentiated learning, individualised learning, competency-based learning, and teacher developed individualised learning plans to project-based learning and adaptive technologies* (Holmes et al, 2018 p. 15). From these different names one can understand that personalised learning has received a lot scholarly attention. The overall aim is knowledge, skill, and competence. This approaches to learning are more innovative and entrepreneurial there permit student to think beyond the curriculum and are able to invent new product of concepts. *"Learning experiences, instructional approaches, and academic support strategies intended to address the specific learning needs, interests, aspirations, or cultural backgrounds of individual students*" (Holmes et al**,** 2018 p. 15) technical education especially in the STEM subject personalised learning work in the improvement of student engagement and academic achievement

Ogden (2019) personalized learning is transformative in constructing how students are instructed and how learning is organized. In this learning system every student is a respected and valued as a contributed actor and part of the learning environment in personalized learning. Students are empowered to recognize the power of their own and other's ideas in knowledge development and innovation strategies knowledge application. A personalized learning environment has a heavy dependence on technology. This means that technical schools must equip their workshops with modern technological tools and logistics that permit students can easily access designs and application online to improve their competence. These are effective ways of preparing the student for the job market.

Online tools need to be reliable, so depending on the existing system, there may be additional costs to ensure technical issue. Personal integrity, respect, and appreciation for qualities of the individual are key components to student agency. Efficacy is the second important element to a sense of age participating in reasoning, problem-solving, communicating with teachers and other students, and investigating mathematical problems to determine a solution. Therefore, curriculum developers in the innovation must analysis the dynamics of self-efficacy in the effective implement of STEM curriculum in technical education. These will go a long way to improve quality and sustainable education (Ogden, 2019).

Personalised learning approach can integrate the Blended learning model which is an approach to instruction is implemented in a variety of ways in multiple educational settings. Blended learning is defined as student learning in a hybrid experience of in class and online instruction, where they are given choices in their path, pace, and space (Ogden, 2019). At this dimension teachers act as facilitators in the teaching process.

Curriculum perception of personalised is long history of techniques, from teacher- developed individualized learning plans to student-cantered instruction for skill and competence development increasingly research in STEM also demands more interesting turning points to building large-scale data collection and analysis which enable technologically mediated problem solving mechanisms for better curriculum implementation. Adaptive personalized learning informs educational stakeholders of the relevant of the curriculum content (BULGER, 2016). personalized learning encompasses such a broad range of possibilities, from customized interfaces to adaptive tutors, from student-centred classrooms to learning management systems, that expectations run high for their potential to revolutionize learning. Less clear from these descriptions are what personalized learning systems actually offer and whether they improve the learning experiences and outcomes for students. (Jones, & McLean 2012). Defining the content of personalised learning system for effective STEM implementation in technical school will enhance learning and educational outcomes.

2.1.4. Outdooring learning

The status of outdoor activities varies in and within different educational mission and system well as cultures. Technical education especially STEM in the today's knowledge environment require field visits and hand on learning of experiential learning which permit student to creative and adaptive in their learning processes., The objective of outdoor learning is to broaden and challenge presupposed understandings of technical education and practical theorisation of education allocative efficiency that need accompany education process. Outdoors learning create networks of learning system out of the school setting which bring about the contact between education and society. We consider outdoor learning in curriculum innovation as strategic of creative practical opportunities for students of identify a range of knowledge and conditions for skill development and training in their specific discipline. (Grindheim et al, 2021)

Stevenson et al (2021) thinks that Most definitions of OSE focus on science instruction held in an outdoor setting, often paired with activities designed to connect student affectively with nature The outdoors is an excellent setting for promoting observation skills and engaging in science practices such as construction, conducting experiments in a non-controlled setting, and revising hypotheses based on unanticipated conditions or outcomes Stevenson et al (2021). The outdoors is also well-suited for interdisciplinary learning, where students connect science concepts across disciplines. Adoption and development of STEM curriculum in the americium technical and vocational training will demands integration outdoor as innovative approach to effective curriculum implementation.

Outdoor learning in technical education will go beyond the simple site visits to immersion into the industrial and services production and manufacturing of products where engineering and innovative technical processes and operations take place. For instance, construction or electricity programs provide opportunities for students to learn about field feasibility, and soil testing and operation and management of electricity transmission station and thermal plant, collect, analyse, and report quantitative data on architectural design and projection realisation; and support of competence development connections using both theoretical and practical tool that support students' sense-making Stevenson et al (2021). This dimensional concrete and experimental/experiential learning approach suitable approaches to curriculum innovation and effective curriculum implementation.

OSE also provides an ideal opportunity to reinforce the notion that persistence and hard work are inherent in science learning. This stimulates in the student the insights of community engagement which contribute to socio-economic development. Outdoor contexts are more frequently novel to children, as progressively fewer are afforded opportunities for exploration in the outdoors due to increased indoor screen time and parental fears of outdoor setting Stevenson et al (2021). This also signifies more invest in human and financial resources in creating opportunities for education to better improve on their knowledge and competencies.

2.1.5. Innovative/ creative thinking

Innovative/creative thinking and personal responsibility for their activities in the modern production and community. innovative knowledge is created through the organization of innovative education in the context of innovative reflection of technical school teachers and management are based on the principles: insight, generation of innovative ideas, synergy and Synectic which is techniques of problem solve through creative thinking most often within small group, which assists not only to achieve the results of innovative thinking, but to develop skills and competence for the workplace (Ignatova et al, 2019). Connectives in innovative

Thinking about change and improve in experiential learning teams. There curriculum development in STEM subject should consider individualised learning and team learning which help the student to develop mechanisms to innovation. These techniques create the opportunities situational, design product analysis and architectural invention in the conceptualisation and materialisation for ideas and knowledge.

Awang, and Rally (2008, p. 636) says **"***creative" means bringing into being something that was not there before and has been brought into being. The word "creativity" covers a wide range of different skills. Creative skills needed to change concepts and perceptions."* Creative thinking should take its place alongside our other methods of handling information. A person sitting down with the deliberate intention of generating an idea in a certain area and then proceeding to use a creative thinking technique systematically should represent a normal situation. Curriculum innovation is all about thinking creatively and developing approaches and methods help advance the educational system. Technical education needs creative thinker In STEM it will help transform the Cameroon industrial and economic landscape. The ability of creative and innovative thinking skills students in solving the problem of locating dominating set by using research-based learning that led to learning in 21stcentury, and later, students can think independently, and able to build up inspiration and ideas without the help of others (Yudha et al, 2018)

> "Creativeness is defined as a way to look at and solve problems from a singular perspective, avoiding orthodox solutions and thinking outside the box. This creative process allows you to discover connections, meet new challenges and seek resolutions that are uncommon, original, and new" (Gafour & Gafour, 2020, p.2)

A way of observing problems or situations from a fresh perspective that means unorthodox solutions (which may look unsettling at first). Creative thinking is often stimulated both by an unstructured process like brainstorming, and by a structured process like heuristic program (Gafour & Gafour, 2020)

Design thinking is an important component of innovative thinking in the curriculum development process. Therefore, considering design thinking innovation can contribute tremendously in the effective implementation of STEM.

> "Design Thinking is a human centred approach to innovation that draws from the designer's tool kit to integrate the needs of people, the possibilities of technology, and the requirements for business success." "Design Thinking is a methodology that we use to solve complex problems, and it is a way of using systemic reasoning and intuition to

> explore ideal future state. We do this with the end user or the customer in mind, first and foremost. (Hob craft, ND, 2)

Curriculum development need methodologies and theories in the innovation processes. Design thinking play a significant role in engineering and technological patterns and porotypes are developed from design conceptualisation which is an action creative idea.

2.1.6. Effective Implementation of STEM curriculum

STEM is defined as science, technology, engineering, and mathematics skills, often applied in an interdisciplinary context (such as creating computer applications, advanced manufacturing, automobile engineering) **(**Kogiso et al 2017, p.). Cameroon educational system at the technical sector is not yet have STEM curriculum. Curriculum developer with the STEM field should adopt innovative strategies that will be to students' knowledge and competencies with the integration of ICTs and experiential learning approaches which contribute to industrial and economic growth. In this study, we discuss STEM skills as important complement to ICT skills; many trends evident in STEM skilling are reflected in ICT skilling and more statistical data is available on STEM skilling than on ICT skilling. **(**Kogiso et al 2017)

Junior STEM junior STEM as the area of secondary schooling that encompasses students aged 12–15 years. In the Cameron context, this is referred at as junior technical secondary as the education systems across Cameroon are generally divided into two sectors, primary school for students aged 5–12 years and then secondary school for students aged 12–18 years. In other contexts, different signifiers will be used to refer to these years of schooling. (Jorgensen & Larkin, 2018)**.** STEM Education and Equity It has been widely recognised that participation and success in the STEM areas has been quite biased, with girls, low-income students, Indigenous students, and rural/regional students at greater risk of not participating, or failing, in these areas (Jorgensen & Larkin, 2018) and (Barthelemy & Moritz, 2015). The major features of according (OECD, 2013):

Learning by doing. The interactive, reactive, and often collaborative nature of educational gaming enable learning by doing of complex topics by allowing students to (repeatedly) make mistakes and learn from them. Real-life based gaming allows experimentation that would otherwise be too costly or dangerous (OECD, 2013).

Student learning. Educational gaming which covers specific topics or subject areas and take place within a set of rules can increase students' achievements and subject-specific knowledge

(OECD, 2013).

Student engagement and motivation. Based on play and increasing challenges, educational gaming can foster student engagement and motivation in various subjects and education levels (OECD, 2013).

Students' thinking skills. Games have the potential to help students find new ways around challenges, use knowledge in new ways and "think like a professional" (OECD, 2013).

Among other things outdoor learning from the experiential approach will add more impetus to effective implementation of STEM curriculum.

2.2. THEORETICAL FRAMEWORK

2.2.1. Diffusion of innovation Theory by Everett Rogers

Rogers's diffusion of innovations theory is the most appropriate for investigating the integration of information and communication technologies in effective implementation of STEM subject in Cameroon technical secondary school. In fact, much diffusion research involves technological innovations so Rogers (2003:13) usually used the word technology and innovation as synonyms. For Rogers, a technology is a design as an instrumental of action that reduces the uncertainty in the cause-effect relationship involved in achieving a desired outcome. It is composed of two parts: hardware and software. While hardware is the tool that embodies the technology in the form of a material or physical object, software is the information base for the tool (Rogers, 2003:259). Since software (as a technological innovation) has a low level of observability, its rate of adoption is quite slow.

For Rogers (2003:177), adoption is a decision of full use of an innovation as the best course of action available and rejection is a decision not to adopt an innovation. Rogers defines diffusion as the process in which an innovation is communicated through certain channel over time among the members of a society system. In this theory innovation, communication channels, time and social system are the four key components of the diffusion of innovations. Some four main elements in the diffusion of innovations are.

Communication channels: are processes in which participants create and share information with one another in order to reach a mutual understanding

Time: the time aspect is ignored in most behavioural research. He argues that including the time dimension in diffusion research illustrates one of its strengths. The innovation-diffusion process

Social system: The social system is the last element in the diffusion process. Rogers (2003) defined the social system as "as set of interrelated units engaged in joint problem solving to accomplish a common goal

Innovation decision process: innovation-decision process as "an information-seeking and information-process in activity, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation" For Rogers (2003), the innovation-decision process has five steps: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. These stages typically follow each other (Sahin, 2003**)** science and technology policy innovation strategy technical human support services technical support services mobilising financial **r**esource**s** international cooperation (Kayal, 2008).

Innovation Rogers offered the following description of an innovation. An innovation is an idea, practice, or project that is perceived as a new by an individual or other unit of adoption (Roger, 2003 P.12). An innovation is an idea, practice, or project that is perceived as new by an individual or other unit of adoption" (Rogers, 2003, p. 12). An innovation may have been invented a long time ago, but if individuals perceive it as new, then it may still be an innovation for them an innovation may have been invented a long time ago, but if individuals perceive it as new, then it may still be an innovation for them. The newness characteristic of an adoption is more related to the three steps (knowledge, persuasion and decision) of the innovation decision process that will be discussed later. In addition, Rogers claimed there is a lack of diffusion research on technology clusters. For Rogers (2003:14), a technology cluster consists of one or more distinguishable elements of technology that are perceived as being closely interrelated.

Uncertainty is an important obstacle to the adoption of innovations. An innovation consequence may create uncertainty: consequences are the changes that occur in an individual or a social system as a result of the adoption or rejection of an innovation (Rogers, 2003:436). To reduce the uncertainty of adopting the innovation, individuals should be informed about its advantages and disadvantages to make them aware of all its consequences. Moreover, Rogers claimed that consequences can be classified as desirable versus undesirable (functional or dysfunctional), direct versus indirect (immediate result or result of the immediate result) and anticipated versus unanticipated (recognized and intended or not), Nutley et al (2002) in (Peixoto et al, 2003) for innovations to take place have influence in the organisation some knowledge where different human science must be taken into consideration. These are:

(1). Philosophy: the nature of knowledge and how knowledge is used in practices (epistemology). The study of whether certain innovations or technologies should be used (ethics).

(2) Anthropology how cultures have evolved and have influenced each other, including how knowledge and technologies have diffused within and across cultures.

(3.) Sociology - interpersonal and intergroup behaviours, including the influence of social structures and norms on behaviours and practices.

4.) Library Science: how knowledge dissemination can be facilitated, specifically how knowledge and information can be stored and catalogued so that it can be easily accessed.

(5.) Psychology: human behaviour and the factors that influence individuals to act, particularly cognitive and emotional states.

(6) Economics: market forces that influence innovation diffusion, including how diffusion influences pricing strategies, and vice versa.

(7.) Education: how knowledge can be shared so that it is understood, used and valued. Structures and land structures influence the spread and use of knowledge.

(8) Business Studies -the organisational characteristics that enhance the innovativeness of organisations as well as the ways in which innovations can be effectively marketed.

(9) Political Science how policies are implemented, including how centralised and decentralised governmental structures influence the implementation of policy.

(10) Technology Transfer - how technology can be used and adapted for use in various practices. (11.) Communications Theory**:** how various communications, including mass media campaigns, can affect dissemination, diffusion, and knowledge utilisation?

- **Relevance of the theory to the present study**

This theory is being relevant in curriculum to effective implementation of STEM subject in technological secondary school in Cameroon give that the learning environment is change and educational policies toward digitalisation and e-learning are becoming more demanding. Also, the working environment requires that students with knowledge STEM education should be capable of manipulating information and communication technologies. Curriculum innovation in STEM subject serious considerations of ICTs. The theory from the innovation generate potential for to venture into more engineering inventions that will revolutions the technological development in industrial management. These innovative instructional practices will facilitate the teaching learning process and they will go a long improve on skill development, enhance competencies development and contribution sustainable education of the Cameroon industrial and business sustainable development. The appropriation of these tools and channel will permit the development of human capital has entrepreneurial skills

2.2.2. Social Cognitive learning theory

Social cognitive theory accounts for the social origin of human thought and action developed by Albert Bandura, in (1977, 1980s and 2000s) In Social Foundations of Thought & Action: A Social Cognitive Theory" Bandura writes that SCT extends the scope of its precursor, social learning theory**,** by encompassing "psychosocial phenomena that extend beyond issues of learning". He distinguishes STC from social learning theory by explaining the two-part meaning of the new label. (Bandura 1977)

"The social portion of the terminology acknowledges the social origins of much human thought and action; the cognitive portion recognizes the influential causal contribution of thought processes to human motivation, affect, and action." (Wood & Bandura, 1989) The relabelling carries no claim of theoretical parentage**.** From the SCT perspective, human functioning is influenced by the reciprocal interaction of various behavioural determinants, cognitive and other personal factors, and environmental events Bandura, (1989). Humans exercise certain capabilities within this reciprocal framework to function successfully. The capabilities are symbolizing, forethought, vicarious, self-regulatory, self-reflective, and inherent. (Bandura, 2002)

Symbolizing capability: the human capacity for symbolizing affords freedom from the onerous and sometimes dangerous trial-and-error process of learning from experience. Symbolizing allows abstract thought through which the individual can conceptualize possible experience and test it out with rational thought **(Bandura, 1989)**.

Forethought capability: Most human behaviour is purposive and therefore "regulated by forethought". Forethought can entail weighing probable consequences of actions, establishing goals, and planning courses of action. Symbolising is a tool for carrying out forethought. It enables the individual to conceptualize a behaviour and its outcome and create motivation or inhibition to guide the selection of a course of action **(Bandura, 1989)**.

Vicarious capability: A person can learn a behaviour by observing the actions of others and the consequences of those actions. The human capacity for learning vicariously also precludes the need for the trial-and-error, learning-by-action approach to achieving behaviour. Humans learn many important activities by modelling observed behaviour language, for example, or driving a car. The human capability for vicarious experience is fed by burgeoning mass communications outlets that provide a rich symbolic environment that expands modelling opportunities **(Bandura, 1989)**.

Self-regulatory capability: Individuals use a combination of personal and societal standards to evaluate their behaviour and change it as necessary. This self-monitoring can have a motivational or inhibitory impact when a person is considering action (Lent et al, 1994).

Self-reflective capability: Through self-reflection, people evaluate their behaviour and adjust it according to the consequences of the behaviour and its compliance with internal and external (society) standards. This "metacognitive activity" is integral to the individual's perception of their self-efficacy, or competence. Bandura points out that self-reflection can also produce faulty thought pattern. Human nature: "Genetic factors affect behavioural potentialities". Human action is a combination of learned cognitive abilities and inborn psychophysiological factors (Lent et al, 1994).

Also, key to SCT are the concepts of agency and self-efficacy. In "Social Cognitive Theory in Cultural Context," Bandura writes, "Successful functioning requires an argentic blend of individual, proxy, and collective modes ("Cultural", 269). The individual is an agent who intentionally influences his own life. In some instances, an individual may need to call upon another individual or institution for help if he or she does not have access to certain resources of influence that the other individual or institution does have (proxy mode). Collective agency is achieved when individuals in a society pool their resources to affect a desired result. Agency implies the ability to conceive of and affect action---cognition and behaviour Lent et al, 1994).

SCT holds that self-efficacy is a determinant of how well an individual thinks and performs. Self-efficacy is the extent of the individual's self-confidence in their competence to cope with various levels of challenge. (Lent et al, 1994) "People tend to avoid tasks and situations they believe exceed their capabilities, but they undertake and perform assuredly activities they judge themselves capable of handling")**.** STC identifies the determinant variables that influence social cognition and demonstrates how they interact. Bandura writes that "theories are interpreted in different ways depending on the stage of development of the field of study. In advanced disciplines, theories integrate laws; in less advanced fields, theories specify the determinants and mechanisms governing the phenomena of interest. It is in the latter sense that the term theory is used in this book **(**Nabavi**,** 2012)

- **Relevance of the theory to the present study**

There is pertinence to this work in that, it helps to explain how autonomous learning or personalised learning can be carried, out. It also explains how cognitive capability of self-regulation and self-reflection can create creative and innovative thinking capabilities can enable student to general knowledge. The social consciousness of students instils the constructive abilities based on experience and knowledge. Curriculum innovation in the STEM subject through the social cognitive approach can help improve the transmission of knowledge and development of relevant competencies. Curriculum development in secondary technical education must work to ensure that students are Contributive agents in innovation of the curriculum. their experiences have significant impact on the effective implementation of STEM education.

The social cognitive approach to education is still one of the challenging areas in which Cameroon education stakeholders are still struggling with. Build social cognitive capabilities of learning STEM subject help instil practical knowledge that will mainstream innovation in them. Most developing countries have challenges developing this as of the education system. We believe curriculum innovation from social cognitive approach will response adequately to innovative and practical demands in education.

2.2.3. Experiential learning theory

Experiential learning theory is an education learning theory which developed upon the work of prominent 20th century scholars who gave experience a central role in their theories of human learning and development notably John Dewey, Kurt Lewin, Jean Piaget, William James, Carl Jung, Paulo Freire, Carl Rogers and others (Kolb, 1999) to develop a holistic model of the experiential learning process and a multilinear model of adult development. According to Kolb, (1999) the theory is built on six propositions that are shared by these scholars.

1. Learning is best conceived as a process, not in terms of outcomes. (Siddique et al 2010) To improve learning in higher education, the primary focus should be on engaging students in a process that best enhances their learning a process that includes feedback on the effectiveness of their learning efforts. As Dewey notes, "*Education must be conceived as a*

continuing reconstruction of experience: . . . the process and goal of education are one and the same thing" (Dewey 1897: 79 in Kolb & Kolb, 2017)

2. All learning is relearning. Learning is best facilitated by a process that draws out the students' beliefs and ideas about a topic so that they can be examined, tested, and integrated with new, more refined ideas. (Kolb & Kolb, 2017)

3. Learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world. Conflict, differences, band disagreement are what drive the learning process. In the process of learning, one is called upon to move back and forth between opposing modes of reflection and action and feeling and thinking.

4. Learning is a holistic process of adaptation to the world. Not just the result of cognition, learning involves the integrated functioning of the total person thinking, feeling, perceiving, and behaving. (Parahakaran, 2017)

5. Learning results from synergetic transactions between the person and the environment. In Piaget's terms, learning occurs through equilibration of the dialectic processes of assimilating new experiences into existing concepts and accommodating existing n concepts to new experience.

6. Learning is the process of creating knowledge. ELT proposes a constructivist theory of learning whereby social knowledge is created and recreated in the personal knowledge of the learner. This stands in contrast to the "transmission" model on which much current educational practice is based, where pre-existing fixed ideas are transmitted to the learner. (Kolb & Kolb, 2017).

Concrete Experience (CE) and Abstract Conceptualization (AC) and two dialectically related modes of transforming experience Reflective Observation (RO) and Active Experimentation (AE). According to the four-stage learning cycle immediate or concrete experiences are the basis for observations and reflections. These reflections are assimilated and distilled into abstract concepts from which new implications for action can be drawn. These implications can be actively tested and serve as guides in creating new experiences (Beaudin &Quick, 1995)

The learning style inventory and the four basic learning styles are diverging, assimilating, converging, and accommodating (Healey & Jenkins, 2000).

- **Relevance of the theory to the present study**

Experiential learning theory is constructivists approach to learn in which knowledge is built on concrete and abstract experiences. The competency-based to teaching and learning is rooted in this approach. Technical education where practice and development of model and prototypes is highly expected adopt experiential learning approach in curriculum development and effective teaching in STEM is indispensable. In this light outdoor learning is the best approach to gaining concrete experience that will result to conceptualisation and eventually creative destruction and disruptive innovation. All of these contribute rapid diffusion of new knowledge and technologies.

2.2.4. National Innovation System Theory

National innovation theory in a multi-model theory of economic development which has received great scholarly attention over the years, theory was developed the in the 1980s. In OECD (1997) national innovation system has perceived by different authors in different ways. "The *network of institutions in the public and private sectors, whose activities and interactions initiate, import, modify and diffuse new technologies*." (Freeman, 1987) • cited in (OECD 1997). This author sees the system at the interaction s of institutions in the diffusion of technologies. This technological diffusion is defined in clears but the most important the interactions the dissemination of innovation.

National innovation system is also seen as "*. The elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge ... and are either located within or rooted inside the borders of a nation state."* (Lundvall, 1992) • cited in (OECD 1997, p. 2) this definition goes ahead to support Freeman 1987) view by insisting on production diffusion which are grounded in the nation system. This explains and internal innovation system of innovation "*... a set of institutions whose interactions determine the innovative performance ... of national firms*." (Nelson, 1993) • cited in (OECD 1997, p.2) this view emphasises on the performance of innovation system. The effective implementation of the STEM subjects in technical schools demands an effective development of national innovation system that permit student to be performant.

" *.. the national institutions, their incentive structures, and their competencies, that determine the rate and direction of technological learning (or the volume and composition of change generating activities) in a country*." (Patel and Pavitt, 1994) • cited in (OECD 1997, p.2). This perspective of national innovation system for incentive structure and competencies in ensure technological learning. This implies that curriculum innovation in technical education must consider the innovation system landscape the country in relation to its implementation

> "That set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies, and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies." (Metcalfe, 1995) cited in (OECD 1997, p. 2).

National innovation system is an interconnection of structures the boost innovation processes. STEM subjects as an innovative and technological orientated learning and teaching in secondary schools can be inspired from the national innovation system theory approach to curriculum innovation impact on implementation of the curriculum in technical secondary schools.

- **Relevance of the theory to the present study**

The consideration of national systems in curriculum development creates strategies for technical education and vocational training to connection industries and business organisations. This will lead to experience and knowledge sharing. Equally, practical competencies and entrepreneurial initiatives will be developed for an endogenous economic growth. An integration ICTs, personalised learning, outdoor learning, and innovative and creative thinking strategies can be expended from the national innovation system. These will make technical and vocational training institutions more pertinent to socio economic development at the national and supranational levels.

2.3. REVIEW OF RELATED EMPIRICAL LITERATURE

Ossono and Foretia (2013) explain that STEM education is an acronym used to refer to a focus on Science, Technology, Engineering, and Mathematics encompasses a vast array of disciplines which include engineering, computer sciences, mathematical biology, physics, and robotics, among others. Concept is evidenced in the multitude of disciplines; STEM fields affect virtually every component of everyday life. They signal that an increase in the number of students in STEM education and an expanding the pool of graduates pursuing STEM careers are critical ingredients to the economic health of every country. They think that developing a STEM-skilled labour force allows a country to quickly lift its population out of poverty and increase its per capita income. Also, the think that for most of sub-Saharan Africa and indeed in Cameroon, the current educational system does not encourage a STEM driven curriculum. Their study is more policy orientated and lack scientific methodologies that adequately address the of STEM education within education system

Wang (2020) thinks that science, Technology, Engineering, and Mathematics (STEM) education is vital to all students. Student motivation, both intrinsic and extrinsic, have been found to be very influential in how successful a student is in a STEM classroom. The study examined what correlations between teaching approaches, intrinsic motivation, and extrinsic motivation of students in an undergraduate, non-major, introductory chemistry course at a mid- sized, four-year university in the Midwestern United States. In the focus groups, students were highly motivated by grades and programmes requirements. However, students who enjoyed guided learning had significant differences between intrinsic value, self-determination, and self-regulation. Though students found the course challenging and uninteresting, the external motivation of grades increased their intrinsic motivation, which is reported to be associated with high levels of effort and task performance This correlation seems to suggest guided learning can have an impact on student motivation in an introductory STEM course. This study focused more study motivated in studying STEM. Which our concern focuses on the curriculum innovation and effective implementation STEM subject

Williams and Mangan (2016) examined recent secondary school student interest in careers in the STEM areas is declining in New Zealand. In response to this, a programme was developed in New Zealand for young professional technologists, engineers, and scientists (known as ambassadors) to visit schools and carry out a variety of interventions to educate and encourage students to choose STEM careers. For the research Methodology, mixed-methods convergent parallel design was adopted for the study. The interventions include careers talks and classroom activities, organized by regional facilitators who are employed by the Institution of Professional Engineers New Zealand (IPENZ) to co-ordinate the programme across New Zealand. The goal of this research was to ascertain whether ambassador interventions are influential on students' attitudes to careers and curriculum choices in school. The main finding was that the ambassador interventions were influential on student career decision processes, though not all students were influenced. The facilitators work effectively in recruiting, training, organizing and supporting the ambassadors, and the ambassadors' belief in the value of what they are doing helps ensure effective interventions.

Bencheva (2020) believes that the understanding of the world through science education is needed today more than ever after the COVID-19 crisis. Education systems have been based on transferring knowledge based on industrial society and now on post-industrial society, seldom including hands-on, student-centred methodologies. Using technology as a practical and pragmatic approach, can deliver the values of transition and of community-living-with environment to new generations that must challenge transition and lead towards the post-transition world. Together with environmental challenges, we are currently experiencing a significant industrial transformation, the fourth industrial revolution, where science along with the advancement of technology is evolving at an unprecedented speed. Education institutions are noted for being 'extremely slow in adopting the advancement of technology' in the classroom. Together with the critical perspective to information and needs for digital solutions in education. To meet the challenges of rapidly evolving new technologies, STEM formal classroom education is not enough to acquire the necessary skills. The paper studies EU and Bulgarian polices for encouraging learning outside the classroom and in particular education in STEM and ICT field. Some of good practices of outside the classroom science education across Europe are identified. Teachers from Telecommunications department at University of Ruse implemented different projects for teaching outside the formal education students from Ruse schools in the field of ICT and STEM. Some of the experimental projects for teaching outside of the classroom by professionals from Telecommunication department are presented in the paper.

Bush et al (2016) in This paper report on a highly structured Mathematics-Science Partnership (MSP) professional development (PD) program focused on the integration of science, technology, engineering, arts, and mathematics (STEAM) in elementary mathematics and science. With a support system including higher education STEAM education and content faculty, community informal learning partners, an external evaluation team, school administrators, and expert STEAM teachers, twenty-five teachers and five STEAM instructional coaches met together for whole-group PD as they developed and then implemented integrated STEAM problem-based inquiries in their classrooms. The study used *Data Collection and Analysis* multiple sources of qualitative data. This paper describes how the PrimeD framework guided the STEAM PD program through a collaborative and reflective process.

Best et al (2019) focused on exploring STEAMtrix, a STEM out of-school time (OST) education program that incorporates the arts (STEAM) for kindergarten through 12thgrade (K-12) students. The study explores whether STEAMtrix could lead to interest and awareness of careers self-concept. Thirty-eight students from African American and biracial, African American and Caucasian, backgrounds at a medium-sized community centre participated in STEAMtrix, an eight-session STEAM OST were collected before and after programming. Self-report measure through survey monkey online survey software. Results demonstrated that the pedagogical and curricular features Keywords: Multicultural, science, technology, engineering, and mathematics (STEM), out-of-school time(OST), science, technology, engineering, arts, and mathematics (STEAM), kindergarten through 12th grade Çetin, and Demircan (2020). Present a review focused on STEM education through scientific, historical, and multiple perspectives within the current literature. In line with the purpose of the study, the history of STEM, approaches to STEM in early childhood education, the orientation, criticism, and questions regarding STEM in early childhood education and recommendations were presented. Since the emergence of the idea of integrating four different fields in education context (i.e., science, technology, engineering, and mathematics), STEM education has attracted the attention of the countries (e.g., United States, Canada, Australia) and these countries have taken steps on how to support STEM education. The big promises of STEM education have encouraged the spread of the idea over many other countries. One of these countries is Turkey. Recently, there has been some attempts of Ministry of National Education to establish STEM centres for the integration of STEM education with the existing national education system, the enrichment of research on STEM, to train STEM teachers and to update the curriculum and the provision of educational environments and materials in conclusion, providing STEM experiences for preschool children will help them better prepared for future educational steps and the challenges of the 21st century. A curriculum that indicates features, like being child-centred and providing STEM-related experiences for children, may be a basis to support children's understanding and skills in STEM for their future learning

Rose et al (2019) identify the critical facets and praxis needed for STEM leaders, both school and teacher leaders, that would more likely lead to program transformation with an I- STEM lens. With the push by government and business leaders for greater emphasis on STEM education at all grade levels, STEM leaders (i.e., educational leadership and teacher leaders) are challenged to pioneer integrative praxes that prepare students for success in a scientifically and technologically driven society. Additionally, these STEM leaders must transverse the barriers of developing transformative educational experiences that involve diverse stakeholders. This study utilized a modified Delphi technique to investigate what STEM leader skills, competencies, and qualities are identified as critical by STEM professionals within integrative STEM education. Findings are presented for the following seven themes: mission and culture, equity and social responsibility, infrastructure and programming, curriculum and instruction, professional growth, evaluation and assessment, and extended learning. These findings may inform the development of courses and programs that prepare or provide professional development for STEM leaders. Results indicated that an I-STEM leader embraces innovation, problem solving, and evidence-based decision-making by employing collaborative leadership strategies (see Table 4) that engender value for an I-STEM curriculum and a mission that is focused upon the well-being and academic success of students. The collaborative leader embraces shared decision-making through team-based structures, in particular, a STEM leadership team comprised of a cross section of educational stakeholders. Collaborative leadership is based upon building relationships among people who recognize their interdependence, share a common goal, and share responsibilities.

Genek and Küçük (2020) evaluate Scientific Creativity level of second third and four grade of student who enroll in STEM course the entire academic year. In this study, a descriptive quantitative research design was used. For the purposes of this study, the instruments were administered to the sample at the end of the 2016-2017 academic year, when the students were already exposed to the elementary STEM program. The universe of this study constitutes students from ten elementary private schools functioning in six different cities in Turkey he samples consisted of 85 second, third, and fourth grade students from two different private elementary schools in Antalya, Turkey Scientific Creativity Test (SCT) and demographic information sheet were used as instruments in this study. In line with the research questions, Demographic Information Sheet was used to gather personal information on participants' favourite school subjects, future occupation, and parental occupation *Integrated Teaching Framework for early STEM Program*. The study is not an experimental study where student performances are tested in the presence and absence of a STEM program. However, the content and the skills covered in the corresponding Early STEM program were found to be associated with the way scientific creativity components are addressed in the well-known Scientific Creativity Test as one independent of any STEM education interventions.

Marsono (2018) postulates that STEM is integrating four specific disciplines area (science, technology, engineering and mathematics) into interconnected learning process based on practical applications. This study aims to gain several ways of advancing students' creative thinking skills through STEM education based on the learning process. This study uses a literature review method with big data from several online database resources. There are several necessary skills needed for employees to face the tighten workforce competition. Creative thinking skills are very crucial for the worker to increase their productivity in the revolution industry. The lecturer needs to design a curriculum with the newest techniques that are ensuring all components of STEM are met with student's' creative thinking skills development. Finally, some suggestions were proposed for future research on reforming and delivering the STEM content to enhance vocational students' creative thinking skills.

Nicolete et al (2017) think that Mathematics is a fundamental skill in many aspects of a student's life. Most students everywhere, and in this study in Brazil, sometimes lack motivation to thrive in such subjects. The work presented in this paper aims to contribute to the development of a multiplatform teaching and learning application using Information and Communication Technologies (ICT), to encourage the study of mathematics from the first years of basic education. The activities are divided into two areas: training teachers and how to integrate technology in the classroom using mobile learning. The experience was conducted with children from the 5th grade, teaching them fractions and mathematics concepts all as part of a research project called "Technology Integration Proposal in Teaching STEM Disciplines in Public Basic Education", supported by CNP the Brazilian National Council for Scientific and Technological Development, and the project "Use of Remote Experimentation on Mobile Devices for Basic Education in Public Schools" supported by FRIDA (Regional Fund for Digital Innovation in Latin America and the Caribbean). In 2011, this project was selected as one of the most innovative research projects in Brazilian education by the Institute for Development and Educational Innovation (IDIE) of the Organization of Ibero-American State for Education, Science and Culture (OEI) and sponsored by Fundación Telefónica.

Sahin and Waxman (2021) present study focuses on the results of a four-year study that examined a Harmony Public School (HPS) high school students' STEM major selection pattern. They utilize 626 12th grade students who were common participants' method for the question 1 and 2 and a mainly qualitative focus for the question 3. Theoretical Framework is the social cognitive career theory is used. The theoretical framework for our study due to its comprehensive and well-established Structure in explaining the development of students' interests and educational and career choices. We used an online survey consisting of 46 questions to request information about five categories of variables: Descriptive statistics for the first question revealed that HPS students had higher rates in STEM career interest in all categories including gender and race/ethnicity throughout each of the four years of the study. For the second research question, we found that male students with higher science self-efficacy scores and less STEM club participation have a statistically significant effect on students' STEM major choice. For the third question, students indicated that their parents and teachers, and courses taken in high school were their top three factors that influenced their STEM career selection Caplan (2018) For the past five years, the Science and Mathematics Department at Columbia College Chicago, in collaboration with After School Matters (ASM) from the city of Chicago, offers two, six weeks' summer programs for high school and rising high school students interested in the Science, Technology, Engineering, Arts and Mathematics (STEAM) fields. During this period (June through August), 80 students spend six weeks on the college campus participating in one of the two following programs: 1) 30 students participated at the Junior Research Scientists and 2) 50 students participated at the Comed Youth Ambassadors. Both programs were designed by faculty and staff of the department. Students attended classes taught by college faculty and staff; participated in engineering design projects and problem-solving challenges and attended other STEAM related activities These summer programs attract high school students from the inner city of Chicago exposing them to STEAM disciplines and careers through rigorous classes, laboratories and real life experiences. At the same time the programs provide them with the full college and career readiness experience. The main goals of this program are to: (1) introduce students to a wide variety of STEAM fields, (2) increase student's engineering mathematics and science knowledge, and (3) facilitate students to learn about different STEAM fields they might be interested in pursuing. To assess the impact of the program, the participants took a pre and post content knowledge test that included basic electricity and energy questions (the main topics covered in the two programs), and a pre and post survey regarding their attitude towards Mathematics, Science, Engineering and the 21st Century skills. In addition, the authors collected participants' expectations of the program at the beginning of the summer session and their impressions of the program after the intervention. Data analysis of the pre and post content knowledge test showed a significant gain in both groups, but their attitude toward STEAM careers did not show significant change. In this paper, the authors will present the programs and will discuss the impact of the program on the participants in each specific program. Introduction

Campbell (2018) observed four pre-school centres, researching science, maths and technology pedagogy and how opportunities presented themselves for learning in outdoor settings. The purpose of this paper was to interrogate STEM practises in the early years, practices that are informed by play-based education pedagogies, to understand approaches to STEM education. The research adopted a mixed methods approach which, in addition to their observations, included a pilot survey and educator interviews. These data are brought together to examine practices of STEM education in pre-schools. We were able to view pre-school centres as places that provide varied, rich experiences for children to develop understandings of STEM. Importantly, we observed that children's STEM experiences enhance their self-belief in their ability to learn STEM, and these early years' opportunities trigger STEM appreciation and its value to everyday life. We were able to conclude from the research results that integrated STEM, particularly science and mathematics, arise through children's play and themes arising from their interests. The findings importantly highlight how different practices and pedagogies are used to support STEM learning.

Arifin and Mahmud (2021) emphasis on STEM integration in education is increasing since the way of thinking acquired through silo approach in traditional learning is not enough to understand and solve real-world problems. Design and design thinking have become increasingly important in STEM education as they are indispensable to creativity, problem solving and innovation. Nevertheless, little attention is given to this field. This study aims to identify the suitable teaching and learning approaches that apply design thinking for STEM integration among students by examining the available literatures. Providing students with the STEM skills can be acquired by adopting new approaches to teaching and learning across the STEM disciplines. For this systematic literature review, six databases were used which produced a total of 7209 articles. Identical articles were removed, and the data set was reduced by using three eligibility criteria in line with the research question, resulting in only 7 articles were chosen as samples for the study. The findings identified the suitable teaching and learning approaches that apply design thinking for STEM integration in education are focused on problem solving, designing activity and collaborative learning. The implications of the study allowed teachers and stakeholders to integrate STEM by applying design thinking through suitable approaches such as problem-focused teaching and learning, design learning and teamwork learning. The recommendation for future research is to conduct a study to see the effectiveness of problem-focused teaching and learning in applying design thinking for STEM integration.

McClary et al (2018) in paper discuss the process for developing design challenges for assessment of self-efficacy, assessment tools, and outcomes from the program delivery. Research regarding STEM programs has shown that participating in these programs leads to increased knowledge and retention of technological concepts. Additionally, participating in STEM programs leads to increased self-confidence, satisfaction, and interest in engineering.

Current research focuses on whether participating in STEM programs increases self-efficacy. However, several factors can influence the effectiveness of these programs. For example, motivation influences the degree to which participants are engaged with activities as does their background knowledge. Additionally, program effectiveness is impacted by the limitations of the learning context itself such that participants will be unable to complete designs if expectations for the design exceed the constraints of their environment. The program is designed to introduce and educate the participants in the various engineering disciplines offered at the collegiate level and culminates in a multi-disciplinary design challenge designed as a "collaborative-benefit" competition. The program is meant to drive students toward collaboration and achievement of a shared goal. The purpose of this study is to examine the effectiveness of an intensive, two-week project-based engineering program for high school students on self-efficacy and engineering identity in the participants. Results from this year's survey suggest that participating in the program increased high school students perceived and actual knowledge of the engineering discipline. Completing the program also led to improvements in self-efficacy and increased interest in the field of engineering.

Mikhaylovsky et al (2021) study STEM and STEAM education as an innovative technology, the authors of the paper conducted a comprehensive theoretical and methodological study on the stated problem. A comprehensive theoretical and methodological study was directed towards the solution to the problem of developing a new model for the STEM and STEAM education system to make correct management decisions in the framework of the country's socio-economic development based on objective data. The object of the study was STEM and STEM education as an innovative technology. The subject of this study is the mechanisms of STEM and STEM education in the system of higher professional education of the Russian Federation. The methodological foundation of the study was the general scientific ideas for holistic, systemic, and integrative approaches to the study, which gave an opportunity to assess a set of interrelated and interacting elements that form a certain integrity. The use of these approaches provided a comprehensive analysis and formulation of the research problem and determined the strategy for its study. Both theoretical and empirical methods of studying the indicated problem were used in the comprehensive theoretical and methodological study presented in the paper. The leading methods of scientific knowledge were the following: the method of comparison; phenomenological data analysis; discourse analysis of the text; theoretical analysis; empirical description (expert assessment method and in-depth interviews). The result of the study is the STEM education model developed by the authors as an innovative technology in the system of higher professional education# of the Russian Federation. The materials of the paper will be useful for specialists in the field of higher professional education, teachers of natural sciences and humanities, the teaching method of which is based on the STEM approach.

Sheffield et al (2018) study STEM in its multiple forms (STEAM, STEMM) has been presented as a solution for many of the world's problems. If its hype is to be believed, it is through the power of STEM and the creation of STEM or S.T.E.M scientists, technologists, mathematicians and engineers that the world economy will be restored; and global issues can be addressed. Whilst it is easy to get caught up in the locally created hype around STEM and the creation of a STEM pipeline, it is pertinent and timely to examine the current status and trends of STEM education across the world at the school and tertiary levels. In this paper a team of STEM educators explores the context of STEM within their respective countries, and together it is hoped that a clearer, shared view of STEM educationist developed, and a future for STEM education is imagined. This paper examines the state of STEM education in four countries: Australia, India, Indonesia and the United States of America (USA). Expert STEM educators from each country reflect on how STEM education is currently viewed and implemented in their country, drawing on the legislation and funding focus and using local data to predict how the future will unfold for STEM education.

Hurson et al (2011) thinks advances in databases, computational intelligence, and pervasive computing, which allow "anytime, anywhere" transparent access to information, provide fertile ground for radical changes in pedagogy. Cyber infrastructure leveraging these technological advances can yield improvements in both instruction and learning, supporting a networked curricular model, facilitating collaboration within and among groups of students and instructors, and providing continuous access to instructional material. The trajectory followed by each student through the curriculum can be intelligently personalized, based on prior knowledge and skills, learning styles, and interests of the student, among other attributes. We propose to achieve these objectives by developing Pervasive Cyber infrastructure for Personalized Learning and Instructional Support (PERCEPOLIS), which serves as the centre piece of an experiment to create a community of faculty and students over a set of campuses, focusing on STEM disciplines. While numerous distance learning methods exist, we believe that the best way to provide STEM education is to use a blended approach - one that embraces both online components and classroom mentoring by qualified faculty members. The goal is to provide high-quality STEM education for the students, while raising the skill set of the entire community through teaching collaboration

(Torres-Crespo et al 2014) describe the process of developing and implementing a STEM Summer Camp that allowed Pre-schoolers to experiment and investigate with materials while learning basic concepts of science, technology, engineering, and mathematics (STEM) through play as part of the educational process. The participants were presented with problems that they needed to solve together. Although the camp emphasized engineering skills and explored gender differences in pre-schoolers' performance in those activities, the main focus was to incorporate play in all the activities. This camp was a perfect example of how children learn more complex skills easily through play

Pearce et al (2022) review re-service teachers (PSTs) often lack the self-efficacy necessary to effectively implement STEM education into their classrooms. Undergraduate research experiences (URE) can help fill this void by providing opportunities for PSTs to engage with STEM content and K–12 students in a field-based research context. This case study details the impact a URE had on PSTs' STEM self-efficacy and views on research. The URE consisted of STEM curriculum development, teaching the curriculum at a local middle school, gathering research data, and presenting results at academic conferences. Participation in the URE positively influenced the PSTs' self-efficacy in STEM and changed their perceptions regarding research. This research provides practical value to educator preparation programs (EPPs) as an option to enhance STEM education for PSTs

Diluzio and Congdon (2015) I develop and deliver a workshop to teach undergraduate Science, Technology, Engineering and Mathematics (STEM) faculty the n creative thinking process and help them to develop modules for their classes. Leaning on ideas back to Plato's *Theaetetus*, we divide the creative process into seven discrete stages, and have developed exercises to help STEM faculty to explore and internalize these concepts. While we believe that many scientists invoke the creative process in their work regularly, we also believe that learning the creative process and practicing creative process thinking can help STEM faculty and students to invoke this process more fluidly, expediently, and effectively. Initial feedback from the workshop indicates that the nine faculty who participated in the workshop report an increased understanding of the creative thinking process and increased comfort level with incorporating these ideas into their classes, among Creative Intelligence, Creative Process, STEM Education, and Synectics.

Nithia et al (2015) examine The Malaysian government heavy investment in n transforming teaching and learning of Science, Technology, Engineering, and Mathematics (STEM) education. The effort included adoption of think and Virtual Learning Environment (VLE) Frog for use by teachers and students. Unfortunately, studies have shown that Malaysian students are still not performing well, especially in Mathematics and Science. Mobile-learning technologies have potential for overcoming these issues if properly planned and executed. This paper reviews literature on the issues related to STEM teaching and learning and proposes utilization of mobile-learning technologies in daily instructional practices. It is hoped that the findings of this study will encourage more research around mobile learning specifically in STEM education.

2.4. IDENTIFICATION OF GAPS

From this review there is limited literature on STEM education in Cameroon. Most the works are from the USA and Asia. This indicate that STEM education has not received scholarly attention in Cameroon. Preparation to become an emerging economic in 2035 demands great technological transformation which the STEM education curriculum can mainstream this development. No of the work has paid serious attention to curriculum and its effective implementation. Our task will be examining curriculum innovation through the integration of ICTs, personalised, outdoor learning and creative thinking as effective strategies in the implementation STEM education. Theoretical the discrepancy of diffusion of innovation through social cognitive and experiential approaches is evident. Therefore, we adopt this these theoretical philosophies to explain curriculum innovation and effective implementation of STEM subjects in technical schools in Cameroon

This chapter handled conceptual framework, theoretical literature which was concerned with diffusion of innovation theory, social cognitive learning theory and experiential learning theory and national innovation system theory to explain curriculum innovation and effective implementation of STEM subjects in technical secondary school in Buea municipality. The empirical literature which focuses on curriculum innovation or development in the STEM curriculum and how it influences educational outcomes. It equally identifies gaps in the literature as means of establishing the position of the present study. From the present literature we underscore that there is no or limited scientific literature on curriculum innovation and the implementation of stem curriculum. Therefore, focusing on this area will create awareness and equally inform the policy makers and community leaders on the importance of developing innovative curriculum for STEM subject and strategies and approaches in the effective implementation of STEM of the curriculum which are geared toward sustainable quality education for sustainable development.

CHAPTER THREE RESEARCH METHODOLOGY

This chapter presents and discusses the methods and procedures used in data collection and analysis. The chapter is made up of the following: Research approach, research design, area of study, population of the study, sampling procedures and sampling techniques, sample size, research instrument, data collection plan, validity of the instrument, piloting of the instrument, reliability of the instrument, administration of the instrument and statistical techniques for data analysis ethical considerations, operationalization of the variables, and the synoptic table.

3.1. RESEARCH APPROACH

The research approach adopted for this study was based on the purpose and objectives of the study. In relation of this study, we adopted quantitative with the use of a questionnaire that is closed ended statement as the main tool of data collection, more so, data sources were obtained from published books, dissertations, thesis and articles written on curriculum innovation and STEM education in the world in general and Cameroon in particular. The quantitative approach is built on the positivistic research philosophy in which data described and inferred based on the numerical statistical data.

3.2. RESEARCH DESIGN

Burns and Grove (2003) define research design as" a blueprint for conducting a study with maximum control over factors that may interfere with validity of the findings". Amin (2005) defines research design as a blueprint, methodology or plan of activities that the researcher uses in carrying out investigation in each given area of problem. In other words, research design refers to the researcher's plan on how to proceed in his or her study. From the above definitions, we highlight that a research design is plan and strategy put in place to carry out scientific investigation. Amin (2005) noted that a research design is necessary because it guides the entire research process to yield maximum fruits and reduce cost or expenditures in terms of effort, time and money. The quantitative nature of the variables under study permits the researcher to use, the correlational research design. The survey research design explores the relationship between two or more variables through a correlational analysis. This intent to determine the degree of the predictability of the variable. It does not imply one causes the other. This design permits the researcher to verify the hypothesis of the study through inferential statistics.

3.2.1. Area of the study

The study is carried out in Buea the headquarters of the southwest region of Cameroon one of English-speaking regions of the country. Buea is found in Fako Division in the Southwest region of Cameroon, Fako is in the tropical rainforest region with the vegetation generally green almost all year round and has some trees in the area. It is rare to move a few distances without seeing green grass, shrubs, and trees. The population of Fako consists of a mix of people from different regions of Cameroon and from different ethnic backgrounds or tribes. The natives of the area are the Bakweri people. The economic activities in Fako are of great importance to the whole country as they include education, commerce and 30% agriculture. Education in the Fako division has over the years been an increase. Buea has grammar, technical and commercial schools. It also has many universities. The study was carried in government technical high school and government technical college Bova both in Buea municipality in the southwest region of Cameroon. This area was choice for convenience and access to data. English medium of education in Cameroon is promotes teaching of STEM subjects. The intention was then to see if technical schools are promoting the teaching of STEM and how curriculum innovation can contribute to it effective implementation in the region.

3.2.2.1. Historical background of GTHS Molyko-Buea

This study is limited to GTHS Molyko-Buea, Fako Division of the Southwest Region of Cameroon. Government technical High School Buea is one of the biggest government technical schools in Cameroon. It is strategically located in the center of Buea and as such provides great opportunities for those interested in technical education in and around Buea municipality. It is located opposite to GBHS Molyko and adjacent to the Catholic University of Buea (CUIB). Government Technical High School Buea was created in 1979 by decree number 113/CAB/PM of 30/08/1979 as Girls Technical College (CETIF) with a student population of about 150. In the year 1990, it was transformed into a 1st cycle Technical college (CETIC), where boys were admitted, and the following trades were taught; Building Construction; Woodwork; and Plumbing. In the year 2000, the school was upgraded to a Technical high school (Lycée Technique) and presently the school has a number of departments such as Civil Engineering; Electro Technology Woodwork; Bespoke Tailoring; Accounting; Tiling; Building

Construction; Plumbing and installation Systems, Electric Power Systems, Secretarial duties; Home economics. The Motto of GTHS Molyko-Buea is DISCIPLINE- HARDWORK-SUCCESS

GTHS Molyko- Buea is one of those outstanding academic institutions that has produced some great technicians and scholars in Cameroon.

Administrative and student population

The school is headed by the principal and has about 17 administrators, 10 guidance counsellors and about 200 teachers. The student population has been on the increase with the awareness of technical education which remains the backbone of an emerging Cameroon. The student's population of 2021/2022 academic year was 3078 students.

3.2.2.2. Historical background of GTC Bova- Buea

GTC Bova is located between Ewunda and Bokova in Buea, Fako division in the Southwest region. It was created in 2001 and still functions only with the first cycle. So, the public exams are four years for CAP and five years for GCE Ordinary Levels. It has about 136 staffs and 298 students. It has a computer laboratory with 8 computers and no internet network since it is a rural area. Their specialty courses include building construction, Woodwork, Electrical engineering, home economics, bespoke tailoring. Accounting and Secretary Ship.

Some Trades Available in GTHS Molyko and GTC Bova and Their Subjects

1) Accounting and Management (AM):
2) Electrical Equipment (EPS):
3) Home Economics.
4) Office Automation (Secretary SHIP):
5) Bespoke Tailoring (Clothing Industrial
6) Automobile Repairs Mechanics
7) Tiling
8) Plumbing and Installation Systems
9) Building Construction and Civil Engineering
10) Electronics

11) Marketing
12) Carpentry and Joinery (Woodwork)

***Subjects Offered*:** Mathematics, English language, French, Daily Accounting Practice (DAP), end of year Accounting, International financial Accounting, Economics, Commercial Mathematics, History, Geography, Hygiene, Legislation, Commercial Correspondence, Commerce, Entrepreneurship, Physical Education, Citizenship, Organisation of Administrative work, Office Automation tools, Computer Accounting and Management (CAAM)

Electrical and Electronic Circuit, Electric machine, Technology/Diagram, Computer Science, Law and Government, Citizenship, Entrepreneurship, Economic Geography, Technical Drawing, Engineering Science.

3.3. POPULATION THE STUDY.

Amin (2005), postulates that population is a complete collection (universe) of all elements (units) having the same characteristics that are of interest in an investigation. Thus, a research population is referring to a well-defined collection of individuals or objects known to have similar characteristics. All individuals or objects within a certain population usually have a common, binding characteristic or feature. A research population is generally a large collection of individuals or objects that is the main focus of a scientific inquiry. It is for the benefit of the population that research is done. The population of this study includes all the teacher population of government technical high school Molyko-Buea and Government Technical College Bova-Buea made up of about 336 teachers Source (DDSE statistical report (2021-2022). The target population here includes all the technical government schoolteachers in Buea municipality. The sample population is gotten from the accessible population and its result is being generalized to the target population. our target population in this study are teachers teaching STEM subjects

3.3.1. Sampling procedures and sampling techniques

A sample is a smaller group selected from a larger population to which it represents the larger population. Sampling is a process or technique of choosing a sub-group from a population to participate in the study. It is the process of selecting a few individuals for a study in such a way that the individuals selected represent the large group from which they were selected (Ogula, 2005). Since the whole population cannot be easily studied the need of a sample is often needed in any quantitative or qualitative research work. The sample is therefore taken from the accessible population to represent and generalised the whole. To choose the schools out of the secondary technical schools in Buea municipality, the researcher used the purposive sampling technique. Purposive sampling is a group of non- probability sampling techniques in which units are selected because they have characteristics that you need in your sample. To do this, the researcher choose the only two government technical schools in Buea which are very active and automatically included it as the sample of the study.

3.3.1.1. Sample size

A sample size refers to participants or objects used for a research project. The purpose of sampling is to obtain a group of subjects who will be the representative of the larger population. A sample size comprises some members selected from the population; it is the process of selecting a sufficient number of elements from the population so that by studying the sample, sampling allows the researchers to study a workable number of from the large group to derive findings that are relevant for all members of the group. Sample size measures the number of individual samples measured or observations used in a survey or experiment. Sample size determination is the act of choosing the number of observations or replicates to include in a statistical sample. The sample size is an important feature of any empirical study in which the goal is to make inferences about a population from a sample. In practice, the sample size used in a study is usually determined based on the cost, time, or convenience of collecting the data, and the need for it to offer sufficient statistical power. For the purpose of this study a sample size of 126 teachers which include both male and female teachers from the two schools. teaching STEM subjects. Considering the table of Krejcie and Morgan (1970) for determining the sample size for a research activity, we assumed an accessible population of 126 teachers to be representative 336 teachers of this population (Amin, 2005).

Table 1: Sample size

schools	**Accessible population**	**Sample size**
GTHS Molyko	200	83
GTC Bova	136	43
Total	336	126

3.3.2. Research instrument

Research Instruments are measurement tools (for example, questionnaires or scales) designed to obtain data for research purposes. Research instruments translate attributes or traits into quantities (Amin, 2005). They are tools used for collecting data and these tools must be systematically constructed in order to obtain accurate information needed for the study the

instrument used for data collection in this study is the questionnaire. Amin (2005) defines the questionnaire as a careful designed instrument used for collecting data in accordance with the research questions and hypotheses. The researcher used closed questionnaire which made the study quantitative in nature. The reason for using the questionnaire to collect data for the study was because the researcher was dealing with a large, sampled population. Besides, the use of the questionnaire also saved time as the questionnaire helped the researcher to reach out to many people and get their responses within a short time. Moreover, the questionnaire guaranteed a greater level of anonymity because teachers were able to give information concerning STEM implementation without fear since their identity such as their names and addresses were not needed in the questionnaire. The researcher used the open-ended questionnaire, because the researcher needed in depth information about teachers' perception towards the implementation of STEM to provide more insights when making recommendations at the end of the study. In addition, the opinion of teachers about the Approach was very necessary because it will help for program modification or curriculum innovation. The researcher also used the closed ended questions because; the respondents‟ responses could be easily grouped and analysed within a shorter period. The questionnaire was design in simple plain language to minimize language ambiguity. Also, the questionnaire was such that a respondent could take a maximum of 20 minutes to complete it. The intention was to increase return rate by making more respondents willing to participate.

The questionnaire constructed had two sections. Section A carried demographic information of the respondents. Section B of the instrument bore 25 states on the integration of the ICTs, personalisation learning, Innovative and creative thinking, outdoor learning, and effective implementation of stem.

The Likert Scale was also used. The Likert scale was used because it is flexible and reliable in measuring attitudes and interest. Since the researcher was appraising teachers' curriculum innovation towards the implementation of STEM. The response categories were weighted from 4-1 for a positive note as illustrated below

Table 4: Response Categories in the questionnaire and their weight Response Categories Negative Weighting Positive weighting 1=Strongly Disagree (SD), 2= Disagree (D), 3 =Agree (A), 4= Strongly Agree (SA)

NB: Neutral was not included because research has proven that respondents who are not willing to answer a particular question put a check on neutral. It is just like an escape for those respondents which ultimately divert the result and the true essence can't be achieved. Researcher argues that neutral is zero opinion and cannot be rated three in the continuum as it used to be.

3.3.2.1. Validation of the instrument

According to Amin 2005 validating is the ability to produce findings that agree with the theoretical or conceptual values; in other words, to produce accurate results and measure what is supposed to be measured. Amin equally adds that validity of instrument means an instrument measure what it is supposed to measure, and data collected honestly and accurately represents the respondent's opinion. To ensure that the instrument measured what it is said to measured, the instruments' reliability was ascertained and later on its use was validated. The first concern of the researcher was to establish construct validity, the ability for the instrument to represent the constructs or themes under investigation. This was ensured by covering content (content validity) in the variables in such a way that the questionnaires represented a full coverage of the domains which represented these constructs. More so, to ensure validity, the researcher did a pilot testing on 20 teachers. The results from the pilot testing showed that they were some questions that were difficult for teachers to answer. The researcher had to modify some questions by rephrasing them and questions that were not important were removed. The results from the teachers that were tested shows that there was a question that was not really linked to the objectives/hypotheses. This question was removed by the researcher, also there was some aspect of uncertainties, and some items were not very clear for easy interpretation especially the open questions. All these were corrected.

3.3.2.2. Face validity

To ensure face validity, the researcher after constructing the instrument read through it, gave to classmates and friends to read and correct. From there, the questionnaire was then presented to the supervisor, who went through the questions in order to ascertain if the questions are related to the objectives/hypotheses of the study as stated in chapter one of the study. All these were to ensure face validity of the instrument. After making the necessary corrections the questionnaire was considered to have attained face validity.

3.3.2.3. Content validity

Content validity focuses upon the extent to which the content of an instrument corresponds to the content of the theoretical concept it is designed to measure According to Amin 2005 content validity refers to the degree to which the test actually measures or is specifically related to the traits for which it was designed. It shows how adequately the instrument samples the universe of knowledge, skills, perceptions, and attitude that respondents are expected to exhibit. The content validity of this instrument was determined using the formula; Content validity index CVI = Number of judges who declare items as valid Total number of judges After receiving feedback from the judges, content validity index was computed and yielded a value of (CVI=0.85). (According to Amin (2005), when the content validity index is of an instrument has an average that's 0.70 or above, the instrument is valid and good to be used for data collection.

3.3.2.4. Reliability of the instrument

Amin M (2005) defines reliability as a measure of how consistent the results from a test are. Reliability is a measure of degree to which research yields consistent results after a repeated trial. An instrument is said to be reliable when it measures a variable accurately and consistently and obtain the same results under the same conditions over a period. What it is measuring. After the questionnaire was constructed and validated, to establish the reliability of the questionnaire, the next step was for the researcher to ensure that the instrument could consistently measure what it measured such that it was dependable and trustworthy. The researcher used the test-retest method and correlated scores of respondents in two occasions to compare the degree of consistency between the two. The researcher carried out a pilot study with 20 questionnaires in two schools selected due to proximity and the fact that they were alike to the target population, this pilot study revealed logistic problems and issues to be dealt with in the questionnaires such as uncertainty in language. This pilot testing gave the researcher more clues on what issues had to be dealt with in contacting the respondents and other ethical issues.

- **Piloting the instrument**

The term pilot study is used in two different ways in social science research. It can refer to so-called feasibility studies which are "small scale version(s), or trial run(s), done in preparation for the major study". However, a pilot study can also be the pre-testing or 'trying out' of a particular research instrument. One of the advantages of conducting a pilot study is that it might give advance warning about where the main research project instrument could fail, where research protocols may not be followed, or whether proposed methods or instruments are inappropriate or too complicated. Moreover, pilot testing helps to point out any problem in the test instructions, instances where items are not clear, formatting issues and any other issues are identified when a pilot test is done; Piloting of the questionnaires for the study was done by taking 20 questionnaires to teachers in two different Schools that will not participate in this study. During which the researcher keenly observed the ease with which the respondent cloud handles the items. Areas where they had difficulties were identified and necessary corrections made. The questionnaire was equally taken to evaluation experts for corrections and suggestions. This determined the extent to which the instrument could solicit useful information relevant for the attainment of the objectives of the study.

3.3.2.5. Administration of instrument

According to Kothari, (2004) data collection procedure comprises of steps and action necessary for conducting research effectively and the desired sequencing of these steps. The researcher embarked on the process of collecting data from the field upon a discussion of the research topic and approval of questionnaires by the supervisor. Thus, the researcher collected an authorization from the dean of the faculty of education, university of Yaoundé 1. This authorization permitted the researcher to collect data from the selected schools in the Buea Municipality, Fako division. The researcher presented the letter to principals of the two government technical schools. The principals gave the researcher the authority to start administering the instrument at the researcher’s convenience. This process permitted the researcher to create familiarity with the administrative staff who enormously helped the researcher during the data collection process. During the data collection process, the researcher explained the objectives of the study and also assured the teacher of confidentiality. The researcher also clarified the respondents on areas that seems difficult. After data had been collected from each school, the researcher moved to the next the school. At the end of each data collection session, the completed questionnaire copies were collected on the spot. The process of data collection took the researcher 2weeks on the field (kumar 2011).

Table 2: Reliability Statistics

Cronbach' s Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.930	0.925	50

3.4. DATA COLLECTION PLAN

A Data Collection Plan is a well thought out approach to collecting both baseline data as well as data that can provide clues to root cause. The plan includes where to collect data, how to collect it, when to collect it and who will do the collecting. This plan is prepared for each measure and includes helpful details such as the operational definition of the measure as well as any sampling plans. For the purpose of the study, data was collected from government technical secondary school teachers in Buea Municipality. Questionnaires will be administered to teachers at their convenient time where they can fill it and this will be done by the researcher.

3.4.1. Data analysis procedure

The researcher after completing the data collection process, the data was packaged in one envelope and their data was also grouped according to the schools with the name labelled on it. All these were to ensure that there was no missing questionnaire. After organizing the data, the questionnaires were numbered, and each question was codified (both the opened ended and closed questions). The next step, the researcher did was to build a typing mask in Excel. After this stage, the data was entered in the excel mask. After the researcher finished entering the data, the next step was to verify the data in order to avoid biases and errors. After verification process, the data was now imported from excel to SPSS software to be analysed. Data analysis is a process of inspecting, cleansing, transforming, and modelling data with the goal of discovering useful information, informing conclusions, and supporting decision making. It has a number of advantages over other techniques. When added to its simplicity and easy to understand. It makes it to be preferred by the researcher. Spearman Correlation will be used to determine the degree of association. The spearman Correlation coefficient is a technique for investigating the relationship between two qualitative variables. Spearman's correlation coefficient (p) is a measure of the strength of the association between the two variables. The statistical package for the social scientist (SPSS version 20) software will be used to carry out all the above-mentioned analysis

3.4.2. Model specification

CI= β (IICTs+ PL+ OL+ ICTh) …… EISTEMS

IICTs represents integration of information and communication technologies influence effective implementation of STEM subjects

PL represents personalised/personalisation of learning influence effective implementation of STEM subjects

OL represents outdoor learning influence effective implementation of STEM subjects

ICTh represents innovative and creative thinking influence effective implementation of STEM subjects.

EISTEMS = Effective Implementation of STEM subjects.

A model is a mathematical representation of reality. This may be seen as a simplified view of reality, designed to enable a researcher to describe the essence and inter-relationship within the system or phenomenon it depicts. Model specification refers to the determination of which independent variables should be included in or excluded from a regression equation. The empirical model for this study is designed to ascertain the magnitude and direction of the relationship between curriculum innovation and effective implementation of STEM subjects. The regression model that captures the relationship between curriculum innovation and effective implementation of STEM

- **Ethical Considerations**

The following ethical issues were respected by the researcher in this study. Research subjects must be volunteers: Respondents in this study were voluntarily asked to participate. The inquiries involving respondents' subjects was far based on the freely given informed consent of subjects; what the research is about, who is undertaking and why it is being undertaken. The advantage of such information was that they gave the respondents the opportunity to be fully informed of the nature of the research and the implications of their participation at the outset.

No harm shall result as a consequence of participation in the research: Research that is likely to harm participants is regarded by most people as unacceptable. In this research the issue of no harm to participants was an important issue by advocating care over maintaining the confidentiality and anonymity. The respondents were given the assurance that their identity will not be disclosed in order to uphold privacy, so as to avoid negative effects that can affect the 169 respondent's private life. They were asked not to write their names on the questionnaire.

The respondents were assured that all the information obtained from them was confidential because it was only to be handed by the researcher and such information was used for research purpose. This means that records of respondents were maintained as confidential (by not storing participants' names and address or letter correspondence on hard drives).

3.5. OPERATIONALIZATION OF THE VARIABLES

A variable is a characteristic on which people can differ from one another. A variable is an element whose value can change and take other forms when we see to another. The variables are normally classified into dependent and independent variable. The two types of variables used in this study are (Amin, 2005).

3.5.1. Independent variable

According to Amin (2005), an independent variable is that ‘‘which can be manipulated upon by the researcher’’. It may be called a predictor variable because they can predict or is responsible for the status of other variables. The researcher manipulates it in order to determine the relationship with the observed state of affairs. The independent variable for this study is teachers' perception. It involves modalities like teachers' views, teachers' readiness, and factors influencing teachers' decision to adopt STEM curriculum.

3.5.2. Dependent variables

In view of Amin (2005) a dependent variable is the characteristics that is used when the statement of hypothesis is made. The dependent variable in this study is the effective implantation of STEM subjects; the effective implementation of STEM subjects like; Teaching method, Program coverage, Effective, planning and delivery of lesson, Teacher application, Teacher discipline, Teacher appearance and posture.

Table 3: The Synoptic table

The main hypothesis	Specific hypotheses	Independent variable	Indicators	Dependent variable	indicators	Statistical model and tool	scale
H0: curriculum innovation has no significant influence on the effective implementation of STEM subjects in government technical secondary schools in Buea municipality.		Curriculum innovation	Integration of the ICTs. Personalised learning Outdoor learning Innovation thinking design thinking Strategic thinking	Effective implementation of STEM subjects	Content Equity Interactive learning Collaborative learning Students' engagement Thinking skills development Effective experimentations Practical tools/ applications Workshops Laboratory		

HA: curriculum innovation has a significant influence on effective implementatio n of STEM subjects in government technical secondary schools in Buea municipality		Well-developed curriculum Teacher professional development Effective planning of courses Programme coverage quality and quantity		
H10: The integration Technology (ICTs) as curriculum strategies has no significant impact on effective implementation	Integration of ICTS	Communication Social systems Learning platforms	Simple Linear regressio n analysis SPSS	Likert scale

of STEM subjects in government technical secondary schools in Buea municipality. H1A: The integration Technology (ICTs) as curriculum strategies has significant impact on effective implementation of STEM subjects in technical secondary schools in Buea municipality.		Content management systems Internet facilities Independent online research Computer laboratories Information storage facilities Digital competences Online supervision Manipulation of ICT tools	version 20	
H20: Personalisation/personalised learning has no significant influence on effective implementation	**Personalisation learning**	Adaptive technologies Learning experiences Learner’s interest		Strongly disagree Disagree . Agree

	of STEM subjects in government technical secondary schools in Buea municipality.		Learners needs Learners' aspirations Socio-cultural background	Strongly agree
	H2A: Personalisation learning has significant influence on effective implementation of STEM subjects in technical secondary schools in Buea municipality.		Socio-economic background Empowerment Transformative learning Self-efficacy Blended learning	
	H30: Outdooring learning as a teacher approach has no significant impact on effective implementation of STEM subjects in government technical secondary schools in Buea municipality.	**Outdoor learning**	Industrial visits programmes Continuous reconstruction of knowledge Synergetic transactions Concrete experiences	

	H3A: Outdooring learning as a teacher approach has significant impact on effective implementation of STEM subjects in technical secondary schools in Buea municipality		Knowledge creations Experiential learning Business community interactions Advocacy learning Out-door experimentation Field inspiration
	H40: Innovative thinking as curriculum innovative strategies does not have any significant influence on effective implementation of STEM subjects in government technical secondary	**Innovative and creative thinking**	Critical Self – reflective Creative destruction Prototype development Architecture invention

	schools in Buea municipality.	Curiosity/Researc h skills
	H4A: Innovative thinking as curriculum innovative strategies does have any significant influence on effective implementation of STEM curriculum in technical secondary schools in Buea municipality.	Complex problem-solving skills Value creation Production and product innovation, Disruptive change skills Complex thinking Design thinking

Style sheet APA 7th edition: In this study we adopted APA 7th edition for the in text citations and references. This abbreviation stands for American Psychological Association. This organisation prescribes the norms which are to be respected in scientific writing in the social and educational sciences.

This chapter presented coherently and succinctly the various elements of the research methodology. These elements included: The research approach**,** the research design, the area of the study**,** population, sample size, Instruments, validity and reliability, model, ethical considerations, operationalization of variables, and the synoptic table. These elements constituted the overall scientific approach of the research process in the educational science. It equally gave a circumscription to present study as an original topic that contribute to knowledge and advance curriculum development practices in technical secondary schools in Cameroon. The chapter four will present, and analysis field data collected through a Likert scale questionnaire with the close ended statements.

CHAPTER FOUR

DATA PRESENTATION AND INTERPRETAION

This chapter discusses the results of field data that were collected through a close ended questionnaire. The questionnaire was constructed based on the selected concepts. The data was collected from two technical secondary schools in Buea municipality, with the sample of 126 respondents. The technique used in presenting the data is one in which data is organized, presented and analysis are made to show the impact on the whole study. It uses tables and charts to descriptive representation of findings. The first part will present data on the identity of the respondents, the second will present analyses of the questionnaire items and the third will verify the hypotheses that were developed during the review of empirical literature. This section deals descriptive on the respondent's identity and individual items on the selected indicator of the study. This data includes, number schools, gender, discipline, level of education and age. Each of concept has 10 items each according to scale measuring the different items. These data permit us to have the statistical details of the various respondents and how the information contribute to the overall responses in the course of the data analysis. This statistical table present the percentages and frequencies for schools, discipline, years, sex and age of the respondents. These frequencies and the percentages show the variations in the different demographic information for the better understands of the demographic structure of respondents and evolution of teacher population within government technical secondary schools in Buea Municipality.

4.1. DATA INTERPRETATION

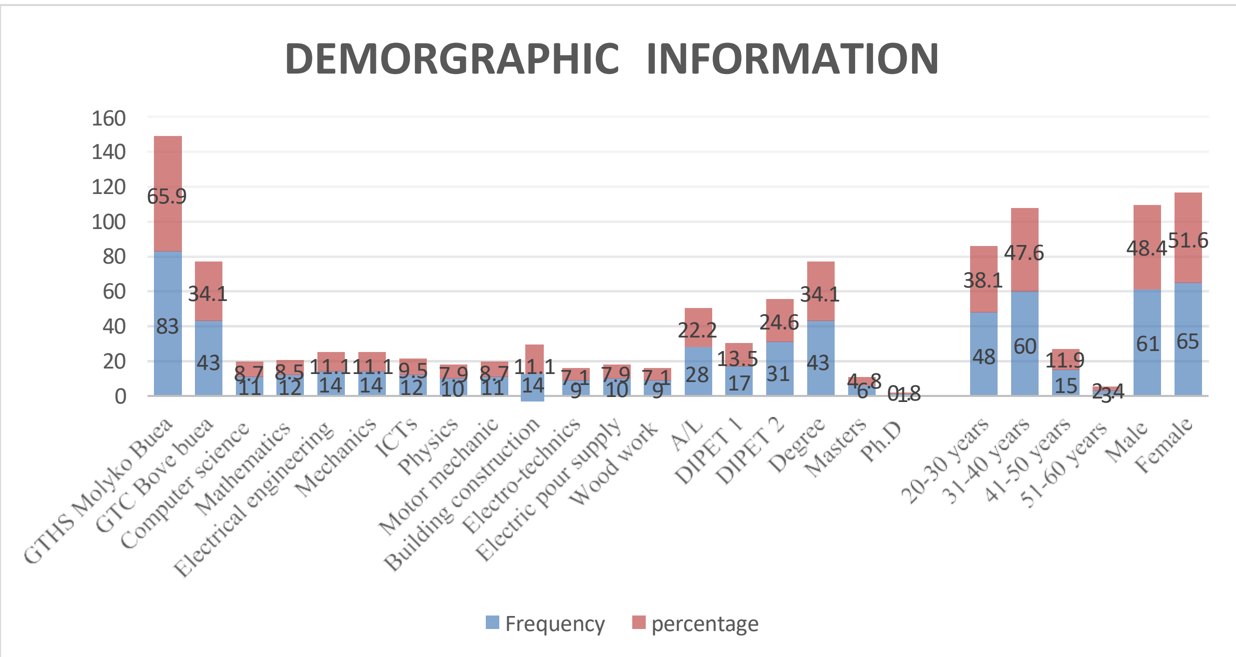
Table 4: Sample distribution according to demographic information on the respondents

Item	Modalities	Frequency	Percentage
School	GTHS Molyko- Buea	83	65.9
	GTC Bova -Buea	43	34.1
Discipline	Computer science	11	8.7
	Mathematics	12	9.5
	Electrical engineering	14	11.1
	Mechanics	14	11.1
	ICTs	12	9.5
	Physics	10	7.9

	Motor mechanic	11	8.7
	Building construction	14	11.1
	Electro-technics	9	7.1
	Electric power supply	10	7.9
	Woodwork	9	7.1
Level of education	A/L	28	22.2
	DIPET 1	17	13.5
	DIPET 2	31	24.6
	Degree	43	34.1
	Masters	6	4.8
	Ph.D.	1	0.8
Age	20-30 years	48	38.1
	31-40 years	60	47.6
	41-50 years	15	11.9
	51-60 years	3	2.4
Gender	Male	61	48.4
	Female	65	51.6

(Source: field data)

Graph 1: Demographic information



This graph presents the sample distribution according to the respondents' demographic information. For the two school-GTHS Molyko Buea represent 83 respondents with the percentage score of 65.9% GTC Bova- Buea represent 43 respondents giving a percentage of 34.1%. This means that GTHS Molyko Buea is the more representative of the two government technical schools. For the STEM subjects: Computer science11(8.7%), mathematics12(9.5%) electrical engineering14(11,1%), mechanics14(11.1%), ICTs12(9.5%), physics10(7.9%), motor mechanic11(8.7%), building construction14(11.1%), electro technics 9(7.1%), electrical power supply10(7.9%) and woodwork 9(7.1%). According to the level of education, A/L28 (22.2%), DIPET1 17(13.5%), DIPET2 23(24.6%), BA 43(34.1%), MASTERS 6(4.8%, Ph. D1
(0.8%). The sample distribution according to discipline indicate that there is relative even spread in the population which can but express the realities STEM education in the Buea municipality. The sample distribution according to age show that between 20-30 years 68(38.1%), 31-40 years 60(47.6%), 41-50 years, 51-60 years 3(2.6%). Based on this statistical distribution the age between 31-40 with the percentage of 47.6% is the most representative of the population. The sample distribution according to sex show that Male61 with the percentage of 48.4% and Female65 giving a percentage of 51.6%. In this regard female gender is more representative than male.

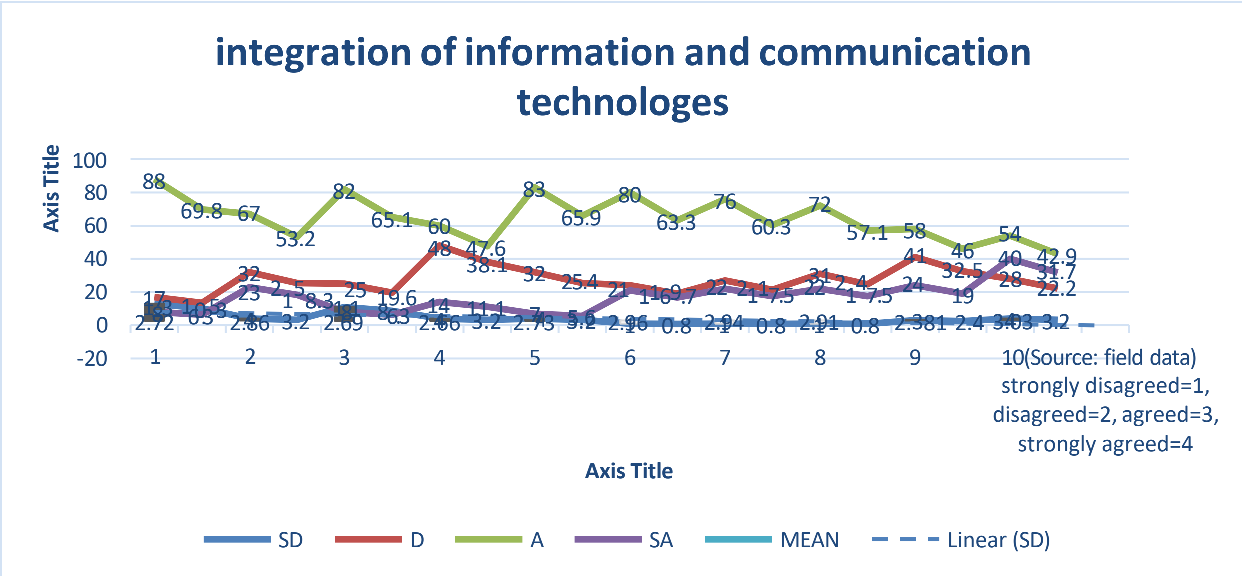
Table 5: Sample distribution according to Integration of information and communication technologie*s*

No	Item		SD	D	A	SA	MEAN
1	Your school provide effective communication channels	f	13	17	88	8	2.72
		%	10.3	13.5	69.8	6.3	
2	There is technology social system for students and teachers interactions	f	4	32	67	23	2.86
		%	3.2	25.4	53.2	18.3	
3	There are available online learning platforms	f	11	25	82	8	2.69
		%	8.7	19.6	65.1	6.3	
4	Your school provide content management system	f	4	48	60	14	2.66
		%	3.2	38.1	47.6	11.1	
5	There is availability connectivity in your school	f	4	32	83	7	2.73
		%	3.2	25.4	65.9	5.6	
6	You can carry out online research effectively and independently	f	1	24	80	21	2.96
		%	0.8	19.0	63.3	16.7	
7	You have great skills in the manipulation of ICT tools and application	f	1	27	76	22	2.94
		%	0.8	21.4	60.3	17.5	
8	Your school has information storage facilities	f	1	31	72	22	2.91

		%	0.8	24.6	57.1	17.5	
9	Your school has a well-equipped computer laboratory	f	3	41	58	24	2.81
		%	2.4	32.5	46.0	19.0	
10	Your school promote the acquisition of ICT competence	f	4	28	54	40	3.03
		%	3.2	22.2	42.9	31.7	

(Source: field data) strongly disagreed=1, disagreed=2, agreed=3, strongly agreed=4

Graph 2: Integration of information and communication technologies



This table show a sample distribution of the respondents' perception on the integration information and communication technologies. In first item 13(10.3%) of the respondents strongly disagreed, disagreed17 (13.5%), agreed88 (69.8%) and strongly agreed8 (6.3%) with the statement that your school provide effective communication channels. This represents the (mean=2.72). Even though most of the respondent agreed at 69.8% but the mean shows a negative perception on this item. For the second item 4(3.2) of the respondent strongly disagreed, disagreed32 (25.4%), agreed 67(53.25%) and 23(18.3%) strongly agreed that There is technology social system for students and teachers' interactions. This sample distribution gives a (mean=2.86). In the third item the 11(.8.7%) strongly disagreed, 25(19.6%) disagreed, 82(65.1%) agreed, and 8(6.3%) strongly agreed that There are available online learning platforms with the mean of (mean=2.69). In the four item 4, (3.2%) respondents strongly disagreed, 48(38.1%) disagreed, 60(47.6%) agreed and 14(11.1%) strongly agreed that Your school provide content management system a giving (mean=2.66). the fifth item show that 4(3.2%) strongly disagreed, 32(25.4%) disagreed, 83(65.9%agreed and 7(5.5%) strongly There is availability connectivity in your school agreed with the (mean=20.73). in the sixth item 1(0.8%) respondent=) strongly disagreed, 24(19.0%) disagreed, 80(63.3%) agreed and 21(16.7%) strongly agreed with the statement that You can carry out online research effectively and independently these statistics represent the(mean=2.96). the seven-item show that 1(0.8%) of the respondent strongly disagreed, 27(21.9%) disagreed,76(60.3%) agreed and 22(17.5%) strongly agreed that You have great skills in the manipulation of ICT tools and applicationgiven average of (mean=2.99). in the eighth item, 1(0.8%) respondent strongly disagreed,31(24.6%) disagreed, 72(60.3) agreed and 22(17.5%) strongly agreed with the view Your school has information storage facilities that giving a(mean=2.91) in item ninth 3(2,4%) of the respondents strongly disagreed, 41(32.5%)disagreed, 58(46.0%)agreed, and 24(19.0%)strongly agreed with the statement that Your school has a well-equipped computer laboratory (mean=2.81). in the tenth item the 4(3.2%) respondents strongly disagreed, 28(22.2) disagreed, 54(42.9%) and 40(37.7%) agreed strongly with the statement that Your school promote the acquisition of ICT competence. (Mean=3.03%). The individual scale level majority of the respondents agree with this item, but the over mean show negative integration of ICTS as effective curriculum innovation strategy to effective implementation of STEM Subjects in technical school in Buea municipality.

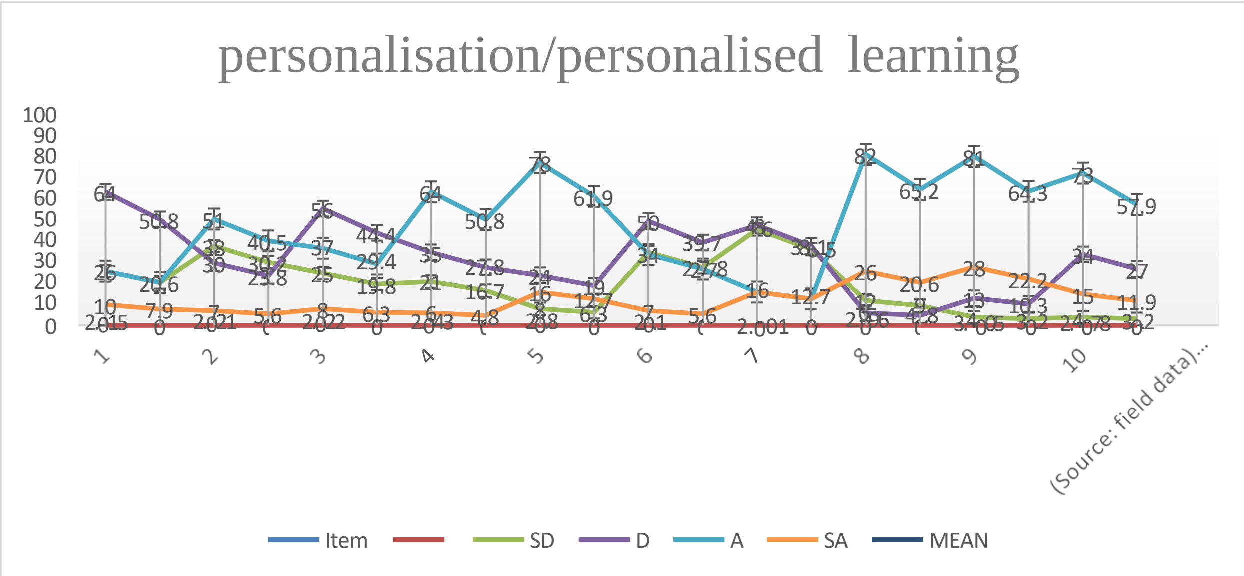
Table 6: Sample distribution according to Personalisation/personalised learning

No	Item		SD	D	A	SA	MEAN
1	There is available adaptive technology for personal learning	f	26	64	26	10	2.15
		%	20.6	50.8	20.6	7.9	
2	The programmes address students' learning needs	f	38	30	51	7	2.21
		%	30.2	23.8	40.5	5.6	
3	The students learning through their personal experiences	f	25	56	37	8	2.22
		%	19.8	44.4	29.4	6.3	
4	The learning process take into account students' interests	f	21	35	64	6	2.43
		%	16.7	27.8	50.8	4.8	
5	The teaching programmes consider students aspiration in skills development	f	8	24	78	16	2.80
		%	6.3	19.0	61.9	12.7	
6	The technical education programme considers students' socio-cultural background	f	35	50	34	7	2.10
		%	27.8	39.7	27.0	5.6	
7	The programmes take into consideration students socio-economic background	f	46	48	16	16	2.01
		%	36.5	38.1	12.7	12.7	
8	The teaching programme is for students' self-empowerment	f	12	6	82	26	2.96
		%	9.5	4.8	65.2	20.6	

9	Your curriculum engaged in transformative learning processes	f	4	13	81	28	3.05
		%	3.2	10.3	64.3	22.2	
10	You integrate blended learning strategies as pedagogic approach	f	4	34	73	15	2.78
		%	3.2	27.0	57.9	11.9	

(Source: field data) strongly disagreed=1, disagreed=2, agreed=3, strongly agreed=4

Graph 3: Personnalisation/personalised learning



The table above presents the sample distribution according to respondents' views on personalised learning as curriculum innovation strategy in STEM education. In the first item 26(20.6%) respondents strongly disagreed, 64(50.8%) disagreed, 26(20.6%) agreed and 10(7.9%) strongly agreed that there is available adaptive technology for personal learning result to the (mean=2.15). the second item show that 38(30.2%) respondents strongly disagreed, 30(23.8%) disagreed, 51(40.5agreedand7(5.6%) strongly agreed with the statement that the programmes address students' learning needs at (mean=2.21). the third item indicate that 25(19.8%) respondents strongly disagreed,56(44,4%) disagreed, 37(29.4%) agreed and 8(6.3%) strongly agreed that The students learn through their personal experiences with the (mean=2.22). in the fourth item, 21(16.7%) of the respondent strongly disagreed, 35(27.8%) disagreed, 64(50.8%) agreed and 6.48) strongly agreed with the statement that the learning process take into account students interests at (mean= 243). The fifth item indicates that 8(6.3%) of the respondents strongly disagreed, 249(19.0%) disagreed, 78(61.1%) agreed and 16.7%) strongly agreed that the teaching programmes consider students' aspiration in skills development at an average (mean=2.80). The sixth item shows that 35(27.8%) of the respondents strongly disagreed, 50(39.7%) disagreed, 34(27.0%) agreed and 7(5.0%) strongly agreed with that the technical education considers students' socio-cultural background the (mean=2.10). =) in the seventh item 46(36.5%) of the respondents strongly disagreed 48(38.1%) disagreed, 16(12.7) agreed and 16(12.7%) strongly agreed with the perception that the programmes take into consideration students' socio-economic background. This perception gives an average of (mean=2.01). in the eighth item, 12(9.2%) of the respondents stronglydisagreed,6(4.8%) disagreed, 82(65.2%)agreed, and 26(20.6%)strongly agreed that The teaching programmes are for students' self-empowerment these responses give the descriptive statistics give an average of (mean=2.96). the ninth items show that 4(3.4%) of the respondents strongly disagreed, 13(10.3%)disagreed, 81(64.3%)agreed and 28(22.2%) strongly agreed that with the statement Your curriculum engaged in transformative learning processes (mean=3.05). the tenth item, 4(3.4%)strongly disagreed,34(27.0%) disagreed, 73(57.9%)agreed, and 15(11.9%)strongly agreed with the statement that integrate blended learning strategies as pedagogic approach. Mean=2.78). The overall mean gives negative perception of the respondents' responses. This means that curriculum developers in this domain have devise innovative strategies in improve the effective implementation of STEM Subject in Cameroon secondary school.

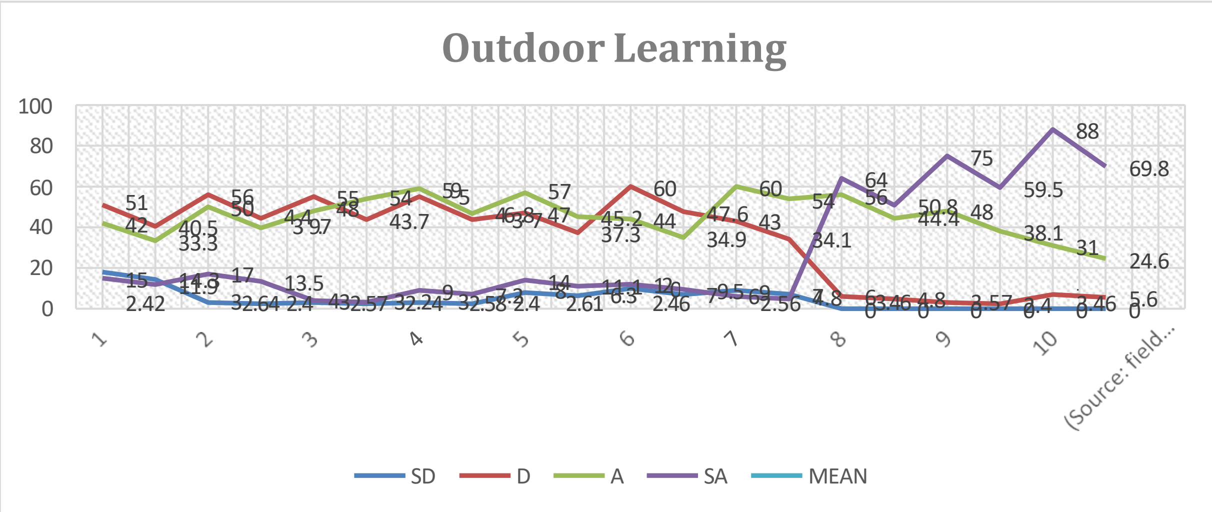
Table 7: Sample distribution according to Outdooring learning

No	Item		SD	D	A	SA	MEAN
1	Your curriculum content has industrial visits programmes	f	18	51	42	15	2.42
		%	14.3	40.5	33.3	11.9	
2	The programmes encourage synergetic transaction in skills and knowledge development teaching	f	3	56	50	17	2.64
		%	2.4	44.4	39.7	13.5	
3	There are opportunities for holistic knowledge and skill adaptation processes	f	3	55	48	4	2.57
		%	2.4	43.7	54.0	3.2	
4	Your institution create avenue for concrete learning experience out of the school context	f	3	55	59	9	2.58
		%	2.4	43.7	46.8	7.2	
5	There are out-door experimentation or knowledge testing opportunities	f	8	47	57	14	2.61
		%	6.3	37.3	45.2	11.1	
6	Your school creation links with the business community for student interactions	f	10	60	44	12	2.46
		%	7.0	47.6	34.9	9.5	
7	There out-door opportunities for knowledge creation and competence development	f	9	43	60	6	2.56
		%	7.1	34.1	54.0	4.8	
8	Out-door is means of field inspiration for student knowledge and skills development	f	/	6	56	64	3.46
		%	/	4.8	44.4	50.8	

9	Out-door provide students with industrial reality and skills are well tested	f	/	3	48	75	3.57
		%	/	2.4	38.1	59.5	
10	You will advocate for outdoor learning programmes for technical school	F	/	7	31	88	3.46
		%	/	5.6	24.6	69.8	

(Source: field data) strongly disagreed=1, disagreed=2, agreed=3, strongly agreed=4

Graph 4: Outdoor Learning



This table presents statistical sample distribution according to respondents' view on outdoor learning in technical education in Buea municipality. In the first item 18(14.3) of the respondents strongly disagreed, 51(40.5%) disagreed, 42(33, 3%) agreed, and 15(11.9%) strongly agreed with the statement that your curriculum content has industrial visits programmes (mean=2, 42). In the second item 2(3.4%) of the respondents strongly disagreed, 56(44.4%) disagreed, 50(39.7%) agreed and 12 (13.5%) strongly agreed with the view that The programmes encourage synergetic transaction in skills and knowledge development teaching(mean=2.64). the third item show that 3(2.4%) strongly disagreed, 55(43.7%) disagreed, 48(54.0%)agreed, and 4(3.2%) strongly agreed that There are opportunities for holistic knowledge and skill adaptation processes(Mean=2.57). in the fourth item 3(2,4) of the respondents strongly disagreed, 55(43.7%) disagreed, 59(46.8%) agreed and 9(7.2%)strongly agreed with the statement that Your institution create avenue for concrete learning experience out of the school context(mean=2.58). the fifth item indicates that 8(6.3%) strongly disagreed, 47(37.3%) disagreed, 54(45.2%)agreed and 14(11.1%)strongly agreed that There are out-door experimentation or knowledge testing opportunities(mean=2.61). in the sixth item, 10(7.0%) respondents strongly disagreed, 60(47.6%) disagreed, 44(34.9%)agreed and12(9.5%) strongly agreed that Your school creation links with the business community for student interactions(mean=2.46). The seven shows that 9(7.1%) strongly disagreed, 43(34.1%)

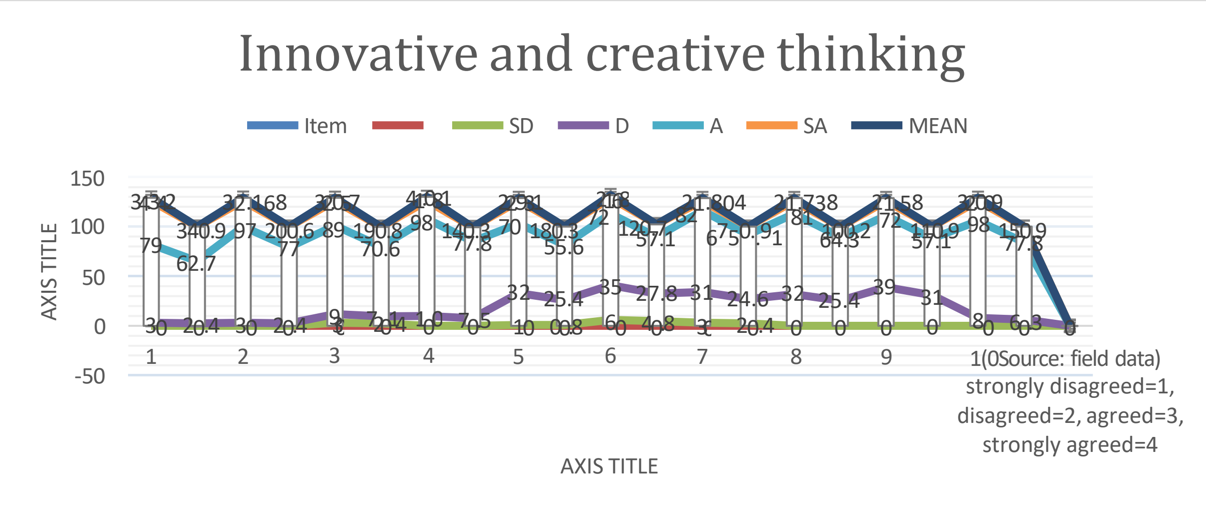
disagreed, 60(54.0%) agreed and 6(4.8) strongly agreed that There out-door opportunities for knowledge creation and competence development (mean=2.56). for the eighth items 6(4.8%) of the respondents disagreed, 56(44.4%) agreed, 64(50.8%) strongly agreed that Out-door is means of field inspiration for student knowledge and skills development(mean=3.46). in the ninth item 3(2.4%) disagreed,48(33.1%) agreed and 75(59.5%) strongly agreed with the statement that Out-door provide students with industrial reality and skills are well tested(mean=3.57). in the tenth item 7(5.6%) of the respondents disagreed, 31(24.6%) agreed and 88(69.8%) strongly agreed with the view that You will advocate for outdoor learning programmes for technical school. Even though most of the response expresses a positive view toward outdoor learning the average mean is still very low. This implies. Institutional administrators and curriculum developers have to design strategies of improving the effective implementation STEM subjects in technical schools in Buea municipality.

Table 8: Sample distribution according to Creative/innovative thinking

No	Item		SD	D	A	SA	MEAN
1	You encourage students' self-reflection in their respective subject area	F	/	3	79	44	3.32
		%	/	2.4	62.7	34.9	
2	You transmit value creation strategies to students	F	/	3	97	26	3.18
		%	/	2.4	77.0	20.6	
3	Your school promotes innovative processes and products	F	3	9	89	25	3.07
		%	2.4	7.1	70.6	19.8	
4	You transmit complex thinking skills to students	F	/	10	98	18	4.01
		%	/	7.5	77.8	14.3	
5	Students are transmitted complex problems solving competences	F	1	32	70	23	2.91
		%	0.8	25.4	55.6	18.3	
6	You develop architecture for invention	F	6	35	72	16	2.80
		%	4.8	27.8	57.1	12.7	
7	You encourage prototype development	F	3	31	82	10	2.84
		%	2.4	24.6	65.1	7.9	
8	You have a mastery of design thinking processes	F	/	32	81	13	2.78
		%	/	25.4	64.3	10.2	
9	You prepare students for disruptive change environments	F	/	39	72	15	2.80
		%	/	31.0	57.1	11.9	
10	You stimulate your students curiosity and build research orientated minds	F	/	8	98	20	3.09
		%	/	6.3	77.8	15.9	

(Source: field data) strongly disagreed=1, disagreed=2, agreed=3, strongly agreed=4

Graph 5: Innovative and creative Thinking



This table present a sample distribution according respondents' perceptions on creative/innovative thinking in technical education in Buea municipality. In the first item, 3(2.4%) of the respondents disagreed, 79(62.7%) agreed, and 44(34.9) strongly agreed with the statement that You encourage students' self-reflection in their respective subject area(mean=3.32). in the second item 3(2.4%) of the respondents disagreed, 97(77.0%) agreed and 26(20.6%) strongly agreed that You transmit value creation strategies students(mean=3.18). in the third item, 3(2.4%) of the respondents strongly disagreed, 9(7.1%) disagreed, 89(70.6%) agreed and 28(19.8%) strongly agreed with the affirmation that Your school promotes innovative processes and products(mean=3.07). the fourth item shows that 10(7.5%) disagreed, 98(77.8%) agreed and18(14.3%) strongly agreed with the assertion that you transmit complex thinking skills to students(mean=4.01). for fifth item,1(0.8%) of the respondents strongly disagreed, 32(35.4%) disagreed, 70(55.6%) agreed and 23(18.3) strongly agreed with the statement that students transmitted complex problems solving competences (mean=2.91). for the sixth item, 6(4.8%) strongly disagreed,38(27.8%) disagreed, 72(57.1%) agreed and 16(12.7%) strongly agreed with the statement that You develop architecture for invention (mean=2.80). the seventh item shows that 3(2.4%) of the respondents strongly disagreed, 31(24.6%) disagreed, 82(65.1%) agreed and 10(7.9) strongly agreed with the view that You encourage prototype development(mean=2.84). in the eight item, 32(25.4%of the respondents disagreed, 81(64.3%) agreed and 13(10.3%) strongly agreed with the assertion that You have a mastery of design thinking processes(mean=2.78). The ninth item reveals that 39(31.0%) of the respondents disagreed, 72(57.1%) agreed and 15(11.9%) strongly agreed with the perception that you prepare students for disruptive change environments (mean=2.80).

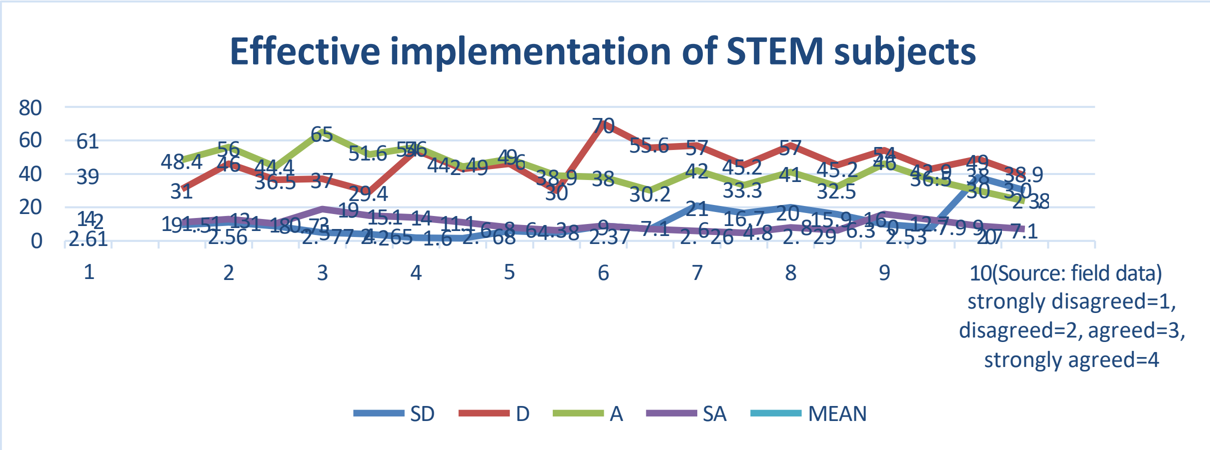
lastly, the tenth item 8(6.3%) disagreed, 98(77.8%) agreed and 20(15.9%) strongly agreed withthe statement that you stimulate your students' curiosity and build oriented research minds. On the scale level, a great number of the respondents agreed and strongly agreed to some of the items on creative/innovative thinking. But the means indicated that there is a negative tendency in the development of this competences. Institutional stakeholders must work to ameliorate the situation of promoting innovation and inventions in technical school. The 21st century is marked by this kind of thinking that curriculum innovation must consider this as fundamental for educational change in Cameroon.

Table 9: Sample distribution according to effective implementation of STEM subjects

No	Item		SD	D	A	SA	MEAN
1	There is content equity in the development STEM subjects	f	12	39	61	14	2.61
		%	9.5	31.0	48.4	11.1	
2	These subjects consider students' engagement	f	11	46	56	13	2.56
		%	8.7	36.5	44.4	10.3	
3	Students' thinking skills are development in the STEM subjects	f	5	37	65	19	2.77
		%	4.0	29.4	51.6	15.1	
4	There are effective interactions/monitoring in the implementation of STEM subjects	f	2	54	56	14	2.65
		%	1.6	42.9	44.4	11.1	
5	There are effective practical tools/applications for the implementation of STEM subjects	f	6	46	49	8	2.68
		%	4.8	30.0	38.9	6.3	
6	There is effective collaboration/cooperation in the teaching of STEM subjection	f	9	70	38	9	2.37
		%	7.1	55.6	30.2	7.1	
7	You have well equipped workshops for STEM subjects	f	21	57	42	6	2.26
		%	16.7	45.2	33.3	4.8	
8	You have well equipped laboratories for STEM subjects	f	20	57	41	8	2.29
		%	15.9	45.2	32.5	6.3	
9	Teachers have up-to-date pedagogic skills in teaching STEM subjects	f	10	54	46	16	2.53
		%	7.9	42.9	36.5	12.7	
10	The curriculum of STEM subjects is well development	f	38	49	30	9	2.07
		%	30.2	38.9	23.8	7.1	

(Source: field data) strongly disagreed=1, disagreed=2, agreed=3, strongly agreed=4

Graph 6: Effective implementation of STEM subjects



This table presents the sample distribution according respondents views on the implement of STEM subject in government technical secondary schools in Buea municipality. The first item reveals that 12(9.5%) of the respondents strongly disagreed, 39(31.0%) disagreed, 61(48.4%)agreed and 14(11.1%)strongly agreed that There is content equity in the development STEM subjects(mean=2.61). for the second item 11(8.7%) of the respondents strongly disagreed, 46(36,5%) disagreed, 65(44.4%)agreed and 13(10.3%)strongly agreed with the view that These subjects take into account students' engagement(mean=2.56). In the third item, 5(4.0%) of the respondents strongly disagreed, 37(29.4%) disagreed, 65(51.6%) agreed and 19(15.1%) strongly agreed that Students' thinking skills are development in the STEM subjects (mean=2.77). The fourth item indicate that, 2(1.6%) of the respondents strongly disagreed, 54(42.9%) disagreed, 56(44.4%) agreed and 14(11.1%) strongly agreed thatThere are effective interactions/monitoring in the implementation of STEM subjects (mean=2.65). In the fifth item, 6(4.8%) of the respondents strongly disagreed, 46(30.0%) disagreed, 49(38.9%) agreed and 8(6.3%) strongly agreed with the assertion that There is effective practical tools/applications for the implementation of STEM subjects (mean=2.68). The sixth item reveals that 9(7.1%) of the respondents strongly disagreed, 70(55.6%) disagreed, 38(30.2%) agreed, 9(7.1%) strongly agreed that There is effective collaboration/cooperation in the teaching of STEM subjects (mean=2.37). The seventh items show that 21(16.7%) of the respondents strongly disagreed, 57(45.2%) disagreed, 42(33.3%) agreed and 6(4.8%) strongly agreed with the statement that you have well equipped workshops for STEM subjects (2.26). On the eighth item 20(18.9%) of the respondents strongly disagreed, 57(45.2) disagreed, 41(32.5) agreed and 6(6.3%) strongly agreed that you have well equipped laboratories for

STEM subjects (mean=2.29). The ninth item indicates that 10(7.9%0 of the respondents strongly disagreed, 54(42.9%) disagreed, 46(36.5) agreed and 16(12.7%) strongly agreed that a Teachers have up-to-date pedagogic skills in teaching STEM subjects (mean=2.53). In the last item, which is the tenth, 38(30.2%) of the respondents strongly disagreed, 49(38.9%) disagreed, 30(23.8%) agreed and 9(7.1%) strongly agreed with the statement that the curriculum of STEM subjects is well development (mean2.07). From this statistical presentation, it is evident that the implementation of STEM subject in technical schools Buea municipality is not yet effective. Therefore, curriculum innovators must harness frameworks to enhance effective STEM implementation in technical education in Cameroon. Curriculum innovation with contextual and experiential realities can be strategic insight to unlocking technological innovation in Cameroon.

4.2. INFERENTIAL STATISTICS

This part presents inferential statistics of the sample population of the study. This is made up of a model summary, ANOVA table and coefficient table. All these tables present the predictability potential of each independent variable on the dependent variable. In this way, it permits us determine the influence of curriculum innovation and effective implementation of STEM subjects in government technical schools in Buea municipality, Cameroon.

Table 10: The model summary table

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.791[a]	.625	.613	3.76402	.625	50.420	4	121	.000

a. Predictors: (Constant), ICTh, PL, ODL, IICTS

This table presents the model summary of the multiple linear regressions of four independent variables were entered into (IICTs, PL, OL and ICTh) with the coefficient of the multiple determination of R square change of 62.5% variation from the dependent variable - conflict resolution (CR) with the df (4,141) significance of change of 0.000. Based these results curriculum innovation has significant influence on the effective implementation of STEM subjects. Therefore, curriculum innovation is an important factor in curriculum design in Cameroon.

Table 11: Table of ANOVA

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2857.401	4	714.350	50.420	.000[b]
	Residual	1714.314	121	14.168		
	Total	4571.714	125			

a. Dependent Variable : EISTEM

b. Predictors: (Constant), IICTs, PL, OL, ICTh

In this table the overall model is significantly useful in explaining the influence of F (50, 420)- degree of freedom(df) = (4,125), p< 0.005 at the significant level of 0.000 f change. This results equally give the significance of curriculum innovation in relation to effective implementation of the STEM subject in government technical schools in Buea municipality.

Table 12: Coefficient table

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-9.947	3.204		-3.104	.002
	IICTs	.179	.091	.127	1.965	.052
	PL	.759	.089	.564	8.501	.000
	OL	.412	.102	.259	4.045	.000
	ICTh	.035	.059	.033	.583	.561

a. Dependent Variable : EISTEM

This table shows a standard multiple regression which was conducted to ascertain the influence of curriculum innovation on effective implementation of STEM subjects, the results in this table help in the prediction and categorisation of the variables. This this table presents the standardised and unstandardized coefficient which involves the STD error and the beta, it gives the significance level indicating the predictability of the variable

Hypothesis testing

Based on the coefficient table, the hypotheses developed for this study are tested to determine their effects and level predictability of each of the independent variables. The results enable to see which of the independents variables is the most predictive.

H_{10}: The integration Technology (IICTs) as curriculum strategies has no significant impact on effective implementation of STEM subjects in technical secondary schools in Buea municipality.

H_{1A}: The integration Technology (IICTs) as curriculum strategies has significant impact on effective implementation of STEM subjects in technical secondary schools in Buea municipality.

In the coefficient table the first independent variable entered was integration of information and communication technology (IICTs). The findings show that the integration of (IICTs) =B (0.179, std error (0.079), β (0.127), t (1.965), sig (0.052) PV < 0.005. Based on these statistics, the significance is 0.052 = 0.005 and is partially correlated at 12.7%. This signifies that there is statistical significance between the independent (curriculum innovation) and dependent variable (effective implementation of STEM subjects). These findings reject the null hypothesis that ***The Integration Technology (IICTs) as curriculum strategies has no significant impact on effective implementation of STEM subjects in technical secondary schools in Buea municipality***. However, the alternative which postulates that ***The Integration Technology (IICTs) as curriculum strategies has significant impact on effective implementation of STEM subjects in technical secondary schools in Buea municipality is retained.*** In this line IICTs is an important indicator of curriculum innovation in Cameroon technical education especially in STEM curriculum. Curriculum developers must work to ensure the integration of ICTs in the STEM curriculum as means of enhance quality technical education for the 21st century. Government and the various stakeholders must heavily in ICTs in technical education in Cameroon.

H_{20}: Personalisation/personalised learning has no significant influence on effective implementation of STEM subjects in technical secondary schools in Buea municipality.

H_{2A}: Personalisation learning has significant influence on effective implementation of STEM subjects in technical secondary schools in Buea municipality.

The coefficient table equally present the second independent variable personalised learning (PL) = B (0.759), std error (0.089), β (0.564), t (8.501), sig. level 0.000 < pv 0.005 and partial correlated at 56.4%. This means a corresponding increase in personalised learning will yield a corresponding improve in STEM subject. The evidence of this statistical representation rejects the null hypothesis that ***Personalisation/personalised learning has no significant influence on effective implementation of STEM subjects in technical secondary schools in Buea municipality. Consequently, the alternative which opines that Personalisation learning has significant influence on effective implementation of STEM subjects in technical secondary schools in Buea municipality.*** Anchoring on this this alternative, personalised learning is an indispensable indicator of curriculum innovation. Curriculum designers and planner must envisage personalised learning as an effective tool of STEM curriculum in Cameroon technical education. The competences and knowledge development in technical education have to be grounded on an innovation curriculum to captures the student needs and engagement in curriculum innovation as means of stimulating invention and discoveries.

H_{30}: Outdooring learning as a teacher approach has no significant impact on effective implementation of STEM subjects in technical secondary schools in Buea municipality.

H_{3A}: Outdooring learning as a teacher approach has significant impact on effective implementation of STEM subjects in technical secondary schools in Buea municipality.

Outdooring learning is the third independent variable which entered into the model. OL=B (0.412), std error (0.102), β (0.259), t (4.045), sig. (0.00) < PV0.005 at a partial correlation of 25.9%. This implies that, Outdoor learning has an increasing potential of 25.9% if it is considered at every level of curriculum innovation in STEM education in Cameron. From this statistical presentation, 0.000 is less 0.005 PV rejecting the null hypothesis that ***Outdooring learning as a teacher approach has no significant impact on effective implementation of STEM subjects in technical secondary schools in Buea municipality***. Therefore, it affirms the alternative that ***Outdooring learning as a teacher approach has significant impact on effective implementation of STEM subjects in technical secondary schools in Buea***

municipality. Outdooring is a strategic element of curriculum innovation in technical education. Developing frameworks and mobilising resources for the implementation of outdoor learning in Cameroon technical education is an effective strategy in transformative of STEM education. Socio-economic development Cameroon depends on the innovation coming in from STEM education.

H_{40}: Innovative/Creative thinking as curriculum innovative strategies does not have any significant influence on effective implementation of STEM subjects in technical secondary schools in Buea municipality.

H_{4A}: Innovative/Creative thinking as curriculum innovative strategies does have any significant influence on effective implementation of STEM curriculum in technical secondary schools in Buea municipality.

The four independent variables entered into the model was ***Innovative/Creative thinking*** (ICTh) =B (0.035), std error (0.059), β (0.33), t (0.582), sig. 0.56 <PV 0.005 and a partial correlated of 03.3%. Significance that creative/innovative do not significant contribution to model. From the standardised coefficient, calculated value and the partial correlation, there is lower degree of predictability by the creative/innovative thinking on the effective implementation of STEM subject. Therefore, the null hypothesis ***creative/Innovative thinking as curriculum innovative strategies does not have any significant influence on effective implementation of STEM subjects in technical secondary schools in Buea municipality*** is accepted while rejecting the alternative. In this light, the curriculum developers must double their vision to influence curriculum implementation in STEM education. Creative/innovative thinking can only thrive in a conducive environment. Therefore, technical education stakeholders have to come tools which teachers and students to reinvigorate innovative thinking capabilities. The attainment of this objective contributes to sustainable socio-economic development of the country.

Capturing from this presentation and interpretation of the statistical field data, personalised learning and outdoor learning are the most predictive of the variables, followed by integration of information and communication technology a, creative/innovative thinking is the third predictive and effective planning is the four and last predictive of the variable. At individual level each of the variable an influence on the dependent variable. However, the multiple regression show that personalised learning and outdoor learning are most influential and should be consider serious in the curriculum development processes in STEM education in Cameroon technical education.

By and large, this chapter presented and interpreted the descriptive statistics with frequencies and percentages. This descriptive statistic involved: demographic information on sex, age level of education and school of the participants. The items of each of the independent variables were also present interpreted according to scales of strongly disagree=1, disagree=2, agree=3 and strongly agree=4. Equally, the item scale range has mean determining the perceptions of the respondents on the constructs under investigation. After, these descriptive statistics, inferential statistics were likewise presented and interpreted. The inferential statistics consist of: A model summery, ANOVA table and coefficient table. These tables were used to test the hypotheses in terms of their predictability and categorisation (impacts on the dependent variable). From the coefficient table the variables were classified or categorized according to their degree of predictability. Therefore, it can be concluding without any possible energy of double that curriculum has significant statistical influence on the effective implementation of STEM subjects in technical secondary schools in Buea municipality.

CHAPTER FIVE

DISCUSSION OF FINDINGS, SUMMARY OF THE FINDINGS LIMITATION OF THE STUDY, PERSPECTIVES FOR FURTHER RESEARCH, RECOMMENDATIONS AND CONCLUSION

The main objective of this study is to examine the impact of curriculum innovation on effective implementation of STEM subjects in technical secondary schools in Buea municipality. This chapter deals with the discussion of findings from the quantitative data which were carried out under the predetermined hypotheses. The discussions at this capture the view from the empirical literature, theories and results obtained from the field to give new orientation to curriculum development in technical education Cameroon secondary school. It will propose perspectives for further research drawn from the challenges encountered in the course of this study. And recommendation is made to various stakeholders in the secondary technical education sub sector to ameliorate the system for better performance.

5.1. DISCUSSION OF FINDINGS

The discussion of findings follows a consistent data presentation and builds argument based on data and previous empirical works. These discursive arguments are supported by theoretical approaches selected for the study.

The integration of information and communication technologies into STEM education is an important tool of curriculum innovation for effective implementation of STEM subject in government technical secondary schools in Buea municipality

The findings show that the integration of information and communication technologies (IICT0s sig (0.052) PV < 0.005. Based on these statistics, the significance is 0.052 = 0.005 and is partially correlated at 12.7%. This signifies that there is statistical significance between the independent (curriculum innovation) and dependent variable (effective implementation of STEM subjects). These findings The Integration Technology (IICTs) as curriculum strategies has significant impact on effective implementation of STEM subjects in technical secondary schools in Buea municipality**.** In this line ICTs is an important indicator of curriculum innovation in Cameroon technical education especially in STEM curriculum. Curriculum developers must work to ensure the integration of ICTs in the STEM curriculum as means of enhance quality technical education for the 21st century. Government and the various stakeholders must heavily in ICTs in technical education in Cameroon (Ossono & Foretia, 2013)**.**

According Bencheva (2020) understanding of the world through science education is needed today more than ever after the COVID-19 crisis. Education systems have been based on transferring knowledge based on industrial society and now on post-industrial society, do not most often including hands-on, student-centred approaches (Ossono & Foretia, 2013). He believes at Using technology as a practical and pragmatic approach, can deliver the values of transition and of community-living-with environment to new generations that must challenge transition and lead towards the post-transition world (Bencheva, 2020).

From this view, Technological integration the effective implementation of STEM education in technical education is veritable means of transformation the Cameroonian society. The industrial transformation that is fourth industrial revolution requires more developments in the science-oriented careers for technological innovation to thrive in Cameroon. The STEM curriculum innovation in Cameroon technical education must align with the advancement of technology which are evolving at a tremendous speed (Bencheva, 2020).

Technical Education institutions are observed as 'extremely slow in the integration the advancement of technological innovations in the curriculum or workshop and classroom situation. The critical perspective to information technologies and high demand of digital solutions in education is on the rise (Bush et al, 2016). To response to these fast new technological changes STEM formal technical education classroom education is not yet sufficient to acquire the expected competences and knowledge for the Cameroon job market. Bencheva (2020) focused EU and Bulgarian polices for encouraging learning outside the classroom and in particular education in STEM and ICT field. Conversely, we advocate for more engagement through technology for curriculum innovation in technical education in Cameroon. Equipping Teachers digital technological skills will further reinforce capacity technical knowledge delivery (Bencheva, 2020).

From this point of view diffusion of innovation according to Rogers (1983) requires ensuring five element: Communication channels: are processes in which participants create and share information with one another in order to reach a mutual understanding**. Time: t**he time aspect is ignored in most behavioural research. He argues that including the time dimension in diffusion research illustrates one of its strengths (Ossono & Foretia, 2013)**.** The innovation-diffusion process**. Social system:** The social system is the last element in the diffusion process. Rogers (2003) defined the social system as “as set of interrelated units engaged in joint problem solving to accomplish a common goal**. Innovation decision process: i**nnovation-decision process as “*an information-seeking and information-process in activity, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation” For Rogers (2003).* Technological innovation is very important to curriculum innovation which contribution to policy development in STEM education in Cameroon the descriptive statistic in our results shows that there is still a negative perception with the degree of integration of ICTs (Ossono & Foretia, 2013). Information and communication technologies contributes significantly to *the* innovation-decision process constitute five steps (knowledge, persuasion, decision, implementation, and confirmation (Rogers, 1983). The appropriation of technologies into STEM education from the diffusion of innovation perspective will lead to the transformation of technical education in Cameroon secondary (Ossono & Foretia, 2013)

Personalisation/Personalised learning as a factor of curriculum innovation in technical education in Cameroon influences the effective implementation of STEM education

The findings on personalised learning (PL) reveals a statistically significant at 0.000 < pv 0.005 and partial correlated at 56.4%. This means a corresponding improvement in personalised learning will yield a correspond change in STEM subject. The evidence of this statistical representation opines that Personalisation learning has significant influence on effective implementation of STEM subjects in technical secondary schools in Buea municipality**.** Anchoring on this this alternative, personalised learning is an indispensable indicator of curriculum innovation. Curriculum designers and planner must envisage personalised learning as an effective tool of STEM curriculum in Cameroon technical education. The competences and knowledge development in technical education must be grounded on an innovation curriculum to captures the student needs and engagement in curriculum innovation as means of stimulating invention and discoveries (Ossono & Foretia, 2013)**.**

McClary et al (2018) discussed the process for developing design challenges for assessment of self-efficacy, assessment tools, and outcomes from the program delivery. Research regarding STEM programs has shown that participating in these programs leads to increased knowledge and retention of technological concepts. More so, personalisation in the STEM education leads to increased self-confidence, satisfaction, and interest in engineering. The development of personalised learning strategies is curriculum innovation approach to enhance self-efficacy. Nevertheless, several elements influence the effectiveness of STEM education. The curriculum effectiveness is impacted by the limitations of the learning context itself such that participants will be unable to complete designs if expectations for the design exceed the constraints of their environment (McClary et al, 2018).

The programmes is designed to introduce and educate the participants in the various engineering disciplines offered at the collegiate level and culminates in a multi-disciplinary design challenge designed as a "collaborative-benefit" competition. The program is meant to drive students toward collaboration and achievement of a shared goal. The purpose of this study is to examine the effectiveness of an intensive, two-week project-based engineering program for high school students on self-efficacy and engineering identity in the participants. Results from this year's survey suggest that participating in the program increased high school students perceived and actual knowledge of the engineering discipline. Completing the programmes also led to improvements in self-efficacy and increased interest in the field of engineering (McClary et al, 2018).

The Social cognitive learning theory is an educational learning theory was developed Albert bandura in the 1989. *"Social cognitive theory favours a model of causation involving triadic reciprocal determinism. In this model of reciprocal causation, behaviour, cognition and other personal factors, and environmental influences all operate as interacting determinants that influence each other bidirectional*" (Bandura, 1989, p. 2). The personal factors in social learning are very important in curriculum innovation in technical education. Therefore, modelling STEM curriculum to fit into the personalisation of competences acquisition is indispensable training transformation. The major principles of this theory as postulated by Bandura are: Symbolizing Capability in innovation, Vicarious Capability in competency development, Forethought Capability in knowledge #construction and theory testing, Self-Regulatory Capabilities for personalisation learning and Self-Reflective Capability. All of these personalised capabilities learning is highly needed STEM education in Cameroon. This theory has a great deal to influence curriculum innovation and implementation in the 21st century school system mark rapid technological development and innovations which demands a more holistic approaches to teaching learning (Bandura, 2002). This theory can better explain personalised learning in STEM subjects as innovative strategy in curriculum implementation.

The incorporation of outdoor learning is a strategic insight to curriculum innovation that influences the effective implementation of STEM education in the Cameroon technical secondary education

Outdoor learning is an important component of curriculum innovation in technical education in Cameroon. Our finding reveals that 0.00 < PV0.005 at a partial correlation of 25.9% influence effective implementation of STEM education in Cameroon. This implies that Outdoor learning has an increasing potential 25.9% if it is considering at every level of curriculum innovation in STEM education in Cameron. From this statistical presentation, 0.000 is less 0.0 05 PV Therefore, it affirms the alternative that Outdooring learning as a teacher approach has significant impact on effective implementation of STEM subjects in technical secondary schools in Buea municipalit***y.*** Outdooring is a strategic element of curriculum innovation in technical education. Developing frameworks and mobilising resources for the implementation of outdoor learning in Cameroon technical education is an effective strategy in transformative of STEM education. Socio-economic development Cameroon depends on the innovation coming in from STEM education (Ossono & Foretia, 2013).

Rose et al (2019) identified that the critical facets and praxis needed for STEM leaders, both school and teacher leaders, that would more likely lead to program transformation with an STEM lens. Here, they are concern with leadership and programmes transformation. in this study our concern is directed toward curriculum innovation as major contribution to technical education change. With the push by government and business leaders for greater emphasis on STEM education at all grade levels, educational leadership and teacher leaders are challenged to pioneer integrative praxes that prepare students for success in a scientifically and technologically driven society (Rose et al, 2019). Additionally, these STEM leaders must transverse the barriers of developing transformative educational experiences that involve diverse stakeholders. This study utilized a modified Delphi technique to investigate what STEM leader skills, competencies, and qualities are identified as critical by STEM professionals within integrative STEM education. Findings are presented for the following seven themes: mission and culture, equity and social responsibility, infrastructure and programming, curriculum and instruction, professional growth, evaluation and assessment, and extended learning (Rose et al, 2019). These findings may inform the development of courses and programs that prepare or provide professional development for STEM leaders. Results indicated that an STEM leader embraces innovation, problem solving, and evidence-based decision-making by employing collaborative leadership strategies that engender value for an STEM curriculum and a mission that is focused upon the well-being and academic success of students (Rose et al, 2019). The collaborative leader embraces shared decision-making through team-based structures, in particular, a STEM leadership team comprised of a cross section of educational stakeholders. Collaborative leadership is based upon building relationships among people who recognize their interdependence, share a common goal, and share responsibilities (Rose et al, 2019).

From the Experiential learning approach outdoor learning in field approach ti experience or hand-on learning (Kolb, 1999). According to Kolb, (1999) the theory is built on six propositions that are shared by these scholars: Learning is best conceived as a process, not in terms of outcomes. (Siddique et al 2010) To improve learning in higher education, the primary focus should be on engaging students in a process that best enhances their learning a process that includes feedback on the effectiveness of their learning efforts. As Dewey notes, "*Education must be conceived as a continuing reconstruction of experience: . . .the process and goal of education are one and the same thing"* (Dewey 1897: 79 in Kolb & Kolb, 2017)

All learning is relearning. Learning is best facilitated by a process that draws out the students' beliefs and ideas about a topic so that they can be examined, tested, and integrated with new, more refined ideas. (Kolb & Kolb, 2017). Learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world. Conflict, differences, band disagreement are what drive the learning process. In the process of learning, one is called upon to move back and forth between opposing modes of reflection and action and feeling and thinking. Learning is a holistic process of adaptation to the world. Not just the result of cognition, learning involves the integrated functioning of the total person thinking, feeling, perceiving, and behaving. (Parahakaran, 2017) Learning results from synergetic transactions between the person and the environment. In Piaget's terms, learning occurs through equilibration of the dialectic processes of assimilating new experiences into existing concepts and accommodating existing n concepts to new experience. Learning is the process of creating knowledge. ELT proposes a constructivist theory of learning whereby social knowledge is created and recreated in the personal knowledge of the learner. This stands in contrast to the "transmission" model on which much current educational practice is based, where pre-existing fixed ideas are transmitted to the learner. (Kolb & Kolb, 2017).

Concrete Experience (CE) and Abstract Conceptualization (AC) and two dialectically related modes of transforming experience Reflective Observation (RO) and Active Experimentation

(AE). According to the four-stage learning cycle immediate or concrete experiences are the basis for observations and reflections. These reflections are assimilated and distilled into abstract concepts from which new implications for action can be drawn. These implications can be actively tested and serve as guides in creating new experiences (Beaudin &Quick, 1995). The learning style inventory and the four basic learning styles are diverging, assimilating. Converging and accommodating (Healey & Jenkins, 2000).

Innovative/Creative thinking can be core capabilities in the transformation of STEM education in Cameroon technical secondary education

The development of creative/innovative thinking is a curriculum innovation process that impact on the effective implementation of STEM education in Cameroon technical education. The findings of our study indicated a prediction of 0.56 <PV 0.005 and a partial correlated of 03.3%. This significance that creative/innovative according to respondents has least significant contribution to STEM education. From the standardised coefficient, calculated value and the partial correlation, there is lower degree of predictability by the creative/innovative thinking on the effective implementation of STEM subject. Therefore, it is clear that the null hypothesis creative/Innovative thinking as curriculum innovative strategies does not have any significant influence on effective implementation of STEM subjects in technical secondary schools in Buea municipality is accepted while rejecting the alternative. In this light, the curriculum developers must double their vision to influence curriculum implementation in STEM education. Creative/innovative thinking can only thrive in a conducive environment. Therefore, technical education stakeholders have to bring tools which teachers and students will need to reinvigorate innovative thinking capabilities. The attainment of this objective contributes to sustainable socio-economic development of the country (Ossono & Foretia, 2013).

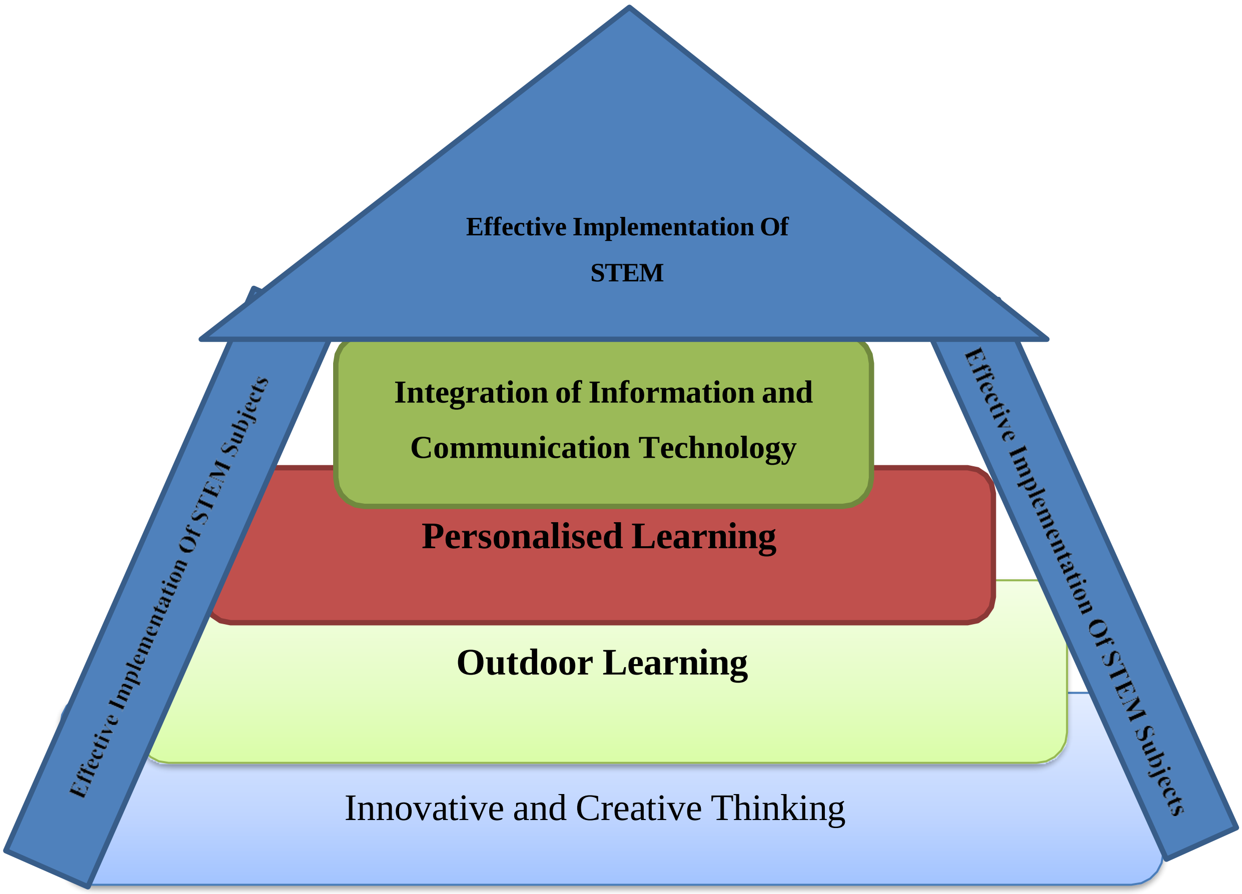
Diluzio and Congdon (2015) I develop and deliver a workshop to teach undergraduate Science, Technology, Engineering and Mathematics (STEM) faculty. The creative thinking process and help them to develop modules for their classes. Creative thinking enables learning to build inventive initiative that can galvanise technological innovation. They divide the creative process into seven discrete stages and have developed exercises to help STEM faculty to explore and internalize these concepts. Technical education in Cameroon must ensure that the development of creative thinking as a curriculum innovation strategy for effective implementation of educational policy (Diluzio and Congdon, 2015).

While they believe that many scientists invoke the creative process in their work regularly, they also believe that learning the creative process and practicing creative process thinking can help STEM faculty and students to invoke this process more fluidly, expediently, and effectively. Therefore, incorporating this component is the teaching process with ameliorate competences acquisition for technological development Initial feedback from the workshop indicates that the nine faculty who participated in the workshop report an increased understanding of the creative thinking process and increased comfort level with incorporating these ideas into their classes, among Creative Intelligence, Creative Process, STEM Education, Synectics are curriculum innovation insights (Diluzio and Congdon, 2015)

. In OECD (1997) national innovation system has perceived by different authors in different ways. "The *network of institutions in the public and private sectors, whose activities and interactions initiate, import, modify and diffuse new technologies*." (Freeman, 1987) • cited in (OECD 1997). This author sees the system at the interaction s of institutions in the diffusion of technologies. This technological diffusion is defined in clears but the most important the interactions the dissemination of innovation. The interactions in the national innovation system enable learners to cultivate innovative thinking skills. Educational stakeholders have work in fostering the technical education innovation system which creative intelligence is at the forefront of teaching.

National innovation system is also seen as ". *The elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge ... and are either located within or rooted inside the borders of a nation state."* (Lundvall, 1992) cited in (OECD 1997, p. 2) this definition goes ahead to support Freeman 1987) view by insisting on production diffusion which are grounded in the nation system. This explains and internal innovation system of innovation "*... a set of institutions whose interactions determine the innovative performance ... of national firms*." (Nelson, 1993) • cited in (OECD 1997, p.2) this view emphasises on the performance of innovation system. The effective implementation of the STEM subjects in technical schools demands an effective development of national innovation system that permit student to be performant (OECD 1997). This perspective of national innovation system for incentive structure and competencies in ensure technological learning. This implies that curriculum innovation in technical education must consider the innovation system landscape the country in relation to its implementation National innovation system is an interconnection of structures the boost innovation processes. STEM subjects as an innovative and technological orientated learning and teaching in secondary schools can be inspired from the national innovation system theory approach to curriculum innovation impact on implementation of the curriculum in technical secondary schools.

Figure 1: Curriculum Innovation and STEM Implementation model (Researcher, 2023)



5.2. RECOMMENDATIONS TO EDUCATIONAL STAKEHOLDERS

Recommendations help in the improvement of curriculum development and STEM education in technical secondary school and even in general education in Cameroon. This shows how curriculum innovation impacts on effective organisation performance of the technical school system in terms of results, quality learning, competence development, professional development, and knowledge and competencies transmission**.** In this light, it is important for us to propose some processes to be adopted for curriculum innovation and effective implementation of STEM education.

- We recommend that more conferences should be organized to train STEM teacher on the innovative approaches to effective STEM implementation. With the first focus being to change the mentality of teachers when it comes to the newly implemented professional development of teachers. This will go a long way to enhance on curriculum development which can be seen as an incremental innovation strategy for quality education
- Equally necessary measures should be put in place to ensure that the seminars organized come to a compromise when it understands human relation management as veritable strategy for conflict resolution in secondary in Cameroon.
- The technical secondary education stakeholders should provide a better technical innovation environment that will ensure that teachers can comfortably and conveniently teaching creative and innovative skills that can lead to inventions in STEM fields.
- Teacher should be consulted when coming up with any curriculum innovation proposals in technical education approach since they are the key implementers of the curriculum, and they contribute to the overall knowledge, skills and competence transmission. When this is effectively done, it equally improves on the effective implementation of STEM education in Cameroon technical education which may be generated as result of misunderstanding.
- Incentives should be given to technical secondary school teachers to motivate them to remain active in service for example compensations, grants, loans, in-service training should be given to teachers. School administration should ensure that staff development programmes such as in-service programs, refreshers courses, seminars, workshops, equipment of school with modern libraries and information technology centres be put in place to ease teachers research and lesson preparation. These practices will go a long way to ameliorate promote the development of STEM curriculum and STEM education in the Cameron technical school.

5.3. SUGGESTION FOR FURTHER RESEARCH

- This study was limited to technical secondary schools in Buea municipality in the southwest region; a study can be conducted on the similar topic can be carried out in engineering schools Cameroon.

This study was carried only in the Buea municipality another study could be carried in the entire southwest region for a better understanding of curriculum innovation influence on the effective implementation of STEM education in the southwest region of Cameroon.

A comparative study can also be carried out between government and private technical secondary schools in Cameroon on the curriculum innovation and effective implementation of STEM education in Cameroon.

5.4. LIMITATIONS OF THE STUDY

This research as scientific exercise experiences some limitation or difficulties due to area of the study. These limitations include the following: There were limitation in terms of accessing documents on curriculum innovation and STEM education. Few works exist in area making working on the concepts more stressful. Carrying out a scientific investigation of this level requires time, sacrifice and determination. The study was conducted in Buea Municipality southwest region of Cameroon with teachers as the target population. However, the researcher succeeded with the study he experienced or went through hardship and challenge due to the ongoing Anglophone crisis. The researcher encountered a lot of constrains during the findings of this study. The following are the main difficulties encountered by the researcher in course of the study.

Reluctance of some school administrator and teachers provides useful information. In some schools, some teachers were very reluctant to provide full information on the problem under study. The researcher had to visit the schools more than 2 times to reemphasize on the importance of the study. Given the fact that the researcher has a background in mathematics, the assistance of a statistician was unavoidable, as such, it was not only difficult to fine one, but it entailed financial means.

5.5. CONCLUSION

The study is made up of five chapters which include: Chapter one which handled the background to the study, problem objectives and hypothesis of the study. Chapter two discussed on literature review (conceptual review, theoretical framework, and empirical review). Chapter three research methodology. Chapter four presentation and analysis of data to test the hypothesis. Finally, chapter five focused on discussion of findings. This discussion was done in paying attention to literature review.

The instruments used for data collection was questionnaire with closed ended questions making thus, it purely a quantitative study and the data was analysed using descriptive statistics as well as inferential analysis using the multiple linear regression. For the descriptive statistics percentages and frequencies were presented in determining the various perceptions of teachers.

The empirical analysis of the study was done using multiple regression analysis. The regression analysis was used for testing hypothesis at 5% level of significance; in the study some of the alternative hypotheses retained, and the null hypothesis was rejected revealing statistical significance influence of curriculum innovation on effective implementation of STEM subjects in technical secondary schools in Buea Municipality.

From the finding of the study, we concluded that curriculum innovation has a significant influence on the effective implementation of STEM education in government technical secondary schools in Buea municipality. This is based on the fact that all our alternative hypotheses were retained. Based on the findings of the study, significant recommendations were made to the stakeholders of the technical secondary education sub-sector to consider the indicators of curriculum innovation highlighted in this study. STEM education can only become a reality if these factors are effective deployed for sustainable technical education development in the country.

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APPENDIXES

Appendix 1 : Questionnaire

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

THE FACULTY OF EDUCATION

DEPARTEMENT OF CURRICULIUM AND EVALUATION
……….

Masters students Questionnaire

Dear Respondent,

The questionnaire is developed for a Masters' dissertation in the Department of Curriculum and Evaluation (section B: Educational Management), Faculty of Education at the University of Yaoundé 1. At the end of the training, the student is expected to write and defend a dissertation in partial fulfillment of the Programme. I a carry out research on the ***Curriculum Innovation and Effective Implementation of Stem Subjects in government technical Secondary Schools in Buea Municipality***. All information received remain confidential with the researcher and your privacy shall be appropriately secured in line with Cameroon law no 91/023 of December 1991. The questionnaire is designed to collect data strictly for academic purposes. Please answer directly and fully as possible.

Part 1: **Demographic Information Fill in the appropriate information**

School……

Discipline……

. Level of education: AL DIPES I DIPES II BA MS PhD

Age: 20-30 31- 40 41-50 51 -60

Sex: Male, Female

Part 11: Statements on the indicators

Please tick (√) in the box corresponding to your most preferred respond: Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD).

S/N	**Statements**	**Responses**			
SECTION A: integration of information and communication technologies		**SD**	**D**	**A**	**SA**
1	Your school provide effective communication channels				
2	There are technology social system for students and teachers interactions				
3	There are available online learning platforms				
4	Your school provide content management system				
5	There is availability connectivity in your school				
6	You can carry out online research effectively and independently				
7	You great have skills in the manipulation of ICT tools and application				
8	Your school has information storage facilities				
9	Your school has a well-equipped computer laboratory				
10	Your school promote the acquisition of ICT competence				

SECTION B: personalization/personalized learning		**SD**	**D**	**A**	**SA**
1	There is available adaptive technology for personal learning				
2	The programmes address students' learning needs				
3	The students learning through their personal experiences				
4	The learning process take into account students' interests				
5	The teaching programmes consider students aspiration in skills development				

6	The technical education programme takes into account students' socio-cultural background				
7	The programmes take into consideration students socio-economic background				
8	The teaching programme is for students' self-empowerment				
9	Your curriculum engaged in transformative learning processes				
10	You integrate blended learning strategies as pedagogic approach				

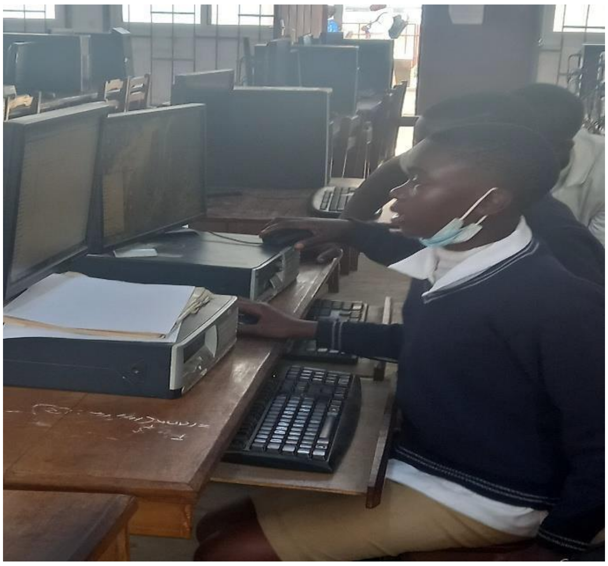
SECTION C: out-door Learning		SD	D	A	SA
1	Your curriculum has industrial visits programmes				
2	The teaching programmes encourage synergetic transaction in skills and knowledge development				
3	There is opportunity for holistic knowledge and skill adaptation processes				
4	Your instruction creates avenue for concrete learning experience out of the school context				
5	There are out-door experimentation or knowledge testing opportunities				
6	Your school creation links with the business community for student interactions				
7	There out-door opportunities for knowledge creation and competence development				
8	Out-door is means of field inspiration for student knowledge and skills development				
9	Out-door provide students with industrial reality and skills are well tested				
10	You will advocate for outdoor learning programmes for technical school				

SECTION D: creative and innovative thinking		SD	D	A	SA
1	You encourage students' self-reflection in their respective subject area				
2	You transmit value creation strategies				
3	Your school promotes innovative processes and products				
4	You transmit complex thinking skills to students				
5	Students are transmitted complex problems solving competences				
6	You develop architecture for invention				
7	You encourage prototype development				
8	You have a mastery of design thinking processes				
9	You prepare students for disruptive change environments				
10	You stimulate in your students curiosity and research minds				

SECTION F: effective implementation of STEM (Science, Technology, Engineering and Maths) subjects		SD	D	A	SA
1	There is content equity in the development STEM subjects				
2	These subjects take into account students' engagement				
3	Students' thinking skills are developed in the STEM subjects				
4	There is effective interactions/monitoring in the implementation of STEM subjects				
5	There is effective practical tools/applications for the implementation of STEM subjects				
6	There is effective collaboration/cooperation in the teaching of STEM subjection				
7	You have well equipped workshops for STEM subjects				
8	You have well equipped laboratories for STEM subjects				
9	Teachers have up-to-date pedagogic skills in teaching STEM subjects				
10	The curriculum of STEM subjects is well developed				

Thanks for your assistance

Appendix 2: Pictures of schools



Appendix 3 : Authorization for research

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° _______/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 **MBEH Yvette** Matricule **19Y3624,** 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 co-supervision of **Professor DJEUMENI Marcelline and Doctor NDJEBAKAL Emmanuel.** Her work titled: **"CURRICULUM DEVELOPMENT AND STUDENTS' MOTIVATION IN STEM COURSES IN CAMEROON: CASE OF SOME SELECTED SECONDARY SCHOOLS IN YAOUNDE VI".**

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 22 MARS 202.....................

For the Dean, by order

DONGO Etienne
Professeur

TABLE OF CONTENTS