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POST GRADUATE SCHOOL FOR  
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DEPARTMENT OF CURRICULUM AND  
EVALUATION

## CURRICULUM APPROPRIATION AND PROBLEM-SOLVING COMPETENCES IN HIGH SCHOOL SCIENCE STUDENTS OF MFOUNDI DIVISION IN YAOUNDE

*A Dissertation presented and defended on the 24th July 2025*

**Option: Curriculum and Evaluation**

**Specialisation: Curriculum Development and Evaluation**

by

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The undersigned certify that they have read and hereby recommend for acceptance by the University of Yaoundé 1 a thesis titled ‘Curriculum appropriation and problem-solving competences in high school science students of Mfoundi Division in Yaounde, in partial fulfilment of the requirements for the award of a Master Degree in Curriculum and Evaluation from the University of Yaounde 1.

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## **DECLARATION**

I, Ayamba Maureen Ojong, hereby declare that this thesis is my original work and that it has not been submitted and will not be submitted for any academic award in any university for a similar or any other degree award.

## **DEDICATION**

To my beloved son Arrey Okot-Obassi Winner.

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## **LIST OF ABBREVIATIONS AND ACRONYMS**

<b>UN:</b>	United Nations
<b>UNESCO:</b>	United Nations Education and Cultural Organization
<b>SDG:</b>	Sustainable Development Goal
<b>GBHS:</b>	Government Bilingual High School
<b>GBPHS:</b>	Government Bilingual Practicing High School

## ABSTRACT

The research is to investigate the impact of curriculum appropriation on problem-solving competences in high school science students of Mfoundi Division in Yaoundé. The problem of the research was inadequate supervision of practical activities within and out of school causing inability for students to practice competences acquired out of school to benefit them reduce dependence on parents. The main objective of the study was to examine the impact of curriculum appropriation on problem-solving competences in high school science students of Mfoundi Division in Yaoundé. Theories used are the pragmatic learning theory of John Dewey (1938), discovery learning theory of Jerome Bruner (1960) and the experiential learning theory of David A. Kolb (1984). The descriptive survey method was used in this study. Observation method was employed to observe subjects and questionnaires used for data collection. Data was analysed with simple linear regression. The findings reveal that curriculum appropriation has a positive impact on problem-solving competences in high school science students, for all responses have a 92% value for hypotheses tested. Observation results showed that students fabricate soaps, produce nutritive foods, and manufacture skin care products but do not extensively practice competences out of school for financial benefits. Teachers mostly supervise students' practical activities in school and students apply problem-solving competences acquired mostly in schools to succeed in their examinations but are unable to practice these competences out of school to initiate self-reliance. We, therefore, recommend that high school science teachers should foster supervision of practical activities out of school through blended learning and students should engage in carrying out practice out of school. They should create platforms and groups for students to work and share through these platforms.

**Key words:** curriculum, curriculum appropriation, problem – solving, competences, problem – solving competences.

## RÉSUMÉ

Cette recherche vise à étudier l'impact de l'appropriation des programmes scolaires sur les compétences en résolution de problèmes chez les élèves scientifiques du secondaire du département de Mfoundi à Yaoundé. Le problème identifié est l'insuffisance de supervision des activités pratiques, tant scolaires qu'extrascolaires, empêchant les élèves de mettre en pratique les compétences acquises hors du cadre scolaire et de réduire ainsi leur dépendance envers leurs parents. L'objectif principal de cette étude est d'examiner l'impact de l'appropriation des programmes scolaires sur les compétences en résolution de problèmes chez ces élèves. Les théories utilisées sont la théorie pragmatique de l'apprentissage de John Dewey (1938), la théorie de l'apprentissage par la découverte de Jerome Bruner (1960) et la théorie de l'apprentissage expérientiel de David A. Kolb (1984). Une enquête descriptive a été menée. L'observation des sujets a permis de recueillir les données, analysées par régression linéaire simple. Les résultats montrent que l'appropriation des programmes scolaires a un impact positif sur les compétences en résolution de problèmes chez les élèves scientifiques du secondaire, avec un taux de réussite de 92 % pour les hypothèses testées. Les observations ont montré que les élèves fabriquent des savons, produisent des aliments nutritifs et conçoivent des produits de soins de la peau, mais n'exercent que rarement leurs compétences hors du cadre scolaire à des fins lucratives. Les enseignants supervisent principalement les activités pratiques des élèves en classe, et ces derniers appliquent les compétences de résolution de problèmes acquises essentiellement à l'école pour réussir leurs examens, mais peinent à les mettre en pratique hors du cadre scolaire pour développer leur autonomie. Nous recommandons donc aux professeurs de sciences du secondaire de favoriser la supervision des activités pratiques hors du cadre scolaire par le biais d'un apprentissage hybride, et d'encourager les élèves à s'exercer en dehors de l'école. Ils devraient créer des plateformes et des groupes de travail permettant aux élèves de collaborer et d'échanger.

**Mots-clés** : curriculum, appropriation du curriculum, résolution de problèmes, compétences, compétences en résolution de problèmes.

## GENERAL INTRODUCTION

Undertaking research usually requires much engagement and commitment of the researcher's resources such as time, finances and humility in making schedules with other individuals to acquire information conversant with the topic. However, the construction of complexes as suitable structures in conducive zones is ideal for learning known as schools, institutions and establishments. These are special places designed exclusively for learning activities where stakeholders such as teachers, students, parents, inspectors of education and institutional proprietors converge for educational purposes. Education is organized such that context, content, goals and objectives are built by the government depending on the type of scholars they desire to develop and the type of problems to resolve constituted in curriculum. Curriculum history in particular and curriculum studies in general have remained restricted to the English-speaking world, where Ornstein and Hunkins (2018) explained that curriculum results from social activity and is designed for present and emerging circumstances.

The quest for adaptable, meaningful curriculum and development goals have been emphasized by education organs such as the United Nations (UN), its organs like United Nations Education and cultural organization (UNESCO). UNESCO sees quality education as a dynamic concept that changes and evolves with time due to the social, economic and environmental context (Tchombe, 2019). The reasons are to improve on the living conditions of humanity, to alleviate poverty which is a plaque to developing countries in the world, especially in Africa and in Cameroon in particular. Such education supposed to provide the required knowledge, skills and attitudes beneficiary for citizens of countries to undertake measures for their transformation. This is carried out following governmental policies, goals and objectives established for the purpose.

A relevant curriculum this modern period should implement pragmatic, discovery and experiential learning methods which involve hands-on activities through project learning from elementary education, secondary and high school education, and tertiary education (Dewey, 1938; Bruner, 1961; Kolb, 1984). This study involves Curriculum appropriation and problem-solving competences in government high schools, with science students doing general education found in Mfoundi division in Yaoundé. Many parents who send their children to do general education are complaining and regretting of being so exhausted by this lengthy energy depleting duty of the seven years cycle; from form one to upper sixth as the students at this stage in high

school are expected to relief them by employing competences acquired in schools to raise funds for their basic needs at least momentarily. This is so challenging to the parent.

This attracted our attention to work by formulating such a topic relating the impact of high school science curriculum in general education and identifying the competences acquired from it, then the activities and actions which may benefit students in the implementation of the competences. Problem-solving skill is one of the important skills recommended this 21<sup>st</sup> century in developing countries in general and in Cameroon in particular as it has long been employed in the developed world to make it what it is today. This skill can be achieved only through education and practice. The education that is needed is the one that will help learners to solve problems of life. This education is linked to the type of curriculum put in place for the learner to appropriate the competences required in schools. According to Tanner and Tanner (1977, cited in Tambo, 2012) curriculum is perceived as the planned learning activities sponsored by the school. Also, Tambo (2012) defined curriculum as the totality of the learning experiences provided to students, in order to achieve predetermined educational goals. To him, curriculum embodies both inside and outside the classroom that are planned and organized by the school and it is designed with specific goals and objectives.

This curriculum embodies many people for it to be properly implemented in schools. But prior to implementation the curriculum has to be developed following the needs of the society concerned and it constitutes many resources such as human resources; teachers, students, principals, curriculum specialists, state agencies, lay citizens; material resources, financial and technological resources. The models of Bobbitt and Charters reveal that developing a curriculum is like planning a person's route to growth, culture, and that individual's special abilities Orstein and Hunkins (2018). That is why a general plan for the educational program can be formulated followed by determining content and experiences necessary for the learner. That is why our purpose or objective of education is to be able to solve our real-life problems that we encounter in the society. The general education sector has been looked upon by many to be of no use, because many learners came out being unable to create opportunities for themselves but dependent on the government for employment. That is why many parents in Cameroon would encourage children or learners to enroll more in technical or vocational schools where they will come out with skills to make them independent in the future but are inhibited by the cost of sponsorship.

Our preoccupation in this study is to examine the impact of curriculum appropriation on problem-solving competences in high school science students, whether such skills are found in the general education sector where learners will come out not only with certificates but with competences that will equip them to solve their real-life problems, and also become self-reliable. As a result, parents will now see many reasons to send their children to this sector. In order to achieve this, the curriculum that has to be put in place has to be learner-centred, reflecting local needs and global trends, where the learners will be active in the teaching learning process. Constituents of such curriculum should explore dimensions of contextual relevance, taking in to account the incorporation a local culture, languages and histories to cause students to be more involved (Alemage 2020). There should be the integration of the communities in curriculum development as this is a manner of addressing significant indigenous needs, priorities and getting them implicated. Curriculum that revives soft skills in learners will enable them become productive by engaging in project-based learning with hands-on activities (Fokou, 2023). When emphasis is laid on reinforcing skills in learner's education, the latter becomes meaningful as they employ critical thinking skills, communication skills, decision-making skills, analytical skills and problem-solving skills in their enterprises. As Fokou (2023) stated 'learning continues to underplay skills, including problem-solving, critical thinking and empathy. Teachers are at the heart of the quality education which to him consist of quality of schools, learning and skills, teachers and teaching, learning and digital transformation and funding for education'.

Meaningful education has to involve investment in technical and vocational aspects as embodied in practical skills to embrace employability (Etoh-Anzah et al., 2022). In time past selected population and especially males were only permitted to attend school and therefore attain literacy and education. The 21<sup>st</sup> century education abounds inclusivity and equity where gender equity is promoted. This is because both sexes have same opportunities in competence appropriation and employability. Education is provided to individuals with special needs such that social insertion becomes a reality as they integrate in services and duties functional to the communities and societies they inhabit. Learners desire to be equipped with competences which enhance self-reliance and independence which serves as foundational aspects to sustainable development. Issues of responsible citizens can only be a reality when education engages in sustainability practices, when learning involves environmental awareness and global competence which prepares learners to interpret and understand global issues. Technological integration is very relevant in the fast-changing world today, therefore digital literacy is syn qua non to enhance

learners in research and access to information, as these are tools that create possibilities for learners to apply knowledge acquired in real-world situations.

When we talk of education, it involves training, instruction, learning through experience teaching, and observation. To make the learning process better, both the teacher and learner draws each other attention in order to focus and exposed what has to be taught and learned Tchombe (2019). This means that the learner is cognizant of what he or she is doing, have a mastery and able to apply knowledge where need be. In teaching, there must be an enabling environment and the use of instructional materials. Dewey (1938) postulates that learners should have command over themselves. This denotes that, via their education they should be able to use all their capabilities. When they use all their capabilities it indicates that they are fully involving their various skills, knowledge to enhance their learning experience. Actors to dispense these curricula are teachers supervised by the administrative heads of institutions known as principals. Their work is enormous and technical as both collaborate to achieve the goals and objectives set in every school year for learners to achieve interesting and excellent results and competences.

The work is divided into five chapters. Chapter one is introduction, chapter two is review of related literature, chapter three is research methodology, chapter four data analysis and presentation of results, and chapter five discussion of results, implications and conclusion.

# CHAPTER ONE

## INTRODUCTION

Research study is an encounter that enables every individual in quest of knowledge to discover their environments to unveil truths or confirm existing truths. Education has proven its grounds as a significant instrument in the transformation of man and his environment from the researches carried out. Research is an investigation requiring that scholars be inspired and empowered knowledge-wise so they intend engage in the various fields of their interest to unveil the truth not discovered and established, to modify or reject existing truth and to increase the propagation of findings in scientific norms (Ross, 2023). Chapter one covers background of study, statement of the problem, justification, objectives, research questions, hypotheses, scope of the study, significance to the study and definition of key terms.

### **Background of the Study**

This introduces the study to information concerned with aspects and facts established from authors from general perspectives about the world, relating to the study environment of Africa and in Cameroon in particular where the population of study is located. Background of the study will be presented as historical background, conceptual background, contextual background and theoretical background.

### **Historical Background**

Historically, before the 20<sup>th</sup> century, many societies conducted education informally through apprenticeship, oral traditions, and customs. According to Trohler (2019) curriculum, as a broad academic field emerged in the 20<sup>th</sup> century predominantly in the United States as structured programs laid down in fields of study so that learners and instructors interact together and individually. From early 1901 the organisation of works and activities within religious institutions such as monasteries, churches and mosques with much focus on religious texts, classical works, including theology, philosophy and liberal arts inspired modern curriculum developers due to the rapid societal transformations taking place within English speaking countries earmarked by industrial revolution, evolution of nation-states and growth of universities (Bobbitt, 1918; Cremin, 1980; Eisner, 1979; Tyler, 1949). Curriculum spread to the rest of the nations of the world from the late 1930s in providing a frame in which different case studies were being developed for comparative purposes. Trohler mentioned later that in

Europe discussions on curriculum focused primarily on subject matter. Curriculum studies emerged from a particular way of understanding the organization of schooling and instruction to create the future citizens. Also, it came up as a reaction to challenges of massive immigration modernisation in terms of life and the growth of large cities and the experiences of the First World War. These experiences led to the publication of methods of teaching patriotism in the public schools especially in New York City in America. Social sciences were established at modern research universities to face social challenges and professors developed programs such as education for citizenship in a democracy and published books in response for the growing demand for more adequate teaching methods, especially with reference to the making of good citizens. Social studies were implemented in their curriculum to reinforce, civics and social responsibilities. Books, like how to make courses of study in the social studies were published to help curriculum makers implement social studies in school. The curriculum was considered a core public educational or instructional means to foster national integration and to reinforce citizens in us and in other parts of the world. Secondary schools were created and raised to high schools for general education, technical education, vocational education and tertiary education.

In Cameroon, curriculum can be traced back to the colonial era when Cameroon was under the German and later French and British rule. During the German colonial period (1884/1916), education in Cameroon was limited and mainly focused on vocational training for the local population. The curriculum emphasized skills that were deemed for colonial administration, such as agriculture, carpentry and clerical work. After World War 1, Cameroon was divided into French and British mandates. Under French rule, the curriculum was influenced by the French educational system where there was the teaching of French language and culture. The curriculum was designed to prepare students for administrative, technical and agriculture careers. Under British rule, the curriculum focused on broad subject areas including; English Language, Mathematics science and social studies. The curriculum aimed to produce well-rounded individuals with a strong foundation in English language. In recent years, as a Republic, Cameroon has continued to update its curriculum to meet the needs of a rapidly changing world alternating from traditional curriculum. Alemnge (2021) specified the revised high school science syllabuses introduced in the academic year 2014/2015 superseding the former curriculum in use in the past thirty years ago. This curriculum has been constructed to reflect the national and international needs in knowledge, know-how (skills) and attitudes. There is a push for the integration of information and communication technology (ICT) in education, as well as a focus on entrepreneurship and vocational training to address the unemployment and

economic challenges. The curriculum of Cameroon is currently structured into three cycles; the basic education, secondary education and the higher education cycle. At the core of the curriculum in Cameroon project-based learning predominates learning by objectives where professionalism of institutions is the main goal of government so as to develop learners capable of implementing knowledge acquired from education (Jona, 2019).

## **Conceptual Background**

The need for an adequate curriculum for the development of skills and competences in individuals is the greatest and salient requirement as every nation and the world over are seeking for significant autonomy and independence in all domains. Concepts such as curriculum appropriation entail the type of content learners have to acquire which will enable them build capacities on initiating critical thinking, analytic skills, communication skills creativity, and decision-making, to name a few in solving real-life challenges. Today, education is considered beneficial as well as before but emphasis on pragmatism through projects realisation makes theory visible to reinforce the transforming human resources, the environment and social relations. A curriculum that focuses on problem-solving tendencies is proven adaptable as developed nations such as Canada, USA, China and more exemplified. The curriculum implemented today in Cameroon exposes competency-based approach which is perceived as adaptable to the present realities of the indigenes. The results of its application should be visible the same in all types of schools – technical schools, general education establishments, and vocational schools. The Cameroonian society in latter times regarded education as a means of acquiring knowledge at the end of every course of study to be recruited more by the government in the public service. This trend is proven fallacious and limited as the growing population of graduates in Cameroon is stricken by unemployment. Unemployment which is a plague in the country is grave and poverty is at a very elevated peak where even parents do not perceive the essential for education. The tendency of employability was misconceived from the onset because government institutions can never employ all the graduates. Therefore, the appropriation of any curriculum when accompanied by competences with the aim of solving individual, collective, and environmental problems will enable self-reliance which promotes job creation as exemplified by developed nations in Europe and Asia. This reason is so rooted in the conception of this study to follow up how the appropriation of a curriculum in an institution may develop human resources in general and specifically how high school science students can develop

autonomy from their curriculum which will lead them to self-reliance in initiating and practising problem-solving competences.

This work identifies with general education establishments since practice, as declared by many is less visible but general education concerns students all over Cameroon comparable to typical professional education. It is an opportunity to write out all stakes involved in this type of learning and to rule out areas that need reinforcement to encourage practice in learners which is accompanied by poverty alleviation to relief parents of the burden of children dependence. If teachers are correctly trained in teachers training colleges, they will intend extrapolate their training skills in the exploration and use of schools' curricular for learners to be transformed. When teachers are not adequately trained on the curricular, they too cannot translate the knowledge and know-how to their students.

When students do not appropriate the competences demanded for their development they will not apply on the field for poverty alleviation. These concepts are very significant and relevant in today education as poor countries search to assume their independence in technological acquisition which is a lee way for progress and development. In this study, we are going to define the following concepts; curriculum, curriculum appropriation, problem solving competences and competences at the end of the chapter.

## **Contextual Background**

In contextual background, Freire (1970), in his book 'Pedagogy of the oppressed' asserted that change comes through education. The knowledge individuals possess and practice leads them to significant transformation, healthy living and eliminates or reduces ignorance that leads to much poverty and deception attached to folklores. The UN and its organs such as UNESCO have emphasised and laid down principles and requirements of education and more over establishment of curriculum which spurs nation to development especially problem solving curriculum (UN). For example, China, Japan, USA education is toward acquiring skills to solve problems (Fogaz, 2018). This has impact in many nations who have revised and reviewed their systems of education which is today blended with modern educative technologies. Cameroon, on her part, at all levels from pre-school, primary school, secondary school and high school, and universities have moved from learning by objectives, to competency- based approach in learning. Such a curriculum put the learner at the centre of all activities as an actor and promotes practice in projects within cooperative learning where skills and competences are developed from peer learners.

Law N0 98/004 of April which is law of orientation in education in Cameroon has laid down the guidelines for education in Cameroon which is applied to nursery, primary, secondary grammar and technical education as well as teacher training colleges. This comprises of teaching the child for his/her intellectual, moral, physical, and civic education appropriation. Increasingly, many scholars are advocating for competency education as a means of meeting the goals of 2030 agenda. The sustainable development goals (SDG) which are 17 also stood as foundation for many countries including Cameroon to move towards problem-solving competences to render learners independent. The SDGS were adopted by United Nations in 2015 as a universal call for action to end poverty, protect the environment, and ensure that all people enjoy peace and prosperity by 2030. These goals are seventeen and interconnected to each other. Our research topic will touch goal number one, two three, four, eight and nine. which are; no poverty, zero hunger good health and well-being, quality education, decent work, and economic growth, and industry, innovation and infrastructure, respectively.

There is evidence here that education is the top priority to all the citizens and it has its objectives and purposes. That is why SDG number four is laying emphasis on quality education. The general purpose of education in Cameroon shall be to train children for their intellectual, physical, civic and moral development and their smooth integration into society bearing in mind prevailing economic, socio economic sociocultural socio-political and moral factors. Secondary schools have been provided with human resources skill to produce such learners through active interaction using different methods, techniques transmitted through face-to- face or through distance or e-learning, and other methods. Both secondary (and high), general and vocational studies emphasise competence building in learners who are capable to solve their own daily life challenges with the application of lifelong learning, critical thinking, decision making tendencies, entrepreneurship and even communication skills. Upon all these endeavours, learners in high schools demonstrate attitudes not accommodating the prescribed curricular written above. The educational system of Cameroon general education still focuses more on theories and abstract concepts with little or no training developing skills. A look at their time table shows there are more hours on theory than on practice. There are eight periods of fifty minutes per period making forty periods per week. There are only two periods for practical per week which are not categorically respected, leading to lapses in competences acquisition, following our field experience during internship. This is one of the reasons why students are incompetent.

The objectives of the syllabus are very pertinent but remain on paper work and there is little application in the field. Their environment remains unchanged, they do not demonstrate any competence related to curriculum appropriation as expected by the society. There is acute and chronic poverty that leads sometimes to students' dropout from schools, lack of school materials such as books, pens, and the like. The situation is so appalling that the professionalisation of education addressed by the president of the Republic of Cameroon seems an illusion. The assertion is that if pragmatism is respected in all the curricular of the fields of study, then Cameroon will be transformed in few years as all learners will implement competences appropriated in their domains in their lives and environments. The situation of youth unemployment is plaguing the nation where the youths remain hopeless when demanded of their future and career. By carrying out a study on this topic will enable youths to be clarified on their morals and civic duties and well as engagement and reinforcement in valuable education. From the national education policy and growth and employment strategy paper (GESP, 2010), the Cameroon vision of 2035 is structured into five learning areas with different weights; the families of situations which hold the syllabus layout the teaching and learning activities and how they are developed/implemented so that learners develop both the subject competences as well as the cross-curricula competences (Alemnge, 2021).

Theoretically, the study retains three theories; the Pragmatic learning theory of John Dewey of 1938, Discovery Learning theory of Jerome Bruner of 1960 and Experiential learning theory of David A. Kolb of 1984. These theories are adapted to the topic because they all provide knowledgeable accounts and arguments to how and why education should employ their theories. To the authors, students are provided with more opportunities in education where they have to engage their cognitive faculties in thinking, creating, illustrating, demonstrating and applicability. They are theories which encourage collaboration amongst learners where peer learning is visible in projects and competences are concretised.

## **Statement of the problem**

In Mfoundi Division of Cameroon, High School Education is traversing significant challenges that shield effective appropriation of curriculum and the development of essential problem-solving competences among students. Even though the state has carried out several innovations such as revision of curriculum, implementation of innovative teaching methods, techniques in teaching, technologies in education, construction and equipment of laboratories and units for reinforcement of capacities of teachers and students, there is still a gap between

the appropriation of the curriculum and problem-solving competences exhibited by insufficient students' outcomes and hands-on practices. Students seem not to practice the skills they acquired to benefit them satisfactorily. Many high school science students in Mfoundi Division manifest limited tendencies to match the curriculum with problem-solving competences in the real-world problems, evidencing deficiency in problem-solving skills which were established as education goals. This study enables to investigate the content of curriculum appropriated by students and the possible competences for problem-solving which enable them meet up with some essential needs.

### **Justification of the study**

The study is carried out as a fulfilment of requirements for validation of Master degree course in curriculum and evaluation in the Faculty of Education in the University of Yaoundé 1. The specialty is curriculum development. The quest to produce learners who are competent in their work life motivated us to engage in studies within this specialty. The unanswered question that always dawned on me as to why students not being productive despite the length of years spent in high schools studying is a factor to realise the research. The cause could not be targeted because of the plausible factors related to the dysfunction. It is a preoccupation that has long been prepared for because our intension is to produce knowledge that will enable readers to be inspired after consuming the piece of work. When learners acquire functional skills and apply them, then, they will become job creators instead of job seekers. The study is very relevant at the moment where everyone is called upon to be an actor in the change process where indigenes will be architects and builders of their country instead of spending fabulous sums of money inviting skilled foreigners to do jobs we are supposed to do. The study is foundational in that it is a pointer to developmental pillars if stakeholders get committed. General education should not be regarded as waste of resources as many graduates end up without the required skills to place themselves in the job market or creators of jobs.

The government of Cameroon in the year 2000 carried out reforms concerning professionalisation of education in the following areas. The government improved the quality of teacher training programs and has created more colleges and institutes to meet the need of teachers. This ensures the training of skilled teachers as well as subject matter expertise. Curriculum reforms have been enacted to compose new subjects and readjusted some areas of lack in primary, secondary schools and higher education relating to the skills and knowledge required for modern workforce which is done by updating textbooks, teaching aids and

assessment methods (Atem, 2023). The government encourages both public and private sectors of education to equip laboratories for both science practical with necessary materials to reinforce competences and those of arts with theatres adapted for learning. Education partners and donors serve as consultants and provide funding to the realisation of objectives of building skills and know-how in learners adapted to modern day workforce. All of the above-mentioned aspects justify why the topic is timely as parents desire their children's financing autonomy at the end of course.

## **Objectives of the Study**

There are the general objective and specific objectives.

### **General Objective**

To examine the impact of curriculum appropriation on problem-solving competences in high school science students of Mfoundi Division in Yaoundé.

### **Specific Objectives**

- 1) To find out the impact of fabrication of soap on problem solving competences in high school science students of Mfoundi Division in Yaoundé.
- 2) To verify the impact of production of nutritive food on problem-solving competencies in high school science students of Mfoundi Division in Yaoundé.
- 3) To assess the impact of manufacture of skin care products on problem- solving competences in high school science students of Mfoundi Division in Yaoundé.

## **Research Questions**

Research questions constitute the general (main) research question and the specific research questions.

### **General or main research question**

What is the impact of curriculum appropriation on problem-solving competences in high school science students of Mfoundi Division?

### **Specific Research Questions**

- 1) To what extent does the fabrication of soap impact problem-solving competences in high school science students of Mfoundi Division in Yaounde?
- 2) To what extent does the production of nutritive food impact problem-solving competences in high school science students of Mfoundi Division in Yaounde?

- 3) To what extent does the manufacture of skin-care products impact problem-solving competences in high school science students of Mfoundi Division in Yaounde?

## **Hypotheses**

There are two types of hypotheses; the general and specific hypotheses.

### **General hypothesis**

Ha: Curriculum appropriation significantly impacts problem-solving competences in high school science students of Mfoundi Division in Yaounde.

Ho: Curriculum appropriation does not significantly impact problem-solving competences in high school science students of Mfoundi Division in Yaounde.

### **Specific Hypotheses**

Ha<sub>1</sub>: Fabrication of soap significantly impacts problem-solving competences in high school science students of Mfoundi Division in Yaounde.

Ho<sub>1</sub>: Fabrication of soap does not significantly impact problem-solving competences in high school science students of Mfoundi Division in Yaounde.

Ha<sub>2</sub>: Production of nutritive foods significantly impacts problem -solving competences in high school student science students of Mfoundi Division in Yaounde.

Ho<sub>2</sub>: Production of nutritive foods does not significantly impact problem-solving competences in high school science students of Mfoundi Division in Yaounde.

Ha<sub>3</sub>: Manufacture of skin care products significantly impacts problem-solving competences in high school science students of Mfoundi Division in Yaounde.

Ho<sub>3</sub>: Manufacture of skin care products does not significantly impact problem-solving competences in high school science students of Mfoundi Division in Yaounde.

## **Delimitation of Study**

Delimitation of study constitutes geographical delimitation, conceptual delimitation, contextual delimitation, time delimitation, and theoretical delimitation.

Geographically, the site of the study is Mfoundi Division in the Centre Region of Cameroon. Mfoundi is a cosmopolitan division harbouring Yaoundé the capital city of the Republic of Cameroon. The topography of Mfoundi is hilly and mountainous. This makes the relief

interesting as the mountains and valleys form zones defined such that the city is marked by portions. At a particular standpoint one could observe that the city of Yaoundé is mapped by the mountains, hills and valleys that define that section but moving to another location one finds out that the valleys, mountains and hills also map out another zone, creating portions of habitations. River Mfoundi runs across the city of Yaoundé and it is the main drainage.

Population wise, Mfoundi division is highly populated with 1,881,876 people according to the statistics of the 2005 census. The population is very active as they engage in activities such as education, commerce, civil service and the like. The population of students is very significant in thousands as Yaoundé has a mild climate that favours learning. Students are attracted by the prestigious schools, peaceful and attractive people and environment to study in the different fields of their desires.

Conceptually, the guiding concepts of our research are curriculum, curriculum appropriation competences, problem-solving competences, fabrication of soap, production of nutritive foods and manufacture of skin care products. These are the core concepts whose verification and analysis of results will provide relevant information about the topic for exploitation.

The contextual delimitation is English high school science students of Mfoundi Division in Yaoundé in Cameroon. The study engages science students of the English sub system of education in four high schools which are Government Bilingual High School (GBHS) Mendong, GBHS Etoug Ebe, GBHS Essos and Government Bilingual Practising High School (GBPHS) Yaoundé. The situation of appropriation of the curriculum by students will be verified if it provides enabling competences to fit in the workforce and for problem-solving to curb absolute economic and financial dependence from parents and caregivers.

## **Theoretical Delimitation**

Theories retained for this study are the Pragmatic learning theory of John Dewey, the discovery learning theory of Jerome Bruner and experiential theory of David A. Kolb. All these theories explain project-based learning where pragmatism is recommendable. The theories are adapted in the study because they explain how opportunities are created for learners to manipulate knowledge as they are at the centre of learning. Learners discover knowledge, communicate with the subject matter and are able to construct their own communication concepts making the learning authentic.

## **Time delimitation**

The study runs from September 2023 to December 2024. This is to enable us collect data from the field, process, analyse and interpret. The result is then disseminated for readers to exploit. The period chosen enables us to access high school science students in their various institutions to administer questionnaires and carry out observations.

## **Significance of the Study**

The study will benefit students, teachers, educative authorities, curriculum developers, parents and the community.

## **Students**

Students will learn the constituents of competences they will achieve after being taught the curricula in the series they intend to engage in studying. By presenting these competences students will identify areas of their interest and will exhibit motivation to engage. Pragmatism will also be exercised as students employ competences in creativity. There will be job creators which eliminates joblessness and crime waves.

## **Teachers**

Teachers will reinforce their skills, methods, techniques in disseminating these curricula adequately relating them to the different didactic materials required and the projects and activities which will enable the consolidation of these competences in students for problem solving purposes in real life.

## **Educative authorities**

Educative authorities will modify and adopt types of curricula beneficiary and productive to learners and will recommend these suggestions and modifications to the government and its constituent elements. Counsellors will be specific and adequate in identifying the types of series students have to engage in during counselling and orientation periods. The feedback from the government will reinforce productivity in all the areas of study in high school science syllabuses ensuring learners to exploit advantages adaptive to their society.

## **Curriculum developers**

Curriculum developers will develop or adjust curricula to fit the needs of the students and the objectives of the state for development and progress. The bases of curricula development

should consider change and transformation of learners themselves, their environment and society in general. Considerations should be made on how the learners should insert themselves in the job market after going through their course content in high school. The study will assist curriculum developers to formulate experiences for learners to practice during course and content appropriation and should initiate confidence for practice to wherever necessary.

### **Parents**

The study will expose parents to consider choices visibly before sending their children to various schools and to the series thereof. Parents, while committing for their children's education usually construct objectives of the future of their children as adults and careers. They desire children to practice outstandingly by involving children in meaningful learning where output is inevitably demonstrative, practicable and significant to make them valuable members in their society, to gain meaningful positions of responsibilities in their careers which is satisfactory as realising the goal of life as a parent. This is related to fabrication of detergents, production of nutritive food and manufacture of skin care products which are appropriated the study is relevant to explain the essentials of adaptive science curriculum to solve problems and to deter the argument that general education is worthless and unproductive to learners when compared to technical education which is churning today in the Cameroonian society.

### **Community**

The community selects the kind of education that is fit for them before applying to the nation to create and open schools in some cases. Students and workers emanate from this community, where their aim is development at all levels for the transformation. The community-school relationship is symbiotic in the sense that both work for one another. The study will unfold various aspects the community will hold as a duty to a school and vice versa. It will teach on how to commit and participate in high school science education by exposing learners to research and practice environment such as in agriculture, cuisine, production of relevant products such as detergents, nourishment food and skin care products.

## **Definition of key terms**

### **Curriculum**

Curriculum, according to Tyler (1949) is all the learning experiences planned and directed by the school to attain its educational goals or objectives. Tchombe (2019) defined curriculum as a comprehensive framework that encompasses the planned experiences, intended outcomes,

and the systematic reconstruction of knowledge and experiences in educational settings. Tambo (2012) defined curriculum as a group of courses and other planned opportunities or activities which students have under the guidance of a school or an educational institution. In more simple terms, the curriculum is what students learn in school. We retain Tambo (2012) in this work. The totality of the learning experiences provided to students in order to achieve predetermined educational goals.

### **Curriculum appropriation**

Pina (2014) suggested that appropriation of curriculum occurs when individuals actively engage with the curriculum and interpret it in ways that are personally meaningful, incorporating their own experiences and knowledge in to the learning process. According to Banks (1981) appropriation of curriculum involves incorporating diverse perspectives, experiences and cultural knowledge in to the curriculum allowing students from different background to see themselves reflected in the educational materials and fostering greater inclusivity. Curriculum appropriation is the active involvement of learners in shaping and customizing the learning experiences and content to be more meaningful and relevant to them demonstrated by the implementation and application of the content by learners for self-reliance.

### **Problem-solving**

Problem-solving is the process of finding solutions to difficult, or complex issues in education and life (Polya, 1945). Problem-solving is the process of applying knowledge, skills, and critical thinking to find effective solutions to academic and life problems (Gambril, 2012).

Problem-solving is defined as the process of identifying a problem, developing possible solutions, and implementing the most effective solution (Evans & Belloti, 2016). The definition by Evans and Belloti is retained in this research.

### **Competences**

McClelland (1973) defined competences as the knowledge, skills and characteristics associated with high performance as in school activities in projects, assignments, and assessments. According to Raven (1984) competences are complex combinations of knowledge, skills, understanding, values, attitudes and desire which lead to effective, embodied human action in the world, in a particular domain (such as in the case of high school science students in general education). Boterf (1994) defined competences as the ability to mobilise, integrate and transfer

a set of resources (knowledge, know-how, qualities, experiences, values, attitude) to face family of situations (that involve high school science students). To Maznevski and Kuhnert (2003) competences are the knowledge, skills and behaviours that individuals demonstrate in order to perform effectively in specific roles or occupations. They put together a little combination of cognitive, affective and psychomotor aspects. The definition of Maznevski and Kuhnert is retained for further exploitation.

### **Problem-solving competences**

According to Brophy and Alleman (2006) problem-solving competence is the ability to engage in a process to understand a problem, devise a plan, carry out that plan, and evaluate the extent to which the plan is used to solve the problem. Problem-solving competence is the ability to apply cognitive skills and strategies to overcome obstacles and find effective solutions to problems (Sternberg, 1996). For Pajares and Urdan (2006) problem-solving competence is the integration of knowledge, skills and attitudes that enable individuals to identify problems, explore alternatives, implement solutions, and evaluate outcomes. The last definition is retained for further exploitation. Problem-solving competences is the capacity to relate theory into practice which acts as a satisfactory response to the needs of the people. Applying knowledge to real life situation or hands-on activities that allow them to see the practical application of the knowledge they have gained.

### **Fabrication of soaps**

Watson (2016) referred fabrication of soap to the saponification process defined as the chemical reaction that occurs when fats or oils react with an alkali (such as sodium hydroxide) to produce soap and glycerine. Fabrication of soap refers to the process of creating soap through chemical reactions, primarily saponification, which involves converting fats or oils into soap and glycerine using an alkali, typically sodium hydroxide (for solid soap) or potassium hydroxide (for liquid soap) (Grosso, 2012). Grosso's definition is retained in this work.

### **Production of nutritive foods**

Barber (2014) describes production of nutritive foods as that which ensures sustainability, flavour and nutrition, local and seasonal practices, and culinary perspectives. To Nestle (2018) production of nutritive foods focuses on the food industry's practices, marketing and lobbying efforts which impact the production and availability of nutritional foods. It involves aspects such as nutritional quality, public health impact to prevent diet-related diseases but should improve

overall health. The production of nutritive foods is the process of creating food that provides essential nutrients for human health and well-being.

### **Manufacture of skin-care products**

Rogers (2018) referred production of skin care products as creating effective skin care products by selecting ingredients based on their on their functions, manufacturing process and complying with regulatory standards. Manufacture of skin care products is the process of creation and manufacture of various cosmetic of the skin which nourishes the skin and adds more beauty to the skin.

## **CHAPTER TWO**

### **REVIEW OF RELATED LITERATURE**

Much literature is required to inform readers about relevant aspects covering the topic formulated which is presented in the previous chapter. There are authors who exposed much on themes related to this and it is our intention to review their work, and expound on similar themes. Chapter two discloses conceptual review, theoretical framework and empirical review.

#### **Conceptual Review**

##### **Curriculum**

Education embodies learning, and there are different actors having diverse roles to ensure that the objectives are realised. There are those who possess the knowledge called facilitators required by those in need of the knowledge known as learners. Whether it is informal education, non-formal education, and formal education the actors play different roles. In the light of this study, formal education is identified where programs are sought for to respond to the need of a particular people or respond to particular problems. Formal education refers to the structured and organised educational systems that are established by educational institutions or government. It is organized into various levels such as primary, secondary, and tertiary education. Some key components of formal education include; structured curriculum, qualified teachers, assessment and evaluation and certification.

To Parson (1951) formal education is described as a social institution. This means that education is a recognized and established part of the society with specific functions, expectations and roles. All what concerns education is embodies in a 'package' called curriculum. A curriculum has a lot of benefits to the society as a whole which are as follows; education and skill development. Through curriculum people and individuals receive education in subjects such history, maths, chemistry physics social sciences etc that equipe them with knowledge and skills needed in the society. Curriculum also play a vital role in nurturing active and responsible citizens, educating them about their rights, duties and responsibilities as citizens. A well-informed citizen contributes to a vibrant democracy and more just and equitable society. There is also personal development in curriculum that goes beyond academic knowledge whereby fostering critical thinking, problem-solving creativity, communication and collaboration kills. These skills help individuals to go beyond the challenges or complexities of the modern world

adapt to changes and contribute meaningfully to the society. Another benefit is that of promotion of social cohesion. This foster sharing of societal values, norms and cultural heritage making individuals to have a sense of belonging and identity. A well-designed curriculum provides learners with workforce. That is aligning education with real world demands. This means that learners should be able to solve their real-life problems after acquiring competences from a curriculum (Dewey, 1938). Education is based under some foundations which are philosophical, historical, psychological, and sociological. These are the four key elements through which we can understand the theories, principles and practice of education. These foundations set the demarcation of knowledge of curriculum and define what constitutes sources from which to derive theories, ideas and principles (Orstein and Hunkins, 2017).

## **Educational Foundations**

### **Philosophical foundation**

This foundation answers the question; what is the purpose of school and what subjects, materials and methods can be used to the teaching learning process? Knowledge of philosophical foundation of the curriculum provides the teacher with guidance in the practical matters such as selecting curriculum goals and objectives, subject matter, teaching methods and understanding the relationship between the school and society. We have four educational philosophies in this foundation; perennialism, essentialism, progressivism and reconstructionism.

**Perennialism:** It is to construct a rational person and curriculum should help students to reason, focus on subject matter. Curriculum is constant and not changing. The role of a teacher is to help students think and reason.

**Essentialism:** This refers to a co-body of knowledge and skills that are essential for all students. There is promotion of intellectual growth and the essence is to train competent student. There is specialisation to help students to be professionals.

**Progressivism:** Progressivism is a belief in social progress in the society. Progressivism promotes democratic and social living. With knowledge there is growth and development. Learning is a continuous process and the curriculum focuses on learner's interest and problem-solving. Democratic means learners should have a right to make their own choices. The curriculum in place needs to be reformed to meet the present situation of the society. These reforms are aimed at improving the society. That is why Dewey (1908) says democracy and education go hand-in-

hand. He viewed the school as a miniature democratic society in which students learn the skills for democratic living. Teachers are agent of change in progressivism.

### **Reconstructionism**

Reconstructionism came to redress the issues that progressivism could not answer by late 19<sup>th</sup> and early 20<sup>th</sup> century. Members of this group argued that progressivism laid much emphasis on child-centred education. To them much emphasis should be put in society-centred education that address the needs of all members in the society or all social classes. They also focused on present and future trends and issues of international and national interest.

### **Historical foundation**

The historical foundation refers to the ideas, theories and practices that have shaped the development of curricula over time. The industrial Revolution led to a shift in educational focus towards preparing students for the needs for industrialized society.

### **Psychological foundations**

The field of psychology has played an important role in the development of curriculum in providing learning theories that teachers utilise to facilitate learning. For example, psychologist such as Jean Piaget provided insights into cognitive development and learning theories, influencing curriculum development.

### **Sociological foundations**

This has assisted the understanding of social aspects of the curriculum. Durkheim (1956) discussed the relationship between the society and education. He says education contributes to the transmission of social values and maintenance of social order. This is through the process of socialisation. In effect in developing a curriculum we need to consider the beliefs, customs and values of the society. Acknowledging domains in education renders clear understanding of the various aspects inherent of the latter and how they interrelate.

Domains of the curriculum include curriculum development, curriculum design, and curriculum implementation. Curriculum development consist of various processes (technical, humanistic and artistic) that allow schools and school people to realized certain educational goals. Curriculum development includes the theoretical and technical aspects of the curriculum while curriculum design refers to the way educators conceptualise the curriculum and arrange its major components as subject matter or content, instructional methods and materials, learning

experiences or activities to provide direction and guidance (Ornstein & Hunkins, 2017). There are many types of curriculums.

## **Types of Curriculums**

We have different types of curriculums as will be mentioned as follows; the formal curriculum also known as the written curriculum. This is what is laid down as the syllabus or that which is to be learned by the students. This body of knowledge includes subject like chemistry, biology, physics, economics, history, etc.

### **The taught curriculum**

This is what teachers actually teach in school. Teachers may not teach all what is in the formal curriculum due to lack of resources, lack of time or other environmental circumstances.

### **The tasted curriculum**

This is all what one would find in the tests and examinations learners are required to write. For example, looking at what comes during the GCE A-Levels and O-levels.

### **The hidden curriculum**

This is part of the curriculum that is not intended or planned but important in school for the development of learner's character, attitude but it is neglected. Children for example, learn many things by observing the way teacher's dress, communicate with each other and relate to their duties. They also learn from their age group and classmates.

### **The co-curriculum**

It refers to those learning activities or experiences students are exposed to by their teachers which are not stipulated in the formal or official curriculum. It is made up of activities such as sports, games and club activities (Tambo, 2012).

However, a curriculum is accepted as a program of studies to be taught in school under the guidance of the teacher for learners to appropriate. This curriculum is not unique in all levels of study. It is not also the same in all countries. Each country draws its curriculum depending on the needs of the society. This explanation is congruent with the definition of curriculum by Tambo (2012) that curriculum is a group of courses and other planned opportunities or activities which students have under the guidance of a school and educational institution.

Curriculum models have been established since the existence of formal education, evolving from the traditional curriculum which was teacher centred, basing on lecture and dogmatic methods. These are considered obsolete in modern trends in education due to evolution of ideas and practises. Prominent authors proposed the nature of adaptive curriculum for the modern society as written below.

According to Dewey (1908) the curriculum should be designed based on student's lives and focused on learning by doing and the development of practical life skills. Education should emphasise on a 'manual training' approach where students would engage in hands-on projects and the study of occupations to develop both their practical skills and intellect. Education should consider learning to produce objects taught, for instance; students need benches, food, soap, etc and therefore the physics, maths, computer, biology, chemistry and subjects taught to high school science students should provide knowledge, skills and attitudes about the production of the type of food, soaps and cosmetics. Such experiences should exploit a learning method such as cooperative learning to encourage democracy in education where every student has equal right to express his/her opinion to encourage individual and collection opinions in problem – solving in enabling social reform (Dewey, 1908). Dewey criticised the passive basic class organisation of learners sitting in rows and memorising information causing them to be 'passive' but encouraged education which motivates students' interest and active engagement by 'doing' through guidance. Interdisciplinarity was in the core of his ideology in education, rejecting the study of subjects in isolation. The high school science subjects as part of the curriculum are organised in combinations known as series. There are four series with different subjects cutting across.

Following Dewey, a combination of subjects should serve the purpose of moulding competences in high school students as occupations to be highly exploited progressively unto their adult life as careers such as aeronautics, chemical engineering, civil engineering, teaching, agricultural engineering, laboratory technology, medicine, forestry, food technology, agricultural science, geological mining, soil scientist and nursing. Therefore, every student who completes high school curriculum or program when correctly instructed will be initiated unto any career of their choice. General education will then become very meaningful to learners and their parents or guardians will enhance continuity in sponsorship. Combinations of subjects should be exploited in the harnessing of knowledge, skills and attitudes in high school science students to produce products relevant for practical problem-solving issues such as in the fabrication of soaps,

production of nutritive foods, and the manufacture of skin care products. To Dewey, such activities require interaction in learning methods like experiential learning, and project-based learning where students cooperate and discover knowledge themselves. Learners are placed at the centre of the learning activity and engage in emitting and verifying knowledge individually and in groups. This type of curriculum if appropriately appropriated and practised, then, learners will be transformed and will in tend transform their environments and easily contribute to the building of their communities and societies.

Tyler named the curriculum Tyler rational which emphasises on objectives, learning experiences, organisation and evaluation. To him stated objectives are behaviours expected of learners at the end of a learning experience which in itself is an interaction during lessons such as in activities and environment that are purposeful meant to reinforce achievement by learners. To him, learning should consider the values, interest, desires of learners as a priority which is important in motivating students learning. The organisation of learning should provide knowledge, skills and attitude to help learners solve problems in a logical and coherent sequence. The sequence should unfold following factors as the complexity of the content, the developmental readiness of students and the interdependence of the different learning objectives. The organisation of learning experiences should experience pursue a sequence following taking into consideration continuity, sequence (experiences should be built upon previous learning and to prepare students for more concepts which are more advanced), and evaluation of learning (Tyler,1949).

Therefore, Ralp Tyler proposed four steps model in a curriculum development which are;

- Establishing educational objectives: This entails determining the purpose and goals which the curriculum should achieve considering needs and interests of students, subject matter experts and society.
- Selecting learning experiences: This could be done by identifying the specific learning experience activities and instructional methods which will assist students in achieving the stated objectives.
- Organising learning experiences: Learning experiences should be organised in a logical sequence considering age of learner, and the complexity of the subject matter.
- Evaluating the curriculum: These measures the acquisition level of the learners on the learning experiences and the achievement of the stated objectives. Accomplishing such a task is monitoring the learner so as to decide to validate that the objective is attained or

not. If the objective is attained, the education proceeds to new related objectives but if contrary then remediation is recommended.

Taba (1962) posited that curriculum development should consider the following principles:

-Need assessment

This includes identifying needs of students, the community and society to make the curriculum relevant, responsive and adaptive to people.

-Objective setting

Taba emphasised and recommended that in setting objectives, they should be clear, specific and measurable.

-Selection of content

To her, every content selected should follow a systematic sequence involving the content, concepts and skills. Experience should involve lucid aspects constituting knowledge, skills and attitudes, values for the learner to appropriate and exploit in projects and activities – the basis of experience.

-Organization of content

Every content is organised in a logical scope and sequence for learners to acquire as the basis of sciences to facilitate learning.

-Selection of learning experiences

Teaching and learning activities should unfold according to the topics, and lessons where appropriate teaching methods and strategies that will help students achieve the stated objectives are used.

-Organization of learning experiences

This involves structuring the learning experiences in a way that promotes effective and efficient learning.

-Evaluation

This means developing assessment strategies to evaluate the content to which the learning objectives have been achieved.

Teachers' active involvement in all stages of the curriculum development and development will serve a good stage for an adaptive curriculum because teachers are immediate actors with students on the field.

Previous contents in learning exploited context or examples out of the context of the student and the observation is that the learning remained abstract to the student preventing achievement of objectives at the end of the lesson. The competence-based approach practised in high schools in Cameroon today, considers relating content to context or integrated learning themes/environment of student. This is a foundation for students to understand their living surroundings, identify root cause of problems, and explore resources through education and provide concrete solutions. When this is perfectly applied, learning will find meaning because the interest, values and needs of students are considered. Students will implement the competences appropriated. Taba's recommendation to objective setting includes cognitive, affective and psychomotor domains. Such a recommendation considers the holistic development of an individual.

In Cameroon, Alemnge (2019) presented reforms in primary schools that took in 2018//2019 school year this curriculum is organized around seven national core skills and four broad – based competences, and to be implemented through 10 pathway subjects and eight integrated learning themes this curriculum was develop with the vision to meet the changing needs of Cameroon pupils the society and to harmonise education programs for both English and French sub systems of education which until now, were separated. These reforms of curriculum created a solid foundation for elementary education to relate theory and practice through pedagogic projects, carried out at the end of each pedagogic month. However, in executing a project, pupils have to identify a problem in their context (environment) first, explore resources, cost of resources, and subject areas or lessons taught to exploit in solving the problem identified. The competency-based approach is meant to transform learners who will later transform their communities and societies. For high school science students to have relevant education, the combination of competences appropriated the curriculum of mathematics, physics, biology, chemistry, etc, disposes them to productivity or producers of physical objects in making use of local materials from their environment. By so doing, the environment, the product as well as the producer are valorised, people tend to cultivate and construct their environment to make available the materials needed. This lubricates other avenues and chains of activities where indigenes will be cultivating and others purchasing – a commercial avenue to uplift financial situations. This will mitigate dependence on imported goods, finished products from other countries.

**Table 1: Series of the curriculum of high school science students in Cameroon**

The curriculum of high school science students is grouped into four series which are;

Series (S)	Subjects
S1	Maths and mechanics, chemistry, physics, further mathematics and computer science,
S2	Biology, chemistry physics, maths with mechanics, further maths
S3	Biology, chemistry, maths with statistics, food science and nutrition and ICT
S4	Biology, chemistry, geology, physics and mathematics with statistics.

*Source:* Syllabus manual from the Ministry of Secondary Education of 2019

The first three subjects of each series are the main subjects to which one or two other subjects could be added depending on the ability of the student and the career to pursue. Amongst the goals and objectives stated for high school science curriculum is this 8<sup>th</sup> which states that ‘students should be able of handling problems of everyday life by using ideas, concepts and skills developed. Simple and local materials in the environment are recommended to be used all over the practical lessons to serve the need of the community. One of the competences of high school sciences are regrouped under the following major headings; Make, manufacture or produce some useful objects/materials using the know-how acquired (Ministry of secondary education in Cameroon, 2019). This is the objective that interests us in this study.

In the science syllabus manual provided by the ministry of secondary school, below are the projects that students can realise after going through the Lower sixth and Upper sixth program.

- Preparation and analysis of aspirin
- Effect of acid rain on limestone
- Fabrication of soaps
- Production of body lotions
- Fermentation to obtain alcohols, yoghurt, using carbohydrates from different foodstuffs and fruits
- Distillation and purity control of local drinks
- Production of starch from cassava

- Effect of thermal treatment on the physical and chemical properties of recycled polypropylene.
- Extraction of local medicinal/natural products (e.g., caffeine, fruit juice, perfumes, etc.
- Purification and treatment of water for domestic use.
- Production of dyes and the dyeing of fabrics.
- Production of nutritive foods (pastries such as peanuts, fish pie, fish roll, chin chin, cake; traditional meals such fufu and eru, traditional snacks such as Dakwa, corn and groundnut pudding, etc.).

Subjects that involve practical lessons provide competences to learners which enable them to implement if they are serious. Such subjects include physics, chemistry, biology, food science, computer science and ICT with practical schedule one time per week for each subject. Other practical lessons and common experiments learned are dissections such as dissecting and studying the internal structures of organisms like frogs, earworms or small mammals; in ecology and field studies practical lessons are done by collecting and observing bacteria and other microorganisms; genetic and inheritance, enzyme activity, photosynthesis, cell biology, etc.

When we questioned students on the number of groups of competences carried out for the complete course, that is, for lower sixth and upper sixth they pointed out that they selected only one per subject and studied as recommended by the General Certificate Examination (GCE) Board in Cameroon. These are the words of Miguelle (in anonymity) – an Upper sixth student in GBHS Mendong ‘Our school authorities explained to us that we have to select a single competence and study for practical to be presented during GCE course evaluation. So, our teachers retained and taught us the fabrication of soaps, production of nutritive foods and manufacture of skin care products only.’ For the question ‘have you mastered these competences taught to you as practical, Miguelle response is ‘I have can manufacture soap, cook some pastries such as chin chin, bake cake, puff corn, etc, and body lotion if provided with the materials.’ To the question whether you practice these competences at home for consolidation, her response is ‘I do not practice the competences because getting the products is difficult and they are expensive.’ To the question did you inform your parents about the importance to buy these materials for practice, her response is ‘Yes, I informed my parents but they complained of hardship and never sort to provide me the materials or the money to buy.

This situation limited me from reinforcing the competences appropriated from practical lessons in school for personal practice.’

**Table 2: Some careers denoted from the high school science curriculum**

CAREERS			
Aeronautics	Agricultural engineering	Veterinary medicine	Agricultural engineering
Biochemical engineering	Forestry	Agricultural science	Civil engineering
Computer engineering	Laboratory technology	Food technology	Geological research
Teaching, amongst others	Medicine	Pharmacy, amongst others	Soil scientist, amongst others
	Nursing, amongst others		

*Source:* Syllabus manual from the Ministry of Secondary Education of 2019

## Curriculum Appropriation

Curriculum appropriation involves the various ways or elements through which the curriculum is acquired. It refers to the process of understanding and integrating important competences into one's own practice. It demands more than just memorizing information. When learners appropriate the curriculum, they do not only grasp the content intellectually but also make it relevant and applicable to their own life. Curriculum appropriation involves the development of a curriculum, which typically includes determining the educational objectives, selecting and organising content, designing learning activities and creating assessments. Curriculum appropriation is also the acquisition of competences (knowledge, skills and attitude) by learners in any giving domain of learning and applying knowledge to real life situation or hands on activities that allow them to see the practical application of the knowledge they have gained (Wicomb, 1998; Leonardo & Ronald, 2005). Curriculum developers consider factors such as the needs and goals of learners, subject matter expertise, and educational standards when designing a curriculum. Learning objectives are the intended outcomes of the curriculum. They describe what the learners should be able to know, understand and do after completing the curriculum. Learning objectives guide the selection of content and help in assessing whether the desired goal and learning outcomes have been achieved. Curriculum developers need to decide what knowledge, skills and concepts to include in the curriculum.

## Aspects of Curriculum Appropriation

### Content of curriculum

The content of curriculum to be taught is provided in the program by the educative authorities as syllabus. Teachers procure these syllabuses according to the subjects assigned them to teach. The subjects of high school sciences include biology, mathematics, further mathematics,

chemistry, physics, information and communication technology, computer science, food science and nutrition and geology. Each student makes a choice of highest five subjects and in a combination or series to study. There is the theoretical part of the learning which compels the practical part to complete the holistic training and development of knowledge, skills and attitude of students.

The class timetable schedules lessons for teachers, students and pedagogic supervisors to follow, for good organisation. Dewey (1938) laid emphasis that selected contents of curriculum should take into consideration interests and experiences of students rather than focusing just on pre-determined subject matter, blended with active hands-on activities. Contents of curriculum are structured in a lesson with a duration of fifty minutes or more in a teaching/learning process.

### **Classroom interaction and assessment**

Teachers always prepare guides for contents to be taught known as lessons. A typical content of a high school lesson may be stratified as below.

- Lesson objectives: Objectives constitute specific learning goals and skills that students are expected to develop by the end of the lesson as in the case of fabrication of soaps, production of nutritive foods and manufacture of skin care products.
- Lesson structure: This carries a logical flow from introduction, body and conclusion. The introduction sets context and engages students, the body delivers content and the conclusion provides the takeaways.
- Content selection: Content is selected to retain relevant subject matter aligned with the learning objectives.
- Content sequencing: Content should be built to facilitate understanding of learners sequentially. This should be done teaching from simple to complex, concrete to abstract, and from familiar to unfamiliar topics.
- Instructional strategies: A variety of teaching methods is requested when conducting a lesson. These methods and techniques are incorporated so as to engage students and address their different learning styles which involve direct instruction, guided practice collaborative work, quizzes and assignments.
- Assessment: All forms of assessments are required during the lesson, such as diagnostic assessment which requests the level of acquisition of previous lesson, formative assessment which goes on during the present lesson taught and summative assessment at

the end of the lesson or course. Assessments should be in the form of quizzes, tests of various types, evaluations should follow the higher level of bloom's taxonomy as this will engage students in activities challenging their faculties of reasoning.

- Differentiation: Lessons should be adapted so that content, process, and product of the lesson meet needs of students, involving those with special needs, language disabilities, and other needs.
- Connections: These create interdisciplinarity within teaching context as a link between the lesson and the real-world. It should also connect student's prior knowledge to larger curricula concepts. These demand additional practice, research and projects for students to complete out of the classroom for knowledge consolidation (Hunter, 1994).

Bybee (2013) presented the sequence below for the organisation of a science lesson. The sequence is called the 5E instructional model;

**Engagement:** Engagement stage captures students' interest and attention. The teacher should be resourceful in employing demonstrations, questions, or real-life situations to arouse students' curiosity and connect the lesson to prior experiences and knowledge. This stage sets in to motivate students to learn more.

**Exploration:** Students are asked to explore new concepts, skills by committing to hands-on activities, projects, problem-solving tasks and investigations at this stage. The function of the teacher in facilitating the stage is making observations, gathering data as well as generating questions. By so doing students will develop a deeper understanding of the topic and able to identify gaps about misconceptions, challenging knowledge and principles.

**Explain:** There is introduction of new concepts, definitions and principles related to the new topic by the teacher at this stage. The teacher uses plausible strategies during interaction such as direct instruction, multimedia resources, or guided discussions to engage in the learning activities and clarifies misunderstandings. He utilises scientific knowledge and vocabulary to support the learning.

**Elaboration:** In this stage, students have to apply the new (found) knowledge to new or different context. This is also called transfer of learning (Haskell, 2001; 2000;). The teacher at this point provides opportunities for students to extrapolate and extend their understanding, solve problems, or make connections to real-world situations. The stage prompts students to critical thinking, deeper learning, and transfer of learning to different learning situations.

Evaluation: Evaluation sets in to assess students' learning and to measure the level of attainment of lesson objectives. Various assessment methods are implicated at this situation like formative assessments, summative assessments, even performance-based tasks to apprehend and gauge students' progress. Support and remediation should be given or done to students to ameliorate learning. The evaluation stage provides feedback to students and also allows the teacher to reflect on the effectiveness of the lesson and make adjustments for future instruction.

However, the general sequence for constituting a lesson or learning situation according to Gagné (1985) is as below. He established nine stages for a lesson.

- Gaining attention: This involves capturing learners' interest and focusing their attention from the beginning of the lesson.
- Informing learners of the objective: Objectives and expectations of the lesson should be clearly communicated to learners at the beginning of the lesson.
- Stimulating recall or prior learning: Learners' existing knowledge, skills and attitude related to the new content should be activated through recall or revision at the initial stage of the lesson.
- Presenting the stimulus materials: The didactic materials for the lesson are presented as the lesson proceeds with the different stages.
- Providing learning guidance: It essential to offer support, examples, demonstrations or scaffolding to assist learners make sense of the new relevant materials.
- Eliciting performance: Learners have to be provided with opportunities to actively practice their competences on real-world.
- Providing feedback: Feedback should be given to learners by the teacher on learners' performance to reinforce learning and correct misconceptions that arise.
- Assessing performance: The objectives of the lesson and learner's competent achievements are assessed using appropriate assessment methods.
- Enhance retention and transfer: Reinforcement of retention is encouraged by assigning various hands-on tasks and projects to students. The more students practice the more they adapt knowledge to new situations.

## **Competences**

Wiggings and Tighe (1998) viewed competences as enduring understandings and essential questions that students should be able to demonstrate mastery of through performance

tasks and assessment. According to Marzano (2003) competences are the knowledge, skills and attitude that students need to acquire in order to successfully meet the demands of complex tasks in a particular domain. Boyatzis (2008) developed a model of individual competence which he outlined the different types of competences as cognitive, emotional and social competences. To him, to effect good job performance managers should identify the above competences before engaging in recruiting employees to vacancies. The additional competences Boyatzis made mention of were self-awareness, self-regulation, social awareness and relationship management as pertinent aspects which foster the growth of a company, in their work of development. A lot of reforms has been going on in the education system of Cameroon in recent years to focus more on competency-based learning, moving away from the traditional memorization approach. A study carried out on competency-based approach in Cameroon public schools; modes of appropriation and constrains, examine the various ways teachers acquired knowledge and skills on the use of CBA and challenge they faced in implementing it. Through this approach the learners will not only acquire knowledge but use it in a meaningful way in various situation in life. The teacher is a mediator between the learner and knowledge. Teachers acquired basic knowledge and skills through seminars, and workshops. Some of the challenges teachers encountered are overcrowded classrooms, lack of concrete teaching, inadequate knowledge on how to use the competency-based approach (CBA), difficulties relating to real life situations, and lack of textbooks (Lilian & Wiisahnyuy, 2021).

Angelo (2021) examined how teachers in the Dominican Republic perceived the effectiveness of pedagogical practices in the context of a competency-based curriculum reform introduced in 2014. The aim of the reform was to shift the education system away from a traditional, content-focused approach toward the one emphasizing the development of key competences. Teachers' views were on the extent to which their teaching practice aligned with the competency-based approach, challenges faced in implementing effective pedagogy under the new curriculum, and support needed to improve their teaching methods. Many teachers struggled to fully transition their practices to align with the competency-based approach model. Commonly cited challenges included large class sizes, lack of teaching resources, and insufficient training/support on the new curriculum. Teachers expresses a need for more professional development, classroom resources and opportunities to collaborate and share best practices. This article concludes that successful implementation of competency-based approach requires substantial investment in building teachers' pedagogical capacity and providing the necessary structural supports. Critical factors were identified as ongoing teacher training, access to teaching

materials, and opportunities for peer learning. The findings also highlight the importance of prioritizing teachers' professional needs during major curriculum reforms.

Owala (2021) examined the successes and challenges of implementing the competency-based curriculum (CBC) in Kenya education system. The CBC was introduced in 2017 to replace content-based curriculum with the aim to equip learners with relevant skills and knowledge for the 21<sup>st</sup> job market. Several successes were due to the implementation of CBC. There was a shift towards learner-centred pedagogy which emphasizes on active learning, problem-solving, and the application of knowledge, moving away from the traditional passive teacher-centred. This CBC also focuses on the acquisition of competences, such as critical thinking, communication, and collaboration, rather than just content memorisation. There is flexibility and personalized learning, enabling learners to progress at their own pace and their individual needs. However, the article highlights some challenges faced in the implementation of CBC in Kenya; inadequate teacher preparedness making them to lack the necessary skills to effectively implement it. Resource constraints where schools face shortages of learning materials, technology and infrastructure required to support the implementation of CBC, resistance to change and assessment challenges. Emphasis was put in the continuous investment in teacher professional development, improved resource allocation, and effective communication with stake holders to ensure the successful implementation of CBC in Kenya (Owala, 2021).

### **Appropriation of Practical Competences**

Practical competences precede theoretical lessons in high school learning where teachers and students interact with the content to appropriate knowledge, principles, guidelines, laws and tendencies related to the precise hands-on activity or project to carry out.

Laboratory experiments and investigations: In laboratory experiments and investigations, students demonstrate in a science laboratory hands-on to develop skills experimental design, data collection, and analysis. Students learn how to apply scientific concepts and principles in real-world settings.

Project-based competences: For project-based competences, students will work on projects to solve problems identified in their environment. Interdisciplinarity plays a vital role at this stage because subject combination or series contributes for the realisation of the projects. In the fabrication of soaps for instance, the problem is identified by students. The problem may be students having dirty clothes, and kitchen utensils due to lack of soap to wash them. The probable

solution is fabrication of soaps which leads to identification and buying of resources to make soap. The school provides the materials and following principles and measurement appropriated in the various subjects concerned such as biology, chemistry, mathematics, etc, the mixture is carried out and preserved for usage. The realisation of the project is a means by which students unite in cooperative learning as teams where ideas are shared, collaboration, communication and interpersonal skills are exhibited as well as the encouragement of peer learning. Projects enable students to apply their science knowledge, skills and attitudes to solve real-world problems. In projects these additional activities and life skills are acquired, research, design, presenting findings, critical thinking, problem-solving and empathy.

Simulations and virtual labs: For simulations and virtual labs, students make use of computer simulations and virtual lab environments for the practice of experimental techniques and data analysis, providing opportunities for the engagement in hands-on learning in a controlled setting.

Field trips and observations: Field trips and observations are carried out in museums, science centres, and natural settings to carry out activities, observe events and collect primary data. Such experiences permit students to implement their scientific knowledge and knowhow in authentic contexts. Students practice presenting their findings, defending their ideas, as well as involvement in scientific discourse which reinforces their written and oral communication skills (David, 1984; Gobert & Binns, 2018).

Some of the practical competences appropriated includes; fabrication of soap (liquid, hard), cake, yoghurt, sha drink, folerie, rubbing oil, natural fertilizers to improve the soil for agriculture. Some of these products are consumed and some are being sold to have finances that can enable students to solve their basic problems, for instance the buying of school needs, clothes, medication, food stuffs just to name a few.

### **Problem-solving**

Problem-solving is a skill highly demanded this 21<sup>st</sup> century for learners though it in the 1960s in the USA. Great autonomy in knowledge is boasted of if the individual, student portrays more ability in implementing the latter for his/her benefit to solve problems. Problem-solving follows a logical sequence which requires expense of mental energy to reflect on the issue in question and outlining steps to solve the problem. When people are equipped with correct problem-solving approaches they encounter greater success in life than when they are destitute

of them. Wrong problem-solving approaches lead to expensive errors because they are a source of stress, anxiety and nuisance of every sort. Problem-solving approach is a technique which individuals employ in life to understand and get more knowledge of their environment and to take adaptive decisions for better functioning. To solve a problem, one must be empowered of the different valuable resources related to the situation at hand and then retaining best of the options congruent to one's objectives. Problem-solving skills need to be enhanced often and the ultimate way to do this is through education. Education challenges faculties because students are open to gathering facts through the various processes research, exercises, assignments, projects and fill trips where curiosity plays a major role. When students are tuned to questions there is vacuum create that needs to be filled by responses, and this is one of the major functions of education. Students are taught to search answers to questions asked by themselves, others, books and learning materials and to present them in an acceptable and satisfying manner for exploitation by the public.

Problem-solving exposes the learner more to the actual learning material where basic scientific attitude, knowledge and skills are used. It is for this reason that Dewey (1938), posited that students should be made to developed intellectual tract and sensitivity to solve problems and make inquiries. An inquiry-oriented teaching does provide openings for identification and clarifications.

### **Approaches to Problem-solving**

- Analytical approach: The analytical approach constitutes breaking down the problem into smaller, and more manageable parts, analyse each part separately, and then put the pieces back together to find a solution. This approach is often used in fields like engineering, computer science, and mathematics as well as results of research work.
- Creative approach: This is an approach that focuses on generating innovative and unconventional solutions to a problem at stake.. It involves techniques like brainstorming where the people concerned reflect on the given topic, mind mapping, and lateral thinking to explore new ideas on the projects concerned (Michalko, 2006; Buzan, 2006; de Bono, 1970).
- Systematic approach: The systematic approach involves following a structured process that unfolds step by step to realise a problem. Such steps may include; defining the problem, generating possible solutions, evaluating alternatives, and implementing the chosen solution.
- Collaborative approach; an approach as this one involves working with others to solve a problem. The collaborative approach is beneficiary when work in a collective. It can involve

techniques like group discussions, team – based problem solving, and seeking input from experts, stakeholders and resource persons.

- Intuitive approach: The intuitive approach relies on gut instinct, personal experience, and a deep understanding of the problem domain to generate solutions. The foundational idea of this approach is that our intuition, subconscious mind, and creative insights are powerful tools which solve complex problems. The approach is beneficiary in fields such as business, design and entrepreneurship.
- Trial – and – error approach: This approach involves testing different solutions and learning from the outcomes. The sequence of this approach is;
  - Generating a potential solution or action to try.
  - Implementing the proposed solution by testing it.
  - Observing the outcome and evaluating whether to verify the level of success of the solution.
  - If the solution is not successful, then generate a new proposal of the solution. -Continue this cycle of generating, testing and evaluating the various trials until you attain the most adaptive solution.

This approach is often used in specific research and product development, where experimentation and iteration are essential.

- Empathetic approach: The empathetic approach involves understanding the perspectives and needs of the people affected by the problem. It involves situations where individuals' affectivity is put at stake and there is instability of emotions. The approach commends understanding ongoing perspectives, emotions and experiences of those affected by the problem.

In the advent of a problem, the choice of its solution will depend on the problem itself, the resources available, skills of the problem-solver and confronting any of the problem-solving approaches above before initiation. The most adapted choice is a blend of more than one approaches where there will be increasing possibilities of success.

### **Stages of problem-solving process**

- Problem identification: This is the first stage where students recognize and define the problem in their project. It involves understanding the nature of the problem, identifying the root cause and clearly articulating the problem statement.

- Information gathering: Students collect relevant information about the problem through research, including any data, facts, or background knowledge that can help them understand the problem better. They may consult various sources for the solution.
- Idea generation: The idea generation stage involves brainstorming and generating potential solutions or approaches to the problem individually and collectively as a group. This may involve techniques like mind mapping (visual thinking and brainstorming technique), lateral thinking (approaching problems challenging assumptions, generating alternatives and creativity), or seeking input from others.
- Solution evaluation: Students evaluate the potential solutions or approaches generated in the previous stage. They may use the following criteria; feasibility, costs, effectiveness, and potential risks to assess the different options.
- Solution selection: The solution selection is based on the solution evaluation. This is done by choosing the most promising solution or approach and implementing.
- Implementation: Implementation involves putting the selected solution into action which constitutes processes of planning, allocating resources, and monitoring the progress.
- Evaluation: This is carried out after implementing the solution. The problem-solvers (students) have to evaluate the effectiveness of the selected solution in solving the problem. This stage involves assessing the outcomes, identifying any remaining issues or new problems that have emerged, and making adjustments as need arises along the lines.
- Reflection: Reflection proceeds evaluation and it is the final stage. It involves reflecting on the problem-solving process, learning from the experience, and identifying areas for improvement in future problem-solving efforts (Dewey, 1910; Polya, 1945).

### **Problem-solving competences**

Problem-solving competences refer to the skills, abilities and approaches that individual possesses to identify, analyse, and resolve problems effectively. PISA (2012) defined problem-solving competences as ‘an individual’s capacity to engage in cognitive processing to understand and resolve problem situations where a method of solution is not immediately giving. It includes the willingness to engage with such situations in order to achieve one’s potential as a constructive and reflective citizen.

They involve the ability to identify, define, analyse, and solve complex problems in a variety of context’. For instance, Phayaphrom and Nurritamont (2022) carried out research on

problem-solving competences in Mathematics to demonstrate that problem-solving begins with the abstract phase of thinking (reflection) and moves to the concrete phase of doing where the thought is exhibited or expressed. They demonstrated that students needed to be taught to reflect on their thought before solving Mathematical problems so that they can apply and adapt strategies and tactics they create to different problems and situations. Students have the possibility of developing ways of thinking habits of tenacity, curiosity, and confidence in unusual situations by solving Mathematical problems. Developing skills in problem-solving will serve students better outside of mathematics classroom significantly (National council of teachers of Mathematics, 1906). Problem-solving for students develops from classroom from the knowledge, skills and attitudes appropriated from the different subjects' interactions in a combination, as in high school students' curriculum and extends to practical activities where objects are constructed.

Problem-solving competences are multifaceted and require individuals to engage in critical thinking, employ creativity, make informed decisions and utilize effective problem-solving strategies in diverse contexts. Problem-solving competences permit to relate theory into practice which acts as a satisfactory response to the needs of the people. Also, in problem -solving competences there must be problem identification. This involves recognising discrepancies between the current state and the desired state, understanding the nature of the problem and clarifying the goals to be achieved. Secondly we have analytical thinking. It refers to the ability to analyse complex situations and break them down in to smaller components and understand the relationship among them. The third is creativity. This is the ability to operate original ideas, approaches, and solutions to address challenges and obstacles. You have to think out of the box, you have to break away from convention and traditional methods and come in with a fresh idea to problem-solving.

Problem-solving competences are also vital to individuals in particular and to the society in general. Problem-solving competences help in overcoming challenges of life. It enables individuals or learners to identify problems, analyse problems, identify solutions and implement strategies to address them. Problem-solving competences enhance the ability to navigate challenges successfully. They lead to decision making. When faced with choices or dilemmas, individuals with problem-solving skills can evaluate the available options weigh the pros and cons and make informed decisions. There is also enhancement in innovation, creativity, collaboration, adorability and resilience.

## **Aspects enabling demonstration of competences in the curriculum of high school sciences**

There are many aspects that enable students to demonstrate competences in the curriculum of high school science. One of them is inquiry-based learning. This is achieved when students are given the opportunity to engage in hands-on activities that allow them to explore scientific concepts, design experiments, collect and analyse data, and draw conclusions. This helps learners to develop critical thinking skills, problem-solving and scientific reasoning skills. Project-based learning also helps in the demonstration of competences in high school science curriculum. This is realised by assigning students to apply their scientific knowledge and skills to real-world scenarios. For instance, students can be assigned to carry out a project on the fabrication of soap and manufacture of fertilisers to boost agriculture. This encourages students to collaborate, communicate effectively and think creatively.

Laboratory experiences is another area where students can show their competences in high school science curriculum. Here, students have access to well-equipped science laboratory where they can conduct experiments, manipulate scientific instruments and practice scientific techniques. This helps students to develop practical skills and also work safely in their environment. Assessment also provides an enabling environment for students to express competences in high school science curriculum. Facilitators implement a variety of assessment methods such as performance-based tasks, portfolios and problem-solving activities, that allow students to demonstrate their understanding and application of scientific concepts rather than just memorizing facts.

Interdisciplinary connections, feedback and access to diverse learning resources are other aspects. Learners should be able to use the knowledge gained in science curriculum to integrate it into other subject areas. This will help learners to understand the relevance and application of scientific knowledge. Through feedback from teachers, learners help identify their strengths, weaknesses and areas for improvement. Diverse learning resources ensure that learners have access to a wide range of resources including textbooks, scientific journals, online databases, and videos. This helps them to understand scientific concepts and their exploration. By incorporating these aspects into the high school science curriculum, educators can create an environment that empowers students to demonstrate their competences, develop critical scientific skills, and engage learners.

## **Fabrication of soap and problem-solving competences**

Education in the 21<sup>st</sup> century is orientated towards the development of skills in learners to foster practice. The teacher, in whatever lessons disseminated, is to have as objective; to prepare lessons such that the knowledge thereof is to construct concrete objects visible and useful to the learner. Such construction of objects is displayed in practical works where materials from the environment are solicited for artisan works, home economics, and agropastoral farming which are various aspects of vocational activities (Kolb, 2015; Dyer, 1981; Johnson, 1999). Vocational training (professional or job initiation) is significant for science students in high school for the advantages it generates below. The practical carried out by students build a foundation for certain professions which students will adhere to as they grow -up and develop as adults to earn their living. Some of these advantages of vocational initiation in practical works and project realisations are;

- It enables skill development. Students are opened to hands-on experience and technical skills which are very important to specific careers which later-on will enhance their employability and preparedness for job market (Kolb, 2015).
- Practical application of knowledge. The application of knowledge appropriated from science curriculum is enhanced through engagement in vocational activities in the real world. The initiation of professions commences as such by students putting concepts, theories, laws and principles incorporated into practice such that their consolidation is assured later when they integrate careers in the job market.
- For career exploration. All practices carried out by high school students are attached to life careers. As such students are exposed to career paths in science with the advantage of making them reflecting upon the path so that they can make informed decisions about career options.
- Acquisition of problem-solving skills. Learners interact collaboratively in learning situations, they develop critical thinking, problem-solving, creative skills, imagination and communication skills which enable them overcome the challenges encountered in the course of the realisation of projects (Dewey, 1916).
- Interdisciplinarity learning is assured. To realise a project knowledge acquired from various subjects or disciplines is employed by learners, guided by the instructor to work on projects. For high school science students in this study, projects treated are the fabrication

of soaps, production of nutritive foods, and manufacture of skin care products. The integration of knowledge from mathematics, chemistry, biology, physics, and further mathematics to bring out products of the projects is rightly known as interdisciplinarity. Students perceive for themselves connections involved in the science lessons to achieve the results of experiments.

- Vital for economic contribution. These students produce materials, objects and food items relevant for usage and consumption by themselves and/or the public. When produced in good quantities the goods may be sold for economic benefits, thus, contributing to their educational needs and life fulfilment in required areas.
- Initiation into workforce. High school science students by engaging into practical activities develop basic competences of certain careers which they will later-on identify with in life as they develop into the adult life on graduation from school.

### **The process of fabrication of soap and problem-solving competences**

By definition, Hilditch (1949) describes soap as the product emanating from the reaction between a fatty acid and an alkali, producing a salt in a process known as saponification. Soaps are constituent salts of fatty acids that are produced by the process of saponification, which is the reaction of fats or oils with alkali. Soap production constitutes a series of mixture of chemicals, and plant ingredients such as caustic soda, bleached palm oil, industrial palm kernel oil, sodium silicate, rainwater, spring water or distilled water measured in appropriate quantities to suffice then amount needed by the producer (Gervais & Bella, 2014). These authors emphasized on the respect of safety rules in soap production because the chemicals utilised are very dangerous. The safety equipment to wear are; a jacket, gloves, a protective mask, rubber boots, a pair of goggles, and a series of instructions to guide the producers. The process of soap production, known as saponification involves the preparation of soda solution; allowing the soda solution to settle and transferring it to a container placed in a cooling system. Bleached palm oil which is cooled to ambient temperature is mixed with palm kernel oil. The soda solution is gradually added to the oil mixture with regular stirring to a particular direction – right or left. The stirring continues as the soda solution is added until attaining homogenous paste, which is the soap. The saponification process may unfold up to 60 minutes. Other additives as sodium silicate are added if seen necessary and stirred to regain the homogenous paste. The final paste is now poured into plastic or wooden moulds in the forms chosen by the producer and dried in a shade in the open air for 3 days.

For liquid soap, it has a synthetic chemical product with greater cleansing properties than laundry soap (Gervais & Bella, 2014). Liquid detergent is fabricated using the following products; texapon, alcohol or genapol, - a cleansing agent that is readily used as soon as it is diluted with water, cooking salt, is a softening agent to dilute the texapon in water; spring water or rain water to dilute the texapon or cooking salt to obtain a liquid detergent; sodium benzoate acts as a stabiliser in the mixture; a synthetic fragrance when added improves the aromatic properties of the liquid detergent and a colourant solution is added. All the constituents are mixed in a bucket according to the adequate units decided by the producer. For example, mix texapon, genapol or alcohol (in the form of gel) with cooking salt and stir with vigour for up to 20 minutes obtain homogeneity. To foster the project, water, and the synthetic fragrance of any choice are gradually added, then sodium benzoate, and finally adding a colourant if desired. The content in the bucket is sealed for 5 hours at least and then packed into plastic containers.

Zauro (2016) utilised locally collected raw materials and produced soap. The soap was fabricated using sheabutter oil, palm kernel oil and plantain peels. This project demonstrates students can later invent innovative ways to produce soaps making recourse to local materials found in their environments. The project-based method of learning empowers learners with competences capable of extrapolating (extending) productivity to other areas when relevant materials are made use of. However, types of soaps range from hard soap, powder soap and liquid soap which are fabricated employing same methodology except for the mixture because of the differing products put together. High school science students carried out projects in making liquid soap. The actions were collaborative and constructive as each member participated in the success of the products. Competences and know-how acquired from this practice will enable students transmit further in their homes to assist them in problem-solving where the products are used by themselves or may be sold to raise some income.

### **Production of nutritive foods and problem-solving competences**

Nutritive foods are those that provide essential nutrients necessary for growth, repair and overall bodily function, emphasising the significance of a balanced diet (McGee, 2004). Nestle (2013) perceives nutritive foods as those foods that deliver important amounts of vitamins, minerals, and other nutrients, contributing to health and preventing chronic diseases. Nutritive foods are substances that furnish an individual with essential nutrients required for the growth, development, maintenance, well-being and health of the body. For foods to be considered nutritive, they are made up of a balance of macronutrients (carbohydrates, proteins and fats) and

micronutrients (minerals and nutrients) that retain the body in a state of normal function.

Nutritive foods have the following characteristics;

- Required nutrients: Such nutrients are minerals, vitamins, fats, proteins and carbohydrates.
- Furnish energy: The energy thereof serves as fuel for the running of humans and provides stamina for activities carried out.
- Health and well-being: Nutritive foods contribute to health and well-being; they back up the immune system and therefore assist in preventing diseases.

Some of the nutritive foods' production processes are succinctly explained below.

### **Production of yoghurt and folere**

Nchinda et al. (2008) carried out a study on yogurt production enterprises in the North West Region of Cameroon. Farmers had been trained by Heifer Project International (HPI) and national Agricultural Research and Extension Programme (PNVRA) on the techniques of processing fresh milk into the different types of dairy products such as milk, cheese, butter, ice cream and yogurt. They noted that yogurt was highly preferred by consumers than the other dairy products (Nchinda et al 2008). Yogurt is a nutritive food containing vitamins, minerals, fats and proteins. Minerals like calcium strengthened teeth and bones. Vitamin B12 and riboflavin protects individuals against heart diseases. Phosphorus, magnesium and potassium regulate blood pressure, metabolism and bone health. Proteins support metabolism by increasing energy expenditure and the calories burned on daily bases. It strengthens the immune system. Maiwore et al. (2019) presented the various elements and processes involved in artisan milk and traditional fermented milks consumed in Northern Cameroon. They explained that yogurt is artisanal produced either with reconstituted powdered milk or raw milk. The procedure is as follows, adding one cup of yogurt from the previous day to approximately 20 litres of boiled milk in a container in a pot. The milk in the pot is allowed to ferment for one day at room temperature. After this day, the product is packaged on plastics flasks and kept in a refrigerators and freezers for preservation. The artisan yogurt packs are removed and sold in Maroua, Garoua and Ngaoundere and consumed or sold to the population for economic benefits (Maiwore et al., 2019). Another nutritive food's production process, folere, is explained below.

As explained by Bayoi et al. (2014) folere juice (*Hibiscus sabdariffa*) is the most handcrafted consumed drinks in the Far North region of Cameroon. The recipe for folere production is cinnamon sticks, pineapple, dried hibiscus sepals, water, gloves used optionally,

sliced ginger, flavour of your choice and water. The pineapple is thoroughly washed and peeled then cut into chunks, peels of the pineapple and chunks are put in a large pot and water added. This content is set on fire and allowed to boil for 10 minutes. Hibiscus sepals are added in the pot and boiled for more ten minutes. The pot is removed from the pot and kept to cool for about seven hours. The content is sieved to remove debris. Sugar and water are added to the content in the pot and put on fire to boil while stirring for the sugar to dissolve. This product of folere is put in bottles and put in refrigerators to cool. It is now drunk as the juice is sweet. This can be sold for economic purposes when produced in large quantities. Students can produce a large quantity of folere to be consumed by themselves or sold to the public and use money to solve other problems as a means for needs satisfaction. Other products observed in practical works in these high school science students are the production of chocolate, cake, chin, etc.

### **Manufacture of skin-care products and problem-solving competences**

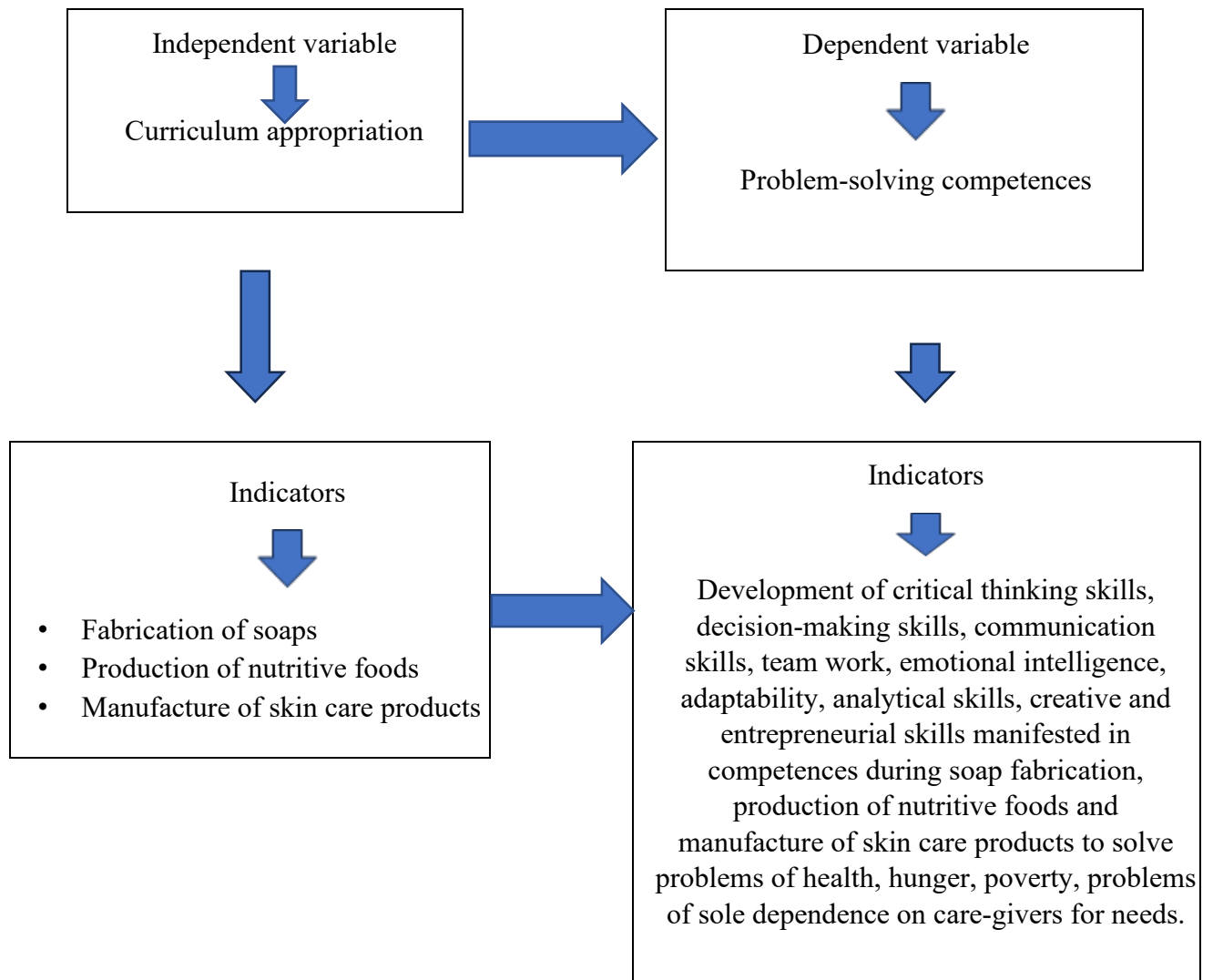
Skin-care products are preparations applied to the skin to cleanse, protect, or enhance its appearance. These include items as shampoos, toothpastes and moistening creams. Many skin care products are manufactured and cosmeticians employ them on daily basis for reasons ranging from body moisture, protection, and lubrication.

### **Manufacture of glycerine or bio-glycerol**

The process used for glycerine production is saponification by the students observed. Other methods suitable for glycerine production are transesterification and fermentation. Glycerine is also known as glycerol. Ingredients required for its production include: animal fats or vegetable oils such as palm oil, sodium hydroxide (lye) and water. In the process of production, students grouped themselves in 5 work stations in the classroom. Using appropriate measurements bleached palm oil was mixed with water in a container and sodium hydroxide added gradually while mixing the content. The content is then set on fire to heat. The heating promotes the chemical reaction of saponification. While still hot, and well mixed, the glycerine settles differently from the soap formed in two layers and is purified through filtration. The soap formed is solid or semi-solid settles as first layer on top while glycerine as a viscous, colourless and odourless liquid settles below the soap. The filtration process that occurs after is for purification purposes to remove impurities unreacted fats, lye and soap residues. The product is ready for consumption as a cosmetic for skin care.

According to Alang et al. (2022) glycerine is also produced in Cameroon through transesterification process by the use of synthesised palm oil. The materials used composed of palm kernel seeds harvested from Widikum village, the kernels were pressed to extract oil, then potassium hydroxide, methanol, hydrochloric acid, sulphuric acid and nitric acid are used to produce glycerine in the right mixture. This process is more complex and industrialised than the saponification process. Ajayi et al. (2024) are more concerned about the sourcing practices of ingredients or suppliers who adhere to labour practices, environmental sustainability and ethical business conduct, and their implications for consumer health. They found out that producers of skin care products live in the vicinity of consumers and that their processes of manufacturing of these products can be hazardous to the population and the environment making it unsafe for dwellers. Glycerine produced by high school science students is small scale production produced in a specific unit of a school – the laboratory, even though classrooms maybe employed for the same purpose. Students strictly follow the hygienic conditions and safety rules given by their coach as they dress in laboratory robes. This is the initial stage of cosmetic production by students and enhancing the activity can serve for entrepreneurship when they leave high school and prevail in the business.

**Figure 1: Diagram for Independent variable, indicators and dependent variable**



## **Theoretical framework**

A theory is a framework or a model that help educators and researchers make meaning to the complex situations that exists in the field of education. Educational theories are aimed to answering some fundamental questions on how students learn, how can teaching be effective and which instructional materials can be use to facilitate teaching and learning. Yin (2014) a theory is a system of construct and propositions that presents a systematic view of phenomena by specifying relationship between variables, with the purpose of explaining and predicting the phenomena. Examples of theories are; behaviourism, constructivism, cognitive theory and social

learning theory just to name a few. The theories used for this study are the pragmatic learning theory of John Dewey, the discovery learning theory by Jerome Bruner and the experiential theory of David A. Kolb.

### **Pragmatic Learning Theory of John Dewey (1938)**

Pragmatic education theory was developed by John Dewey. One cannot talk of pragmatism without mentioning his name. Pragmatism is an approach to learning and teaching that focuses on keeping things practical. According to Dewey, pragmatism is a philosophical approach that emphasizes the practical consequences and real-world applications of ideas and beliefs, Dewey, (1909) “Pragmatism means the will to interpret every notion by tracing its respective practical consequences. Pragmatism ask its usual question. ‘Grant an idea or belief to be true,’ it says, ‘what concrete difference will its being true make in anyone’s actual life? How will the truth be realised? What experiences will be different from those which would obtain if the belief were false? What in short, is the truth’s cash value in experiential terms?’”

The pragmatic education theory of John Dewey highlights the importance of getting things done. Pragmatic theory think that any knowledge that is being learned needs to have a purpose. We also call the pragmatic theory utilitarian because everything needs to have utility or useful.

Pragmatism is a learning approach and teaching that laid emphasis on keeping things done. It was developed by John Dewey. Teachers who are pragmatic use active projects-based learning strategies in the classroom and focus on topics beneficial to student’s lives. Pragmatism involves lessons that have value to the lives of learners. With pragmatic education the classroom involves project-based learning, experimental learning, and play-based learning. pragmatism originated from the Greek Phrases “practice” and “action.” This concept of practice and action can be seen in Dewey (1938) where he explains the importance of practice and action in learning. He stood for experiential, hands-on learning harmonizes or incorporates theory and practice, allowing students to be committed actively with their environment and developed practical skills. To Dewey, education should be a process that prepares students or learners that contribute to the society, prioritizing or reinforcing the link between learning, and doing. Dewey (1938) defines pragmatic education as the process of connecting education with practical real – life experience. Education that needs to be continuous interactive much value needs to be put to experiential learning while keeping aside traditional learning that do not link learning from real – life.

Dewey (1938), further explain the connection between the child interest and curriculum. To him education should be connected to what the child likes or had interest on and his/her experiences rather than imposing a curriculum on him. It is important to integrate the child's interests with school subjects to make relevant learning experiences. By experimental learning Dewey believed that learning should be grounded or firmly planted in real life experiences. Students learn well when they are involved with their environment and participates in hands – on activities. This approach stimulates students to reflect themselves and experiment. Another issue in his theory is learning by doing. That is why he advocated that education should be practical and linked to students' interest and experience. He posited for a curriculum that consolidate academic subjects with real – world problem solving and engagement. By involving students in activities students develop critical thinking skills and benefit practical knowledge. The next point Dewey talk on pragmatic education is child – centred education. He stress that education should be at the interest of individuals or students. When designing lessons teachers should consider student's background schools and abilities. This student – centred approach motivate students to be involved in their own education rather than being passive.

He also talked about social integration and reflective thinking. Social interaction is very important in learning process, as students learn from each other, with each other through collaborative activities and discussions. When students work together and share ideas, they develop special skills and an understanding of different viewpoints. Also, the learning process have to be reflective. Students should be able to think critically, analyse and question assumptions. This critical thinking help students to have an understanding of concepts which enhance intellectual growth.

Another principle is experiential learning. To Dewey, education should be focused on the lived experiences of learners rather than just the transfer of abstract knowledge. This means that learning should involve active hands-on engagement with the subject matter. Also, this experience needs to be continuous. Education should build upon learners' knowledge and experiences, creating a continuous learning process that connects the present to the past and to the future. It therefore means that pragmatic teachers focused on helping learners to take action. They create rich classrooms with project-based learning.

In conclusion Dewey's pragmatic education theory encourages an educational system that is beneficial experiential and socially involved or active. He laid emphasis on the advantages of hands-on activities (learning), student – centred teaching tend the integration of education with

real world experiences and active citizenship. This pragmatic theory of Dewey is related to my work because pragmatic theory underlines the importance of curriculum appropriation and problem-solving competences in education. This is done by shaping or transforming to students needs and experiences and focus on practical problem solving thereby creating a more important and involving leaning environment that equips students with valuable skills for life. These skills that I made mentioning my work are the fabrication of detergents such as liquid soap production of nutritive food. Such as yogurt, folere, cake and manufacture of rubbing oil method that will help students for life to solve their daily problems. Dewey's pragmatic theory emphasizes the importance of involving education to real life experiences and problem – solving. This means that education should be practical and beneficial to the life of students. this is contrary to traditional educational approaches that dwells more on rote learning and abstract knowledge without linking theory to practice.

### **Criticisms of Dewey's Pragmatic learning theory**

- It is believed that sole dependence on pragmatic learning might lead to neglect of foundational knowledge which is relevant for general development of every learner on the different subjects taught.
- As Dewey holds that education is a continuous process and not a fixed outcome, so does not agree with traditional methods used for assessment. It becomes challenging to evaluate the effectiveness of pragmatic learning approach using conventional grading systems (e. g., letter grades A – 90-100, grade point average – GPA).

### **Discovery learning theory of Jerome Bruner (1960)**

Jerome Bruner (1915 – 2016) was an American psychologist and cognitive scientist. He made a lot contributions to cognitive psychology, educational psychology and the philosophy of the mind. His theory is the discovery learning theory which is a learning approach where learners are more engaged in exploration, problem solving and the learner's involvement in the construction of knowledge (Bruner, 1961). The explanation of the theory constitutes the following sub topics or principles.

Active learning: Bruner (1960) considers education at its hallmark when learners are involved with the elements rather than being passive. Learner's passiveness is deterred when they are allowed to explore, experiment and discover knowledge on their own. That is why to him active

learning is when learning is learner-centred approach. Principles of discovery learning theory are;

**Constructivism:** This is in conformity to the constructivist made way manner approach to learning which stipulates that learner's construct their own knowledge of the world due to their experiences and interaction with their environment. By interacting in the realisation of the given task's learners are grouped in teams which are communities of studies where they emit and share ideas as in the fabrication of soaps, production of nutritive foods and manufacture of skin care products.

**Problem solving:** To solve problems, learners should be given complex challenges that will stir up their thought and motivate the use of their existing knowledge to emit hypotheses and validate together. Throughout the challenges they come up with or establish problem solving skills and extend their understanding of concepts. These aspects high school students to develop essential competences which will enable them successful as adults in the long run.

**Scaffolding:** Scaffolding is the process of learning in which learners are provided with a guide and support for them to be involved in the discovering of knowledge (Bruner, 1973; Vygotsky, 1978). The teacher's role here is to direct and ask questions that will provoke learners thinking process. Students manipulate objects and materials of the project through questions they ask themselves interiorly, overtly and loudly. Those areas of complexities require assistance from teachers and peers who appropriated the lesson better. The teacher is encouraged by this approach to provide remediation to learners for proper assurance and certainty as they go through the various stages of projects.

**Spiral curriculum:** In spiral curriculum, Bruner explained as the process of going through important concepts and topics over and over again for learners have greater acquaintance. Spiral curriculum commends teachers to starts from simple notions and topics to complex ones progressively. When learners comprehend simple activities they will be motivated to engage in complex ones afterwards, and they become discouraged when they start with complex and difficult activities. Projects should be broken into and parts and sub-parts for learners to execute and the whole project realised as they get familiarised with such activities.

**Inquiry-based learning:** Inquiry-based learning situates learners to ask questions, explore and carry out investigation their environment to present novel ideas about the topic. As learners work together, they confront obstacles which initiate their reflections actively. This is an approach to

education encouraging hands-on of learners. The questions the students ask enable them to construct possible ways of providing possible solutions to their problems encountered. This is initiating problem-solving skills in learners as they develop further to careers. In Inquiry-based learning, learners exercise in-depth understanding, long-term retention and consolidation of knowledge as compared to traditional teaching methods such as lecture method which renders learners in-active in the acquisition of knowledge (Bruner, 1973). Through inquiry-based learning, learners are actively engaged with the teaching contents thereby developing problem – solving abilities, critical thinking, creativity and collaborative skills (Bruner, 1960).

Bruner (1966) explained different modes of representation which are enactive iconic and symbolic very significant in his approach. Enactive representation is concerned with learning through actions and physical manipulation. Iconic representation involves learning through visual images and diagrams, whereas symbolic representation in learning through language and symbols. All these representations are supposed to be cut across as high school students execute tasks and projects in their course contents. To Bruner, for the teaching/learning process to be effective, he commended it to be able to exploit all these three modes of representation to help learners understand complex issues. Learners, while going through hands-on learning, make connections and relationships with the concepts framing new schemes in their knowledge consolidation.

Jerome Bruner’s discovery theory is closely related to my topic curriculum appropriation as it emphasizes the importance of active learning, exploration and problem-solving in education. According to Bruner, learning is an active process in which learners construct new knowledge and an understanding through their interactions with the environment. He proposed that learners should be actively engaged in discovering and constructing knowledge rather than receiving information passively. This concept aligns with the concept of curriculum appropriation, which emphasizes the significance of students taking of their learning and actively engaging with the curriculum.

Problem–solving competences are an important aspects of both Bruner’s discovery theory and curriculum appropriation. Bruner believed that students should be presented with problems that require them to apply their knowledge and skills. This approach help students to developed problem – solving abilities critical thinking skills and creativity.

In all Bruner’s theory emphasised on the important of active learning, exploration and problem–solving in education, with concepts of curriculum appropriation, these principles

support the development problem-solving competences by encouraging learners to actively engage with the curriculum, explore real world problems and apply their skills to find solutions.

### **Experiential Learning theory of David A. Kolb (1984)**

David A Kolb (1939 - Present) is an American educational theorist and psychologist. The Experiential theory of David A. Kolb is a theory that emphasises that learning is a process that involves the transformation of experiences and involvement of hands-on activities on which help in the acquisition of knowledge and the development of skills. It is an approach that stresses up the active engagement of learners in real-life experiences as a means to acquire knowledge, develop skills and shape their understandings of the world or environment (Schank, 2002). As such learners will develop to become autonomous and become more implicated as actors in transforming their societies. To Kolb (1984) learning is based on four stages referring to as experiential learning cycle; concrete experience, reflective observation, abstract conceptualization and active experiments.

#### **Concrete experience**

At concrete experience, learners' direct engagement with hands-on experiences for example taking part in an activity, conducting experiments practically takes place. They display learning using the materials involved the task to realise the objective. As such, learners come through new situations and obstacles.

#### **Reflective observation**

After concrete experiences, students deliberate and reflect on their experiences from diverse angles, such as assessing what took place, what they felt and what was observed. These deliberations and reflections allows for an in-depth comprehension of the experience and helps identify patterns, connections and potential meanings (Kolb, 1984).

#### **Abstract conceptualization**

This is the area where learners make sense of their experiences by forming abstract concepts or generalisations. Students seek to understand the underlying principles, theories and frameworks that explain their experience, leading them to engage in critical thinking which fosters the construction of knowledge.

## **Active experiment**

In active experiment, students apply the concepts and theories developed in the previous stage to new situations. Students actively experiment with their new knowledge and theories by taking action, testing hypothesis and engaging in further experiences. The more they practice, the more they amass experience. According Kolb (2005) the active experiment stage allows learners streamline their understanding, gain practical skills and discover new insights.

Kolb's experiential learning theory suggests that effective learning occurs when learners engage in all four stages of the learning cycle. It emphasizes the importance of integrating hands-on experiences with reflective observation, abstract conceptualization and active experiment. Learners engage in a cyclical learning process learners which enables them to understand and apply knowledge in real world contexts to be able to solve problems. High school students' appropriate knowledge skills and practical skills from their curriculum which provide them with the necessary competence to carryout projects such as the fabrication of soaps, production of nutritive foods, and manufacture of skin care products. As the students commit to these tasks, there is individual communication as well as interpersonal communication through question and answers, discussions, illustrations, and demonstrations within their groups and teams which all constitute aspects of experiential learning.

## **Empirical Review**

This involves works carried out by other researchers on the same or related aspects of the topic 'Curriculum appropriation and problem-solving competences.' Their works serve to show the existing gap with this study. Empirical review takes into account prior studies related to aspects of the topic or its indicators as written below.

About appropriation and problem – solving competences, Thapliyal (2014) explained the use of blogs as a collaboration tool by students in projects assigned to them as a typical study. This researcher studied how blogs are appropriated by students in projects in the learning of English language as a foreign language. To him, a blog post provides an opportunity for self-expression, whereas reading a blog enables social connection and interaction (Deng & Yuen, 2011). Collaboration is developed when network communities through group reflective blogs, when there is giving and receiving feedback from peers through comments from blog (Minocha, 2009). The study showed that blogs also assist learners to develop a set of self-directed learning skills, which enable students to select and define their own learning goals and undertake critical

evaluation of their learning stages. This study incorporates the learning of language with use of aspects ICT – blogs. It also demonstrates the means of which students set goals and achieve them by using blogs to improve on their communication skills. Communication is a life skill and learning enhance this skill amongst students as they interact projects practices such as fabrication of soaps where students work in teams. Peer learning proffers emission and validation of hypotheses by team members or the different teams within a classroom which activates their thinking mechanisms.

Wiysahnyuy (2021) presented a sequence on curriculum appropriation that explains issues on competency-based approach in Cameroon secondary schools and examines the various ways by which teachers acquire knowledge and skills employing the competence-based approach (CBA). The research method used was cross sectional survey, and convenient and purposive sampling techniques were used to select a sample of 145 respondent from GBHS down town Bamenda, GBHS Bayella, and GBHS Bamenda Nkwen in Bamenda municipality, North west region of Cameroon. The instrument use for data collection was a semi structured questionnaire made up of closed and open-ended items. Data was analysed using descriptive statics specifically frequency count on percentages. The aspects use in the distribution of teacher according to schools are schools, frequency percent, valid percent and cumulate percent in another table of distribution of teacher according to qualification they use aspects like qualification frequency, percent and cumulative percent. For results, she found out that most teachers acquired basic knowledge and skills of CBA through seminars, conferences and workshops which were not really frequent to keep them abreast with the dynamics in the art of the model. Majority of the teachers found it difficult to implement the CBA because of inadequate knowledge and skills, overcrowded classrooms, limited teaching hours, the charged nature of the syllabuses and insufficient pedagogic and learning materials. The study suggested that teachers need diverse professional development activities like in-service training, seminars, conferences, workshops, and individual research to continually appropriate, adapt and use dynamic trends of CBA.

Dolejsova (2020) researched on the topic ‘From Silicon Valley to table: solving food problems by making food disappear.’ She used digital technology to demonstrate how investment in food-technology innovations started by food entrepreneurs in Silicon Valley provide solutions for every day food problems and complex issues concerning food. He noticed that food – tech solutions present opportunities for efficient food practices and challenges to subcultural frameworks and consumption. Her research design was experimentation. Where she used solvent

to quantify the daily food consumption and how it affects their busy schedules. She enabled seed finding startups to increase where these seeds are ground to drinkable powdered based diet which today had grown, has grown to be recognized as complete food diet. This has led to the creation of independent startups offering complete food products (CFP) of diverse nutritional compositions and flavours. Complete food products promoted their products as solutions to various food problems and are delivering better nutrition through innovation. Methodologically, the research design was ethnography and data collection instruments are interviews on a sample of 65 complete food consumers. The sampling method was convenience sampling done using online and sent over forms messaging system. And subsequent snow balling. The period for the interviews was between 2014 and 2017. Each interview span was 60 – 90 minutes and was audio – recorded and subscribed; and transcripts were coded.

Malangtupthong et al. (2022) explored factors that affect mathematics problem-solving student characteristics competency in high school, they employed quantitative study methodologies, their research involves studies on the effects of teachers, attitude towards mathematics and achievement motivation in students' ability to solve mathematical problems. Their study population was 20948 science students of the 2021 batch of the high school called Secondary Educational service area office Samut Sakton and Samut Songkhram. They used online questionnaire to collect data and the partial least square structural equation modeling for data analysis. The analysis was carried out with the ADANCO program. Results were that factor positive affected on mathematical problem – solving competency are a teacher teaching and attitudes towards Mathematics.

### **The gap to complete**

The study we are carrying out has as topic 'Curriculum appropriation and problemsolving competences in the geographical location of Mfoundi division precisely in G.B.H.S. Mendong, G.B.H.S. Etoug-Ebe, and GBHS Essos and GBHS Yaoundé. The population is high school science students while the authors above seek to explore factors affecting mathematical problem-solving students' characteristics competency, and other activities following the authors but our study seeks to find out how students employ problem-solving competences in real world to benefit them, appropriated from their curriculum. It is a study that matches theory to practice where knowledge, skills and attitudes are demonstrated overtly on hands-on practical activities leading to the production of objects which are visible to the world.

Conclusively, the research topic, Curriculum appropriation and problem-solving competences in high school science students of Mfoundi division in Yaoundé emphasizes on the problem that teachers hardly effectively carry out pedagogic supervision after teaching practical projects to cover students' work out of school. The fact that this is not done keeps students docile in exercising projects at home in the real world. The exercise and application of these competences is significant in modern day education which lays emphasis on project-based learning. It is a hand-on approach which demands learners to confront thinking with action to produce concrete objects which are useful and relevant to the learners themselves, the community and the society at large. Theories retained for the study, noted as the pragmatic learning theory, discovery learning theory, and the experiential learning theory all request more collective work as well as individual work from learners where they engage in real world activities. As students carry out activities in fabrication of soaps, production of nutritive foods and manufacture of skin care products, they expose their innate abilities of the content of the curriculum appropriated that enables them to realise the assignments and endeavours due to them. The theories profess the need for learners to be thinkers who produce to make a difference from learners who only think and remain at the level of theoretical work which does not actually strongly impact on their growth and development.

## CHAPTER THREE

### RESEARCH METHODOLOGY

Research methodology provides a description of techniques and methods used to identify, collect and analyse data when a research topic is written. It is a package consisting tools requires for the type of research to carry out, as this is a quantitative study. In this quantitative research study research methodology is the chapter which includes research design, area of study, population of study, sample and sampling technique, instruments for data collection, validity and reliability of instrument, administration of instrument and method of data analysis which explained further.

#### **Research Design**

A research design is a plan that specifies how data related to the problem will be collected for analysis. It is the plan to conduct research, involving the interaction of philosophy, strategies of inquiry and specific methods. A research design provides the overall structure and orientation for the study, guiding the selection of participants, data collection procedures, and analytical techniques (Creswell and Creswell, 2018). A research design is inevitable because it facilitates smooth sailing of research operations, thereby making research as efficient as possible with minimal expenditure of effort, time and money. Research design stands for advance planning of the methods to be use for the collecting the relevant data and the techniques to be used in their analysis, bearing in mind the objective of the research and the availability of stuff, time, and money. This preparation for research design is done with great care for any errors in it may upset the entire project. It has a great bearing on the reliability of the results to be arrived at and as such constitute a pillar of the entire research work. Forgetting to design the research may result in rendering the research project fruitless or futile. This means the efforts expended will not produce the desired result, no matter how much energy or time is devoted to it. It suggests a waste of resources and a sense of hopelessness in undertaking the task. The research design helps the researcher to organize his/her ideas whereby it will be possible for him to reduce inadequacies.

Features of a good research design are shown by some characteristics. A good design must be flexible, efficient, appropriate, economical, etc. It also has the quality to minimise bias

and maximise reliability of the data collected and analysed. For a research design to be appropriate to a particular research problem usually consider some factors, as below;

- The means of obtaining information.
- The availability and skills of the researcher.
- The objective of the problem to be studied.
- The nature of the problem to be studied and,
- The availability of time and money for the research work (Kothari, 2004).

In this study we will use descriptive survey since it is quantitative research with many respondents. This is because it provides an accurate and representative description of the characteristics, attitudes or behaviours of a particular population. Descriptive survey research provides a numeric or quantitative descriptive of trends, attitudes or opinions of a population by studying a sample of that population. Its main aim is to provide the thoughts, opinions, and behaviours of a population. Descriptive surveys assemble data with the purpose of describing the nature of the existing conditions, or identifying standards which existing conditions can be compared, or determined the relationships that exist between events (Creswell and Creswell, 2018).

### **Area of study**

The area of study for this research is Mfoundi Division. It is made up of 7 sub divisions which are Yaounde 1, 2, 3, 4, 5, 6, and 7. Mfoundi Division is bordered to the north by Adamawa Region, to the south by the South Region, to the east by the East Region, and to the west by Littoral and West Regions. The surface area of Mfoundi is 297 km<sup>2</sup>. It is the second largest region in Cameroon after the East Region in terms of land. The main ethnic groups include Bassa, Ewondo and Vute. The Division harbours Yaounde – the capital city of the Republic of Cameroon. It is the political urban area hosting many important structures and personalities such as the Unity Palace, the Congress Hall, auditoriums for the parliament, multipurpose sport stadium, Stadia for football, government ministries, embassies, ambassadors, the president of the republic, government ministers and lots of interesting touristic and leisure sites such as lakes and zoos. It is a division clustered with different activities such as commerce, public service, automobile conduction and more interestingly education. There are schools for the two sub systems of education in Cameroon – English and French sub systems. Institutions for basic education, secondary education and constructed throughout the division to satisfy the need of the

ever-growing population of scholars. Higher education institutions are University of Yaounde 1 and Yaounde II, SIATOU Private institution and Higher teachers' training schools. People from all the other regions of Cameroon have made the division their dwelling place with their families, making the centre region pluralistic linguistic as many national languages are spoken. The practise of bilingualism is visible as Anglophones and Francophones communicate in English and French as official languages. Foreigners from countries like Chad, Nigeria, Gabon, Congo, from all continents are found within Yaounde as they engage in the different functions. Most of the strangers are businessmen and women, diplomats and some serve as experts in different domains solicited by the government. Concerning number of schools, high school science students and science teachers, we have re are 8 Government High Schools, 790 high school science students and 184 science teachers.

### **Population of study**

Research population refers to the entire group of individuals (subjects or participants) the researcher is interested in studying and from which a sample is drawn. It is at times known as mother or parent population and this stands for all English high school science students and their teachers. The population represents the largest group to which the researcher intends to study. The topic concerns curriculum appropriation and problem-solving competences of some public English high school science students in Mfoundi division. The bilingual high schools in the division are Government Bilingual High School (GBHS) Emana, GBHS Nkol Eton, Government Bilingual Practicing High School GBPHS Yaoundé, GBHS Ekounou, GBHS Essos, GBHS Mendong, GBHS Etoug Ebe, and GBHS Ekorozock. These high schools constitute science students who are the subjects for the study. There are 8 Government High Schools, 790 high school science students and 184 science teachers.

### **Target population**

The target population refers to the subset of the mother population to which the researcher is intending to generalising the conclusion. Creswell (2018) explained that the target population in a research study refers to the 'entire group of individuals or objectives to which researchers are interested in generalising their conclusions'. To Creswell, the target population is the ideal group that the researchers would like to study, but in many cases, the researcher may only be able to access a portion of this population known as the accessible population. In this our study the target population is identified from the following schools Government Bilingual High

School (G.B.H.S.) Mendong, G.B.H.S. Etoug Ebe, G.B.P.H.S. Yaoundé, and G.B.H.S. Essos Yaoundé as English-speaking high school science students in Mfoundi division. In this study, the target population is four schools, nine hundred and one high school science students and ninety-three science teachers.

### **Accessible population.**

The accessible population is the population that represents the portion of the population that is available and accessible for the researcher to collect information. We cannot get access to the entire population due to various constraints such as time, budget to cover the expenses, geographical limitation, etc. According to Creswell (2018) the accessible population in a research study is the group of subjects to which the researcher has reasonable access. This accessible population is a subset of the target population the researcher can realistically study, given some obstacles such as money, time, and logistical considerations. In our research the accessible population emanates from the following high schools; G.B.H.S. Mendong, G.B.H.S. Etoug Ebe, G.B.P.H.S. Yaounde, and G.B.H.S. Essos. The accessible population retained for students is seven hundred and fifty (750) students and while that for teachers is eighty-one (81).

### **Sample and sampling techniques.**

A sample population is a subset of the larger (target) population that is being studied or observed. It is a group of individuals that are selected from the target population to represent the characteristics and properties of the entire population (Cresswell, 2018). This sample population is used to make inferences and draw conclusions about the larger population, Creswell (2018), define a sample population as a subset of the target population that the researcher plans to study for the purpose of making generalisations about the target population. This means that to Creswell, there are three key elements of a sample population; the sample population is a subgroup of the larger population, the researcher studies it in order to make generalisations about the larger population, and the sample population is a representative of the target population so that valid inferences can be drawn from the sample data. That is why he says the sample population needs to be carefully selected to make sure it reflects the characteristics of the overall target population. By so doing it will permit the researcher to make credible generalisations from the sample to the target population. The sample population is two hundred and fifty English high school science students and twenty-five English high school science teachers.

Simple random sampling will be employed for the study because each member has an equal chance of being selected. The sampling is relevant for the selection of both students and

teachers. The process is called balloting. Balloting was done as follows, the researcher wrote small papers inscribed with ‘yes’ or ‘no’ and ask learners to select. ‘Yes’, will take part and ‘no. will not take part in the study. Convenient sampling enabled us select schools which gave us easy access to the campus. It is a type of sampling method that enables a sample to be drawn from the part of population that is close to hand. It allows units of the population with easiest access to be sampled by the researcher.

Table 3: Summary table of population and sample for students.

SCHOOLS	TARGET POPULATION	ACCESSIBLE POPULATION	SAMPLE POPULATION
G.B.H.S. Mendong	236	210	104
G.B.H.S. Etougebe	317	290	79
G.B.P.H.S. Yaoundé	139	100	54
G.B.H.S. Essos	209	150	13
Total.	901	750	250

*Source:* From field work 2024.

Table 4: Summary table of population and sample for teachers.

SCHOOLS	TARGETED POPULATION	ACCESSIBLE POPULATION	SAMPLE POPULATION
G.B.H.S. Mendong	23	17	8
G.B.H.S. Etougebe	21	15	7
G.B.P.H.S. Yaounde	19	8	5
G.B.H.S. Essos	18	10	5
Total	81	50	25

*Source:* From field work 2024

## **Instrument for data collection**

We are going to use questionnaires and observation guide, in this study. The questionnaires enable the investigator to collect data from a large population over a short period of time. A questionnaire is a research instrument consisting of a series of questions for the purpose of gathering information from respondents. It is used to support research, and decision making. According to Creswell (2018) a questionnaire is ‘a form used in a survey design that participants in a study complete and return to the researcher. It contains questions or items to which participants respond, often in close-ended or open-ended ways. Creswell, elaborated on some key characteristics of questionnaires; format which include multiple choice liker-scale and open-ended questions. Administration can be done by participants, either on paper or electronically, purpose which is to collect data from a sample of participants that can then be generalised to draw conclusions about a larger population. It has the advantage to reach a large number of participants and finally has limitations of low response rates, inaccurate responses and participants’ inability to clarify questions.

The questionnaires had two respondents; students and teachers and in two parts. The first part was made up of demographic information that consisted of sex female, male, age, grade A1 and A2. The second part of questionnaire concerned fabrication of soaps, production of nutritive foods and manufacture of skin-care products, and skills that operate during practical activities which demonstrate problem-solving competences in high school science students. The items were in statements form with Likert-type response agree (A), strongly agree (SA), disagree (D), strongly disagree (SD). The respondents were expected to respond with a tick (√). They were twenty-one items for students based on the three objectives of the study and five items for teachers.

## **Validity of research instrument.**

Validity refers to as the accuracy with which an instrument measures what it intends to measure. The questionnaires were constructed by the investigator. They were then submitted to the supervisor who checked to ensure the instrument covered all relevant concepts and aspects to make it appropriate for the collection of data. Corrections were made before approval of instrument as good for final administration. A pre-test is carried out. That is questions are given to few students and teachers to answer to control duration, ambiguity if any corrections are made. After corrections we take them to the sample population to respond. After responding, the questionnaires are collected and return rate checked at least ninety-five percent (95%). In this

our study the questionnaire were subjected to content and face validity. According to Creswell (2018), content validity refers to the degree to which the items or questions measure adequately the content that the instrument is intended to measure. Creswell further explains that for content validity is an essential type of validity, as it ensures that the test accurately reflects the construct it is intended to measure. Creswell (2018), face validity is a basic and relatively superficial type of validity that refers to the degree to which a test on the face of it to be measuring what it is supposed to measure. To him, face validity is considered a weak form of validity, as it does not provide strong evidence that the test actually measures the intended construct. Face validity is still important because it can influence the credibility and acceptance of the test. That is why face validity is established as the first step in the validation process

### **Reliability of the instrument.**

Reliability is the degree of consistency with which an instrument measures what it is supposed to measure. If a study is repeated and the same results are found, the study is considered reliable.

Table 5: Reliability table

ITEMS	CRONBACH'S ALPHA (N=20)	NUMBER OF ITEMS
Fabrication of soap	0.961	8
Production of nutritive food	0.940	7
Manufacturing of skin care products	0.934	6
Teachers' questionnaire	0.987	7
Problem- solving competences	0.952	5
Total	0.954	33

*Source:* Administration of questionnaires on the field

Authorisation was accorded from the principals of the schools retained for this investigation as mentioned before now permitted the researcher to gain access to the students and teachers of English high school science classrooms. The researcher did self-introduction and presented his sole reason of seeking their consent to be respondents to research topic at hand. She presented questions to the subjects with supportive explanation. 300 questionnaires as a

whole were given out to the students of these schools on different occasions and 250 were returned, and 30 questionnaires distributed to teachers and 25 returned. Some of the respondents filled the questionnaires immediately and returned to the researcher, others delayed and handed the next day while some did not return.

### **Data analysis technique**

We are going to use regression analysis, especially simple linear regression analysis in this study because it helps to assess the strength and direction of the relationship between the two variables – curriculum appropriation and problem-solving competences. It has the capacity to predict how changes in the independent variable (predictor) affect a dependent variable (outcome). It helps researchers to test hypotheses concerning the relationships between variables, to confirm or refute theoretical predictions. Therefore, linear regression is a statistical method employed in research to show the relationship between two or more independent variables. It has to specificity to estimate how the dependent variable (which is the outcome) is impacted by one or more independent variables (predictors).

### **Observation**

The researcher also used observation method to collect data in the schools retained for investigation. Observation is a fundamental research method that involves systematically watching and recording the behaviour and characteristics of phenomenon, people or situation. It is a core component of scientific research allowing researchers to collect data. Gorman and Clayton (2005) defined observation as the systematic recording of observable phenomena or behaviour in a natural setting. In this study, we used direct observation. This involves observing learners or phenomena directly without relying on self-report or other indirect methods. The researcher observed behaviour, actions and interactions amongst learners following an observation guide. Students were observed in workstations carrying practical activities on fabrication of soaps, production of nutritive foods and manufacture of skin care products.

Pictures below show how workstations were carried out within schools.

### **Observation guide**

An observation guide is a tool that is structured to be used as a guide in the process of observation. It provides the researcher with guidelines for effective observation and feedback on the topic concerned. An observation guide provides a structural framework, consistency and focus on relevant aspects of the topic of investigation to the researcher by keeping him on tract.

We observed high school science students and teachers carrying out practical activities such as fabrication of soaps, production of nutritive foods and manufacture of skin-care products. Some of the criteria we use for the observation are as follows; environmental factors whether it is conducive or not, interaction between learners, specific tasks to be performed, involvement of learners in the realisation of the project and the time taken to realise the project. An observation guide is used in quantitative research for descriptive narration and/or for quantifying using observation checklist. We retained observation guide and employed descriptive narrative in this research. A descriptive narrative using an observation guide refers to a detailed qualitative account of what was observed (Patton, 2002; Spradley, 1980). A descriptive narrative provides us with rich data on actions, dialogues, and non-verbal cues; enhances contextual understanding by giving details of the setting and interactions amongst students and teachers during practical, and for communication as a tool for sharing findings.

The pictures at the annex show practical activities carried out by students under the guidance of their teachers within schools. These practical activities or projects are: Fabrication of soaps, production of nutritive foods and manufacture of skin care products. Photos showing practical activities on fabrication of soaps are exhibited at the annex from the initial point to the end.

A recapitulative table below shows tasks to be undertaken on the field.

Table 3: Recapitulative table of variables, modalities, indicators, and indices

VARIABLES	MODALITIES	INDICATORS	INDICES
Independent variable (IV) Curriculum appropriation Curriculum Science	Curriculum Science	of Fabrication of soaps	Hard soap, liquid soap, powder soap
	Curriculum Science	of Production of nutritive foods	Yoghurts, cake, folere, chocolate
	Curriculum Science	of Manufacture of skin care products	Mentholantum, glycerine.
Dependent variable (DV) Problem-solving competences	Aspects related to solving real life problems encountered	Developed analytical skills, working in a team, developed emotional intelligence and communication skills, adaptability and flexibility to adapt on one's approach and modify strategies.	Identification of problems of -hunger -health -poverty -lack of household needs and school needs -Problems of sole dependence on caregivers for need.

## CHAPTER FOUR

### DATA ANALYSIS AND PRESENTATION OF RESULT

This chapter presents the research findings and analysis of this study. The research work investigates the impact of curriculum appropriation on problem solving competences in high school science students in Mfoundi division. The data was collected with the use of structured questionnaires using a four-point Likert scale. Findings were presented in order to respond to the purpose and question of this study.

#### Demographic Characteristics of Participants

Demographic characteristics of participants in this study include; gender, age and Grade.

**Table 6: Sex distribution of students**

	<b>Frequency</b>	<b>Percent</b>
Male	96	38.4
Female	154	61.6
<b>Total</b>	<b>250</b>	<b>100.0</b>

The table represents the gender distribution of students. In the context of this study, we use a sample population of 250 students. According to the table of respondents 96 male and 154 are female, making a percentage of 38.4 and 61.6 respectively. This variation is due to the fact that there are more females than males in the sample population which was drawn from some retained English High school science students in Mfoundi division Yaoundé; GBHS Mendong, GBHS Etougebe, GBPHS Yaoundé, and GBHS Essos.

**Table 7: Age distribution of students**

	<b>Frequency</b>	<b>Percent</b>
14-16 years	40	16.0
16-19 years	63	25.2
19-21 years	147	58.8
<b>Total</b>	<b>250</b>	<b>100.0</b>

### Age of respondents

The age distribution for this study included the age range of student who participated in this study in Mfoundi division. The result shows that 16.0% are between 14-16 years, 25.2% are between 16-19 years, 58.8% have ages between 19 to 21 years.

**Table 8: Sex distribution of teachers**

	Frequency	Percent
Male	11	44.0
Female	14	56.0
<b>Total</b>	<b>25</b>	<b>100.0</b>

The table represents the gender distribution of teachers. In the context of this study, we use a sample population of 25 teachers. According to the table of respondents 11 male and 14 are female, making a percentage of 44.0 and 56.0 respectively. This variation is due to the fact that there are more females than males in the sample population which was drawn from the above in Mfoundi division.

**Table 9: Age distribution of teachers**

	Frequency	Percent
25-35 years	7	28.0
35-45 years	9	36.0
45-60years	9	36.0
<b>Total</b>	<b>25</b>	<b>100.0</b>

The age distribution for this study included the age range of teachers who participated in this study in Mfoundi Division. The result shows that 28.0% are between 25-35 years, 36% are between 35-45 years, 36.0% have ages between 45 to 60 years

**Table 10: Grade of teachers**

	Frequency	Percent
A1	10	40.0
A2	15	60.0
<b>Total</b>	<b>25</b>	<b>100.0</b>

The distribution of teachers according to their qualification shows 40.0 percent A1 and 60.0 percent are A2. Making the majority of teachers who participated in the study A2.

**Table 11: Fabrication of soap**

No.	Item	SA		A		DA		SD		M	SD
		F	%	f	%	F	%	f	%		
1.	Lessons taught by teachers in class provide me with theories to practice.	150	60	71	28.4	18	7.8	11	4.4	3.44	0.810
2.	Laboratory and workshops have the necessary equipment to carrying out fabrication of soap	159	63.3	79	31.6	12	4.8	00	00	3.58	0.582
3.	I fabricate soap for personal and commercial purposes.	171	68.4	68	27.2	09	3.6	02	0.8	3.62	0.594
4.	I make money from the sales of detergents to solve my real-life problems.	19	7.8	19	7.8	144	57.6	68	27.2	1.95	0.807
5.	I have the ability to develop innovative solutions to overcome challenges encountered in soap fabrication	30	12.0	31	12.4	21	8.4	168	67.2	1.69	0.807
6.	I am given time to practice in groups or individually.	81	32.4	144	57.6	25	10.0	00	00	3.22	0.612
7.	There is follow up from my teachers for quality practice at home.	42	16.8	24	9.6	154	61.6	30	12.0	2.31	0.890
8.	Teachers assign me to fabricate soap at home.	46	18.4	31	12.4	60	24.0	113	45.2	2.04	1.147
<b>Grande Mean</b>						<b>2.73</b>					

Eight items were designed in the questionnaire to respond to this section. All the eight items designed to measure respondents' views on lesson preparation have a mean greater than 2.5. From the results on the statement lessons taught by teachers in class provide me with theories to practice 60% of respondent strongly agree, 28.4% agree, 7.8% disagree and 4.4% strongly disagree. Laboratory and workshops have the necessary equipment to carrying out fabrication of soap 63.3% of respondent strongly agree, 31.6% agree, and 4.8% strongly disagree. I fabricate soaps for personal and commercial purposes respondent strongly agree 68.4%, agree 27.2%, 3.6% disagree and 0.8% strongly disagree. I make money from the sales of soap to solve my real-life problems 7.8% of respondent strongly agree, 7.8% agree, disagree 57.6% and 27.2% strongly disagree. I have the ability to develop innovative solutions to overcome challenges encountered in soap fabrication 12% of respondent strongly agree, 12.4% agree, 8.4% disagree and 67.2% strongly disagree. I am given enough time to practice in groups or individually 32.4% of

respondent strongly agree, 57.6% agree and 10% of respondent disagree with statement. There is follow up from my teachers for quality practice at home 16.8% of respondent strongly agree, 9.6% agree, 61.6% disagree and 12% strongly disagree. Teachers assign me to fabricate soap at home 18.4% of respondent strongly agree, 12.4% agree, 24% disagree and 45.2% strongly disagree.

**Table 12: Production of nutritive food**

No.	Item	SA		A		DA		SD		M	SD
		F	%	f	%	f	%	f	%		
9.	There are enough equipment in the laboratory for production of nutritive food.	183	73.2	60	24.0	05	2.0	02	0.8	3.69	0.548
10.	I validate my courses	167	66.8	83	33.2	00	00	00	00	3.66	0.471
11.	I practice to produce nutritive food in group or individually in the laboratory or workshops.	131	52.4	99	39.6	10	4.0	10	4.0	3.40	0.750
12.	Teacher assign me to produce nutritive food at home.	38	15.2	112	44.8	94	37.6	06	2.4	2.72	0.743
13.	I use nutritive food at home for daily needs or commercial purposes.	08	3.2	16	6.4	162	64.8	64	25.6	1.87	0.658
14.	There are materials needed for the practice of nutritive food production	39	15.6	17	6.8	144	57.6	50	20.0	2.18	0.929
15.	There is follow up by teachers to improve on quality production	29	11.6	36	14.4	182	72.8	03	1.20	2.36	0.699
	<b>Grande Mean</b>						<b>2.84</b>				
	<b>SD</b>						<b>0.00</b>				

Seven items were designed in the questionnaire to respond to this section. All the eight items designed to measure respondents' views on lesson preparation have a mean greater than 2.5. From the results on the statement There are enough equipment in the laboratory for production of nutritive food 73.2% of respondent strongly agree, 24% agree, 2% disagree and 0.8% strongly disagree. I validate my courses 66.8% of respondent strongly agree and agree 33.2%. I practice to produce nutritive food in group or individually in the laboratory or workshops 52.4% of respondents strongly agree, 39.6% agree, 4% disagree and 4% strongly agree. Teacher assign me to produce nutritive food at home 15.2% of respondent strongly agree, 44.8% agree, 37.6% disagree and 2.4% strongly disagree. I use nutritive food at home for daily needs or commercial purposes 3.2% of respondent strongly agree, 6.4% agree, 64.8% disagree and 25.6% strongly

disagree. There is follow up by teachers to improve on quality production 11.6% of respondent strongly agree, 14.4% agree, 72.8% disagree and 1.2% strongly disagree.

**Table 13: Manufacture of skin care products**

No.	Item	SA		A		DA		SD		M	SD
		f	%	f	%	f	%	f	%		
16.	Lesson taught by teachers in class provide me with knowledge to solve problem.	143	57.2	91	36.4	10	4.0	06	2.4	3.48	0.689
17.	Laboratory and workshops have the necessary materials for me to practice	13	5.2	34	13.6	79	31.6	124	49.5	1.74	0.881
18.	I have materials needed for practice at home	227	90.8	13	5.2	07	2.8	03	1.2	3.85	0.502
19.	I can manufacture my own skin-care products.	27	10.8	64	25.6	06	2.4	153	61.2	1.86	1.13
20.	I use skin-care products at home for daily needs or commercial purposes.	09	3.6	10	4.0	72	28.8	159	63.6	3.52	0.740
21.	There is follow up by teachers to verify if i practice at home.	39	12.0	34	13.6	59	23.6	127	50.8	1.86	1.054
	<b>Grande Mean</b>						<b>2.718</b>				
	<b>SD</b>						<b>0.00</b>				

Six items were designed in the questionnaire to respond to this section. All the six items designed to measure respondents' views on lesson preparation have a mean greater than 2.5. From the results on the statement Lesson taught by teachers in class provide me with knowledge to solve problem 57.2% of respondent strongly agree, 36.4% agree, disagree 4% and 2.4% strongly disagree. Laboratory and workshops have the necessary materials for me to practice 5.2% of respondent strongly agree, 13.6% agree, 31.6% disagree and 49.5% strongly disagree. I have materials needed for practice at home 90.8% of respondent strongly agree, 5.2% agree, 2.8% disagree and 1.2% strongly disagree. I can manufacture my own skin -care products 10.8% of respondent strongly agree, 25.6% agree, 2.4% disagree and 61.2% strongly disagree. I use skin-care products at home for daily needs or commercial purposes 3.6% of respondent strongly agree, 4% agree, 28.8% disagree and 63.6% strongly disagree. There is follow up by teachers to verify if i practice at home 12% strongly agree, agree 13.6%, 23.6% disagree and finally 50.8% of respondent strongly disagree.

## Problem-Solving

Five items were designed in the questionnaire to respond to this section. All the five items designed to measure respondents' views on lesson preparation have a mean greater than 2.5. From the results on the statement Developed analytical skills 61.2% of respondent strongly agree, 19.2% disagree, 11.6% disagree and 8% strongly disagree. Develop creativity 16% strongly agree, 16.4% agree, 31.2% agree and 36.4% disagree. Work in a team 72% of respondent strongly agree, 13.2% agree, 12% disagree and 2.8% disagree. Developed emotional intelligence and communication 43.2% strongly agree, 42.4% agree, 6% disagree and 8.4% strongly agree. Adaptability and flexibility to adjust one's approach and modify strategies 19.6% strongly agree, 52.4% agree, 21.2% disagree and 6.8% of respondent strongly disagree with statement.

No.	Item	SA		A		DA		SD		M	SD
		F	%	f	%	f	%	f	%		
22.	Developed analytical skills	153	61.2	48	19.2	29	11.6	20	8.0	3.33	0.968
23.	Develop creativity	40	16.0	41	16.4	78	31.2	91	36.4	2.12	1.076
24.	Work in a team	180	72.0	33	13.2	30	12.0	07	2.8	3.54	0.811
25.	Developed emotional intelligence and communication	108	43.2	106	42.4	15	6.0	21	8.4	3.20	0.888
26.	Adaptability and flexibility to adjust one's approach and modify strategies	49	19.6	131	52.4	53	21.2	17	6.8	2.84	0.812
<b>Grande Mean</b>						<b>3.006</b>					
<b>SD</b>						<b>0.00</b>					

## Teachers Question

Seven items were designed in the questionnaire to respond to this section. All the seven items designed to measure respondents' views on lesson preparation have a mean greater than 2.5. From the results on the statement, I have covered the syllabuses or curriculum content of high school sciences both in theory and practical significantly 48% of respondent strongly agree, 16% agree and 36% disagree. I employ teaching and learning methods that situate learners at the centre during lesson such as project-base 52% of respondent strongly agree, 40% agree and 0.8% disagree. I associate teaching methods with teaching strategies such as assignments, exercises, questions both in school and at home 80% strongly agree, 20.5% agree and 4% disagree. I usually carry out laboratory practice involving either fabrication of detergents like liquid soap or production of nutritive food as yogurt, or manufacture of skin-care product like rubbing oil 12%

strongly agree,16% agree, 64% disagree and 0.8%. I monitor, evaluate, remediate, and provide feedback to theoretical and practical work assigned to students 60% of respondent strongly agree and 40% agree. My students have competences in fabrication of detergents, production of nutritive food, and manufacture of skin-care products 40% of respondent strongly agree, 48% agree, 8% disagree and 4% strongly disagree. Students have been using what they produce in school and home to solve their problems 12% of respondent strongly agree, 8% agree, 72% and 8% strongly disagree.

## Correlation of Variables

To test the previously established hypotheses we used the simple linear regression model in order to test the linearity of the relationship between the independent variables and the dependent variable.

No	Item	SA		A		DA		SD		M	SD
		F	%	f	%	F	%	f	%		
2	I have covered the syllabuses or curriculum content of high school sciences both in theory and practical significantly	12	48	04	16	09	36	00	00	3.12	0.927
3	I employ teaching and learning methods that situate learners at the centre during lesson such as project-base. learning, flipped pedagogy and discovery learning.	13	52	10	40	02	8.0	00	00	3.44	0.650
4	I associate teaching methods with teaching strategies such as assignments, exercises, questions both in school and at home.	20	80	04	20.5	01	04	00	00	3.72	0.678
5	I usually carry out laboratory practice involvin either fabrication of soap like liquid soap or production of nutritive food as yogurt, or manufacture of skin-care product like rubbing oil.	03	12	04	16	15	64	02	8.0	2.32	0.802
6	I monitor, evaluate, remediate, and provide feedback to theoretical and practical work assigned to students.	15	60.0	10	40.0	00	00	00	00	3.60	0.500
7	My students have competences in fabrication soap, production of nutritive food, and acture of skin-care products.	10	40	12	48	02	8.0	01	4.0	3.24	0.778
8	Students have been using what they produce in school and home to solve their problems.	03	12	02	8.0	18	72.0	02	8.0	2.24	0.778
<b>Grande Mean</b>						<b>3.09</b>					

Therefore, in first instance the researcher has produced Pearson correlation of the relationships between the IVs (Fabrication of soaps, Production of nutritive foods, Manufacturing of skin-care products) and DV (Problem solving competences).

## Correlation of variables

**Table 14: Correlations**

Pearson Correlation				
	Fabrication of soap	Production of nutritive food	Manufacture of skin care products	Problem solving competences
Fabrication of soap				
Production of nutritive food	.967 <sup>i</sup>			
Manufacture of skin care products	.956 <sup>i</sup>	.943 <sup>i</sup>		
Problem solving competences	.924 <sup>i</sup>	.927 <sup>i</sup>	.922 <sup>i</sup>	

\*\* . Correlation is significant at the 0.01 level (2-tailed).

The table above shows the correlation between variables. It is important to note that the correlation test is used to show if there is a relationship between variables and the strength of the relationship. The correlation coefficient normally ranges from -1 to 1(Brunel, 2018). When a variable is correlated against itself it gives us a value of 1.

Concerning the strength of relationship, the IVs of the nature of the fabrication of soap, and production of nutritive food, (Pearson's  $r(250) = 0.967, p < 0.000$ ), fabrication of soap and manufacture of skin-care, (Pearson's  $r(250) = 0.956, p < 0.000$ ), fabrication of soap, and problem solving competences (Pearson's  $r(250) = 0.924, p < 0.000$ ), production of nutritive food, and manufacturing of skin-care (Pearson's  $r(250) = 0.934, p < 0.000$ ), production of nutritive food, and problem solving competence (Pearson's  $r(250) = 0.927, p < 0.000$ ), Manufacture of skin-care product and problem solving competence (Pearson's  $r(250) = 0.922, p < 0.000$ ). It can be concluded that there is a strong positive correlation between the IVs and DV.

## Hypothesis 1

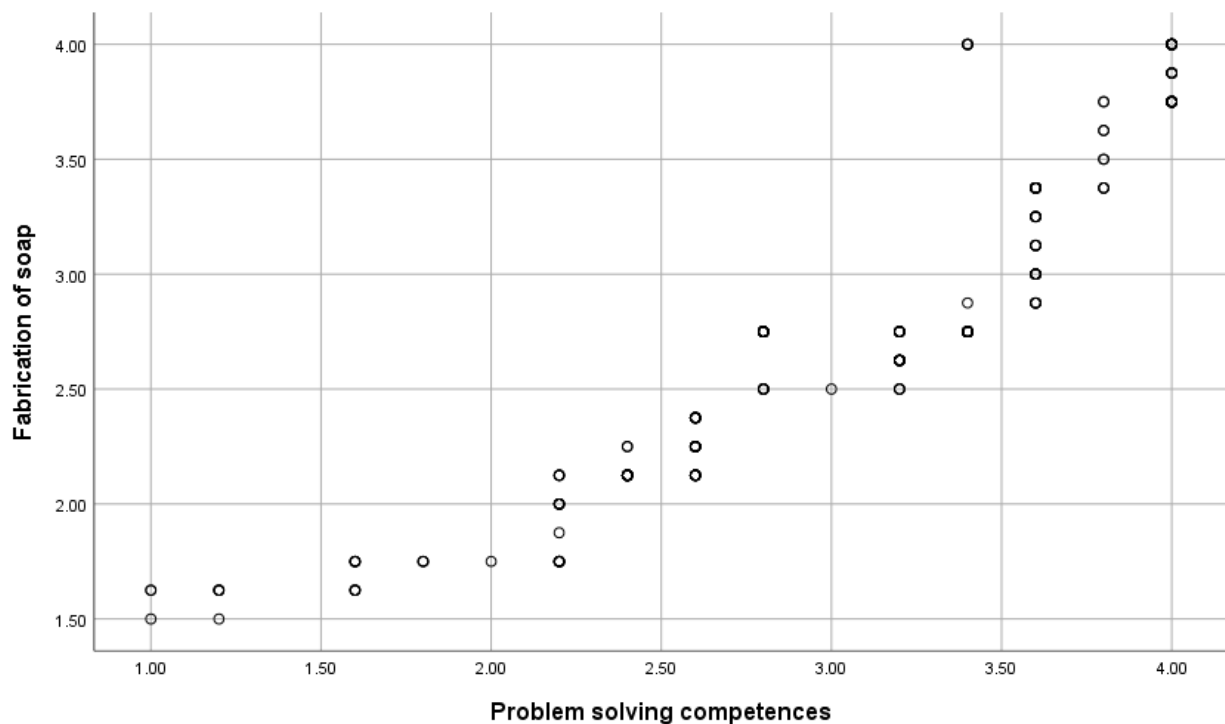
**H<sub>01</sub>: Fabrication of soaps does not significantly impact problem-solving competences in high school science students in Mfoundi division in Yaounde.**

**Table 15: Model Summary for Fabrication of soap on problem solving competence**

### Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.924 <sup>a</sup>	.853	.853	.28342
a. Predictors: (Constant), Fabrication of soap				

**Figure 2: Scatter plot for Fabrication of soap on problem solving competence**



The scatterplot showed that there was a strong positive linear relationship between fabrication of soap and problem-solving competences in high school science students in Mfoundi Division Yaounde, which was confirmed with a Pearson's correlation coefficient of  $R = .924$ . The regression model predicted 8.53% of the variance. The model was a good fit for the data ( $f(1, 248) = 1441.274, p = 0.000$ ).

**Table 16: ANOVA for Fabrication of soap on problem solving competence ANOVAa**

		Sum of Squares				
Model			df	Mean Square	f	Sig.
1	Regression	115.772	1	115.772	1441.274	.000 <sup>b</sup>
	Residual	19.921	248	.080		
	Total	135.693	249			

a. Dependent Variable: Problem solving competences

b. Predictors: (Constant), Fabrication of soap

The next table is the f test. The linear regression f test has the null hypothesis that fabrication of soap does not have a statistically significant influence on problem solving competences at  $p=0.00$ . In other words,  $R^2= 0$ , with  $f(1, 248) = 1441.274$ ,  $p= .000$ , the test is highly significant. Thus, we resume that there is a statistically positive significance relation between fabrication of soap and problem-solving competences in high science school students in Mfoundi Division in

Yaounde.

**Table 17: Coefficient for Fabrication of soaps on problem solving competence.**

		Coefficients <sup>a</sup>				
		unstandardized		Standardized		
		Coefficients		Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	.317	.073		4.334	.00
	Fabrication of soap	.985	.026.924		37.964	.00

a. Dependent Variable: Problem solving competences

The regression results showed a significant positive relationship between fabrication of soap and problem-solving competences ( $t = 37.964$ ,  $p < 0.000$ ). The slope coefficient for fabrication of soap was 0.924, so problem solving competences of high school science students in Mfoundi increases by a factor of 0.924. Supporting the alternative hypothesis there is a significant positive relationship between soap fabrication and problem-solving competences.

## Hypothesis 2

Ho<sub>2</sub>: Production of nutritive foods does not significantly impact problem-solving competences in high school science students in Mfoundi Division-Yaoundé.

**Table 18: Model Summary for production of nutritive food on problem solving competence**

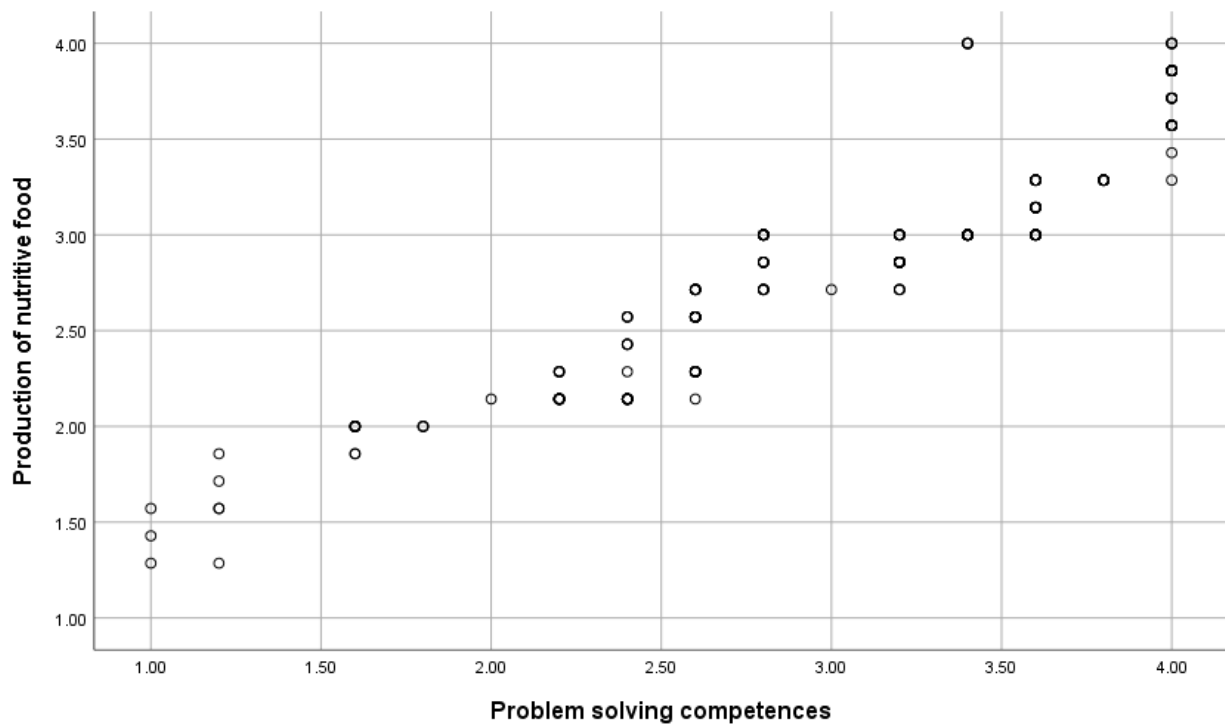
### Model Summary

Std. Error of the

Model	R	R Square	Adjusted R Square	Estimate
<u>1</u>	<u>.927<sup>a</sup></u>	<u>.859</u>	<u>.859</u>	<u>.27757</u>

a. Predictors: (Constant), Production of nutritive foods

**Figure 3: Scatter plot for production of nutritive food on problem solving competence**



The scatterplot showed that there was a strong positive linear relationship between production of nutritive food and problem-solving competences in high school students in Mfoundi Division-Yaounde, which was confirmed with a Pearson's correlation coefficient of  $R = 0.927$ .

The regression model predicted 8.59% of the variance. The model was a good fit for the data ( $f(1, 248 = 1513.217, p = 0.000)$ ).

**Table 19: ANOVA for production of nutritive food on problem solving competence ANOVA<sup>a</sup>**

		Sum of Squares				
Model			Df	Mean Square	f	Sig.
1	Regression	116.586	1	116.586	1513.217	.000 <sup>b</sup>
	Residual	19.107	248	.077		
	Total	135.693	249			

- a. Dependent Variable: Problem solving competences  
b. Predictors: (Constant), Production of nutritive food

The next table is the f test. The linear regression f test has the null hypothesis that production of nutritive food does not have a statistically significant influence on problem solving competences at  $p=0.00$ . In other words,  $R^2= 0$ , with  $F (1, 248) = 1513.217$ ,  $p= .000$ , the test is highly significant. Thus, this shows that there is a statistically positive significance relation between production of nutritive food and problem-solving competences in high school students in Mfoundi Division in Yaounde.

**Table 20: Coefficients for production of nutritive food on problem solving competence Coefficients<sup>a</sup>**

		unstandardized		Standardized		
		Coefficients		Coefficients		
Model		B	Std. Error	Beta	T	Sig.
1	(Constant)	-.304	.087		-3.494	.00
	Production of nutritive food	1.165	.030.927		38.900	.00

- a. Dependent Variable: Problem solving competences

The regression results showed a significant positive relationship between production of nutritive food and problem-solving competences ( $t = 38.900$ ,  $p < 0.000$ ).

### Hypothesis 3

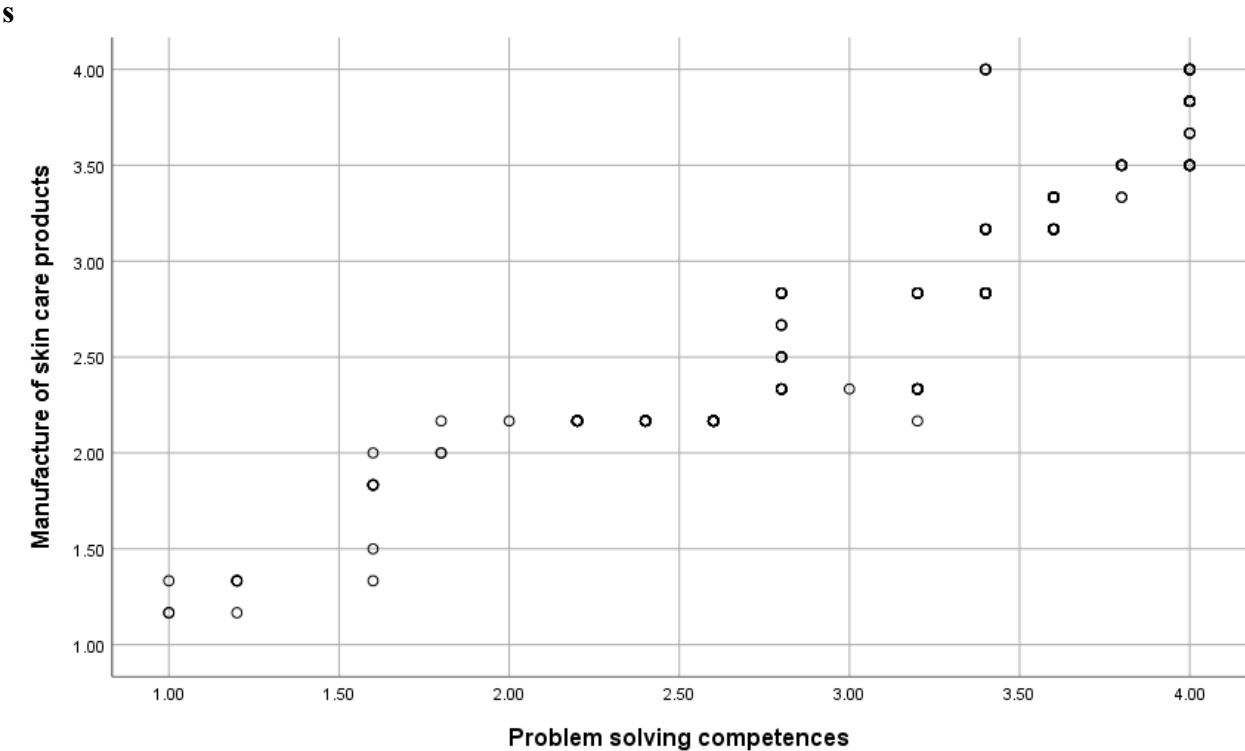
**H<sub>03</sub>: Manufacture of skin care products does not significantly impact problem-solving competences in high school science students in Mfoundi Division-Yaounde.**

**Table 21: Table Model Summary for Manufacture of skin care products on problem solving competence Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
<u>1</u>	<u>.922<sup>a</sup></u>	<u>.849</u>	<u>.849</u>	<u>.28699</u>

a. Predictors: (Constant), Manufacture of skin care products

**Figure 4: Scatter plot for Manufacture of skin care products on problem solving competence**



The scatterplot showed that there was a strong positive linear relationship between manufacture of skin care products and problem- solving competences in high school students in Mfoundi Division-Yaounde, which was confirmed with a Pearson's correlation coefficient of  $R = 0.922$ .

The regression model predicted 8.49% of the variance. The model was a good fit for the data ( $f(1, 248 = 1399.448, p = 0.000)$ ).

**Table 22: ANOVA for Manufacture of skin care products on problem solving competence ANOVA<sup>a</sup>**

Sum of		Model	Squares	Df	Mean Square	f	Sig.
1	Regression		115.266	1	115.266	1399.448	.000 <sup>b</sup>
	Residual		20.427	248	.082		
	Total		135.693	249			

- a. Dependent Variable: Problem solving competences  
b. Predictors: (Constant), Manufacture of skin care products

The next table is the f test. The linear regression f test has the null hypothesis that manufacture of skin-care product does not have a statistically significant influence on problem solving competences at  $p=0.00$ . In other words,  $R^2= 0$ , with  $f(1, 248) = 1399.448$ ,  $p= .000$ , the test is highly significant. Thus, we can assume that there is a statistically positive significance relation between manufacture of skin-care product and problem-solving competences in high school science students in Mfoundi Division in Yaounde.

**Table 23: Coefficients for Manufacture of skin care products on problem solving competence**

**Coefficients<sup>a</sup>**

Model		unstandardized		Standardized		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	.309	.074		4.143	.00
	Manufacture of skin care products	.992	.027.922		37.409	.00

- a. Dependent Variable: Problem solving competences

The regression results showed a significant positive relationship between manufacture of skincare product and problem-solving competences ( $t = 37.409$ ,  $p < 0.000$ ). The slope coefficient for manufacture of skin-care product was 0.922, so problem solving competences of high school students in Mfoundi increases by a factor of 0.922. Supporting the alternative hypothesis there is a significant positive relationship between manufacture of skin-care product and problem-solving competences.

## Observation

We observed learners in their various schools to verify if they are able to apply the theory acquired in class to practice during a specific project of either fabrication of soaps, production of nutritive food and manufacture of skin care products. The observation was carried out in the following schools in their workstations, G.B.P.H.S. Yaounde, G.B.H.S. Essos, G.B.H.S. Mendong and G.B.H.S. EtougEbe. Some materials and resources were contributed by the learners and some in cash so that the teachers can then buy them from the market. The role of a teacher is to guide the learners in what it is to be done and the learners did so that they will be engaged in the projects. Some students were able to produce the products of the project while others were not and they were aided by their classmates or the instructor. Teachers are not invited for supervision out of school reason being that their lessons only end at the school premises. Any lessons out of school, parents have to motivate them financially and some teachers say parents are not in support and as such makes them not to do extra work to help students at home. Practical activities for each subject is once a week for about three hours. Flipped tasks are given to students in order for them to fill their practical manuals. Students who do not contribute materials for projects are not allowed to participate during practical. By so doing all the student are motivated to provide their materials so that they will not miss the practical sessions. Evaluation will be done on their manuals which constitutes 20% of their marks during GCE A Level.

Work stations were created in classrooms during practical periods. Number of students per work station varied from 10 to 15 in some schools and others simply divided two groups for workstations. Where students were many in work stations, access to manoeuvre materials for the soap, food and skin care was difficult for students to take turns in the mixture sufficiently. For this reason, such students remained almost disengaged in the activities. Most of the containers came from schools

## Summary of Findings

RH<sub>1</sub>:

**Ho<sub>1</sub>: Fabrication of soaps does not significantly impact problem-solving competences in high school science students in Mfoundi division in Yaounde**

Findings according to elements within questionnaires are as follow;

Lessons taught by teachers in class provided me with theories to practice displayed 88.4% of positive responses from respondents and 12.2 negative responses. 94.9% accepted that

laboratory and workshops had the necessary equipment to carrying out fabrication of soap while 5.1% refused. 95.5% accepted they fabricated soap for personal and commercial purposes and 4.4% refused. 15.6% responded that they make money from the sales of soap to solve their real-life problems and 84.4% refused. For the item I have the ability to develop innovative solutions to overcome challenges encountered in soap fabrication 24.4% accepted while 75.6% refused. 90% accepted to have been given enough time to practice in school while 10% refused. For the item there is follow up from my teachers for quality practice at home 26.4% agreed while 73.6% refused. 36.6% accepted teachers give them assignment to fabricate soap at home while 63.4% refused.

The linear regression f test has the null hypothesis that fabrication of soap does not have a statistically significant influence on problem solving competences. The regression results showed a significant positive relationship between fabrication of soap and problem-solving competences ( $t = 37.964$ ,  $p < 0.000$ ), the test is highly significant. Thus, we resume that there is a statistically positive significance relation between fabrication of soap and problem solving competences in high school students in Mfoundi Division in Yaounde.

RH2:

**Ho2: Production of nutritive foods does not significantly impact problem-solving competences in high school science students in Mfoundi Division in Yaounde.**

From the results on the statement lessons taught by teachers in class provide me with theories to practice 88.4% accepted while 11.6% refused. For laboratory and workshops have the necessary equipment to carrying out fabrication of soap 94.9% accepted while 5.1% refused. 95.6% accepted that they fabricate soaps for personal and commercial purposes while 4.4% refused. 15.6% respondents accepted they make money from the sales of soap to solve their real-life problems while 84.4% refused. For the item I have the ability to develop innovative solutions to overcome challenges encountered in soap fabrication 24.4% accepted while 75.6 respondents refused. 90% respondents accepted they are given enough time to practice in groups or individually in school while 10% refused. For the item there is follow up from my teachers for quality practice at home 26.4% while 73.6% refused. Teachers assign me to fabricate soap at home 30.4% accepted while 69.2% refused.

The regression results showed a significant positive relationship between production of nutritive food and problem-solving competences ( $t = 38.900$ ,  $p < 0.000$ ). Thus, this shows that there is a

statistically positive significance relation between production of nutritive food and problem-solving competences in high school students in Mfoundi Division in Yaounde.

RH<sub>3</sub>:

**H<sub>03</sub>: Manufacture of skin care products does not significantly impact problem-solving competences in high school science students in Mfoundi Division-Yaounde.**

From the results on the statement there are enough equipment in the laboratory for production of nutritive food 97.2% respondents accepted while 2.8% respondents refused. 100% respondents accepted they validate their courses; therefore, no respondent fails. For the item I practice to produce nutritive food in group or individually in the laboratory or workshops 92% of respondents accepted and 8% refused. 60% accepted that teachers assign them to produce nutritive food at home and 40% refused. For the item I use nutritive food at home for daily needs or commercial purposes 9.6% accepted and 90.4% refused. 26% accepted that there is follow up by teachers to improve on quality production and 74% refused.

The linear regression F test has the null hypothesis that manufacture of skin-care product does not have a statistically significant influence on problem solving competences. In other words, the regression results showed a significant positive relationship between manufacture of skincare product and problem-solving competences ( $t = 37.409$ ,  $p < 0.000$ ). This signifies that there is a statistically positive significance relation between manufacture of skincare product and problem-solving competences in high school science students in Mfoundi Division in Yaounde.

## CHAPTER FIVE

### DISCUSSION OF RESULTS, IMPLICATIONS AND CONCLUSION

Having assembled all data using adaptable tools, methods and analytical techniques, chapter five treats discussions from findings, implications, recommendations and suggestions for further studies. The presentation of research hypotheses will enable us to view the statistical data analysed in order to produce a coherent report.

#### Discussions

This study has as general research question: What is the impact of curriculum appropriation on problem-solving competences in high school science students of Mfoundi division? Results showed that the linear regression F test rejected the null hypothesis affirming the alternative hypothesis was accepted. This theoretically means 'Curriculum appropriation significantly impacts problem-solving competences in high school science students in Mfoundi division in Yaounde. This is generally interpreted that English high school science students in Mfoundi division in Yaounde appropriated curriculum which in turn provided them with problem solving competences through practical activities of Fabrication of soaps, production of nutritive foods and manufacture of skin care products.

#### Fabrication of soaps (saponification)

The works of Wiysahnyuy (2021) in relation to curriculum appropriation and problem solving competences corroborated that majority of teachers (96.5%) responded that they appropriated basic knowledge and skills of competency- based approach, but theirs was retained through seminars, conferences, and workshops which were not really frequent to keep them abreast with the art of the model. Fabrication of soaps involves competences acquired by students as hands-on activities through practical. Both students and teachers reinforce the practice to succeed in final official examination but not to engage for more benefits to the family and community. Wiysahnyuy iterates those teachers faced difficulty to implement the competency-based approach because the knowledge and skills acquired was inadequate and insufficient coupled to the overcrowded classrooms, limited teaching hours, bogus nature of the syllabuses and insufficient pedagogic and learning materials. Appropriation of competences in this study by high school science students is through practical activities in workshops in classrooms with more than one work-stations often. This gave 95.7% as students who responded to have

appropriated sufficient competences and skills through laboratory and work-shops practical activities.

Yaro (2024) writes to underscore the enormous work carried out by the Ministry of Basic Education in Cameroon which compels the implementation of a new curriculum designed to guide the development of basic competences in the learners through project-based learning activities. Project-based learning activities play a central role in enhancing competency-based learning approach by learners demonstrating the knowledge, skills and attitudes acquired during every pedagogic month by carrying out a concrete project to solve any identified problem in their context, which is their immediate environment (Yaro, 2024). Yaro's work points to hands-on engagement which entails practice, maintaining same emphasises as we do in this study in creating awareness that high school sciences are not only theoretical but have potential activities which equip learners with vital competences exposing them to self-reliance and enterprising.

### **Production of nutritive food**

Many students engage in production of nutritive foods such as cake, yoghurt and folere. It is certain that most of these foods are consumed at home and even in high demands by those celebrating parties and anniversaries. From the standard deviation value, 93.6% students responded to have lessons taught by teachers in class providing them with theories to practice. This is sustained by the reason that workshops have available equipment for students to practice. As learners are exposed to sufficient and quality practice in their groups and skills are learned among themselves such as collaboration as team spirit expects each member to execute a task for the group to get the project to completion. As they work together, skills such as communication, creativity, and decision making are exhibited. On the contrary, the works of Tchouatcha (unpublished) reveal that science education in Cameroon lacked laboratory facilities and equipment in schools, there is insufficient training for teachers in utilising available resources effectively, and there is limited funding for educational materials and technology. Shaibou (2024) asserts that student engagement and retention in Cameroon higher educational institutions using interactive and collaborative tools produce elevated student motivation and academic success. The author indicates challenges faced in implementing interactive and collaborative strategies such as limited access to technology, and inadequate training of educators, policymakers, and stakeholders in the Cameroon higher education sector to enhance outcomes and to create more supportive learning environment.

Up to 95.6% of students, apply competences to produce products for personal and commercial purposes when in groups with classmates only in schools but 86.4% of students attest they do not even carry out practical activities at home and few who practice out of school do not sell for money because the quantity of soaps, yoghurt, folere and glycerine is small. The reasons for practice at school is for students to succeed in their practical evaluations in schools. Teachers supervise students' practical activities in school and motivate slow learners who improve before the final practical examinations. Therefore, the motivation for practice in schools for students is to avoid punishment from teachers and administration and for award of marks to succeed end of year courses.

### **Manufacture of skin care products**

Skin care products are very useful to lubricate the skin, given its beautiful nature. The products are rubbing oil such glycerine and Mentholatum to cater for influenza. These are basic commodities for citizens which have low or moderate incomes can afford. Up to 74.4% students respond they have not been carrying out practical activities at home or out of school. This is a serious issue because students define importance of practical activities limiting to success in class and public examinations. Teachers as well limit significance of practice to examination success. This is because all students (100) accept they succeed their practical examinations – informing us of the synergy of effort from teachers and students put forth for the success. Shana and Abulibdeh (2020) find out that when science students engage in more practical work students in experimental group perform better than students in control group, from results of tests given to students. The authors call for teachers to give ample opportunity to student engagement in practical lessons in secondary schools. For this to be effective the administration of schools supplies laboratories and practical workstations with necessary equipment and materials.

Practical promotes students' positive attitudes and also enhances motivation for effective learning in science as Okam and Zakari (2017) discuss. In the Cameroonian context reforms in secondary school curriculum development objectives consider competency- based learning as a pillar which is practised through project pedagogy – signifying that, sciences in secondary schools privilege practical work to boost the activation and integration of the 21<sup>st</sup> century skills in learners. These skills include creativity, collaboration, communication, analytical skills, technological and digital literacy which assist in propagating sciences among learners, teachers and to the world. Intensive exploitation of information and technology tools extends practical products out of school with the implication of social media. Students living in the same or closed

vicinities could form groups around quarters to carry out practical activities out of school and invite teachers to supervise. Where teachers are unable to engage in out-of-school supervision face-to-face, educational technologies are adapted to facilitating supervision such as android phones, iPads, tablets, and the like. Distance learning through the employment of computers, internet, telephones and social media now bridge the gap between school and home because teachers can easily supervise, evaluate, effect feedback, and remediate through them. The effects of e-learning components, including e-notes, e-collaboration, e-assignments, and video conferencing have positive impacts on students' academic performance (Yaro & Yufela, 2021).

### **Implications**

High school science students according to the findings on the topic 'Curriculum appropriation and problem-solving competences', have all appropriated competences from contents taught by teachers both in theory and practice. This is proven because all students responded that they all succeed in their practical exercises in school when evaluated. The students even though competent, most do not apply these skills and competences out of school to produce soaps, nutritive foods and skin care products which may act as source of revenue when sold or used at home and for food as in the case of nutritive food. The results have implications to various stakeholders of education as written in the significance of study.

### **To teachers**

Teachers are those responsible for the guidance, interpretation, teaching, supervision and evaluation of curriculum content on students. They are at the foundations of the implementation of goals and objectives of high school science education set by Cameroon government. The study revealed that all students appropriated problem-solving competences demonstrated in practical results observed by teachers. Teachers were highly implicated in the hands-on process in relating theory and practice as much as required by education stakeholders. The difficult aspect that teachers remained unfulfilled was they not being capable of ensuring students' practical activities transcend the walls of their campuses. Teachers are supposed to be serious in the act of encouraging of engaging parents to set mechanisms out of school for their children to demonstrate the skills acquired either individually or associate in groups for those living in same quarters. This is a significant area where teachers have to emphasis on if high school sciences has to create more meaning integrating, theory, practice, and teachers-studentparent relationship. Low performance of students is usually blamed by teachers' ineffectiveness and when students

perform well in examinations appreciations are orientated to students' hard work and intelligence neglecting teachers' role.

### **To students**

Students are manifesters of all activities done by educators in and out of school. The work of education stakeholders, especially teachers is observed through students' progress and performances in all results be it practical or theory. In situations of deviance in behaviours towards teachers, where students abstain from school and lectures such students do poorly in examination ending up with disastrous results. In this study students have demonstrated that they appropriated the curriculum which enabled exposed them to the dynamism of fabrication of soaps, production of nutritive foods, and production of skin care products. Every student succeeds in practical activities and that is a positive aspect expected by all stakeholders in education. The students limited themselves within the walls of their schools by only validation success in class but failed executing the aspect of transfer of knowledge to benefit them, their parents and the society in which they are integrated. Fabrication of soaps, nutritive foods, and skin care products are a source where students could utilise the end products for their self-care, and family as food where applicable, and could sell some for financial gain for poverty alleviation, this is the initial stage of building skills in enterprising, creation of mini organisations which may engage a series of individuals through the different processes of production and sales. For sciences in high school general education to make meaning to parents above examination success at end of course, students have to exercise much the practices at home.

### **To education administrators**

Educational administrators play key roles of enabling schools to be conducive areas for the teaching/learning process to unfold. Laboratories and classrooms are equipped with the necessary resources that enable student-teacher interaction, and student-student interaction. Administrators as well ensure the effective presence of teachers and students in campuses carrying out duties assigned them. Pedagogic supervision is strong instrument that innovates teachers on novel issues concerning education which lead to enhancing value in education organised by administrators especially school principals. Enriching teachers' knowledge, skills and attitudes is synonymous to developing competences which they later transmit to students. School administrators in this study carried out relevant supervision in school by enabling coverage of curriculum to brought examination success to students but were also limited by not

supervising flipped pedagogy on practical work. Administrators did not exploit blended learning to this aspect and so created a vacuum in students and parents.

### **To parents**

Employability education remains the most demanded by parents for their children for the significance of self-reliance and through accommodation and assimilation of competences. Parents desire their children (learners) to be actors in concretely demonstrating learning through practice in real world. Parents' expectation is for learners to put critical thinking skills, analytic skills, creative skill, communication skills, collaboration skills and decision skills into operation to bring out products that will relief them from the weight of expenses in durable sponsorship. When students fail in this act of none practice of what is learned in school out door, this initiate parents to conclusions of unworthy nature of general science education. They interpret such education as expensive, time wastage, exhaustive, and less profitable compared to technical and vocational education which produces fruits immediately to learners from the skills appropriated by learners.

### **Conclusion**

The topic of study was 'Curriculum appropriation and problem-solving competences in high school science students in Mfoundi Division in Yaounde. The main research question posed was 'What is the impact of curriculum appropriation on problem-solving competences in high school science students of Mfoundi division? Methodology through descriptive survey design enabled us collected data using simple linear regression for data analysis. Response to this research question given by the data is that Curriculum appropriation impacts problemsolving competences in high school science students in Mfoundi division. Students demonstrated their competences in the fabrication of soaps, production of nutritive foods and manufacture of skin care products proven by complete success in practical activities. The teachers dispensed the contents of curriculum employing appropriate pedagogies which facilitated learning. By so doing the null hypothesis which stated that 'Curriculum appropriation does not have significant impact on problem-solving competences in high school science students in Mfoundi division was rejected and the alternative hypothesis confirmed. Students could produce practical products but only to fulfil objectives of succeeding examinations in school and end of course GCE A Level and little continuous implementation of skills at home.

## **Recommendations**

### **To teachers:**

High school science teachers should foster supervision of practical activities out of schools by implementing ICT tools. They create groups and platforms for students to work and share through these platforms. Teachers should appropriate skills on the manipulation of internet and its associates for effective use in lessons and practical activities dissemination, evaluation, feedback and remediation.

### **To students:**

Students should devote much time appropriate necessary competences involved in high school syllabus which are related to practical activities. These activities are the basis of project-based learning which engages hands-on learning. Students should be conscious that education in the 21<sup>st</sup> century makes allusion to achieving skills such as critical thinking, analytical skills, creative thinking, communication skills and collaborative skills in team work. Therefore, they should be conscious to practice competences acquired beyond the school walls also in order to benefit from the schooling process.

### **To school administrators:**

School administrators should exercise their responsibilities in demanding and providing resources be it human resources, financial resources or material resources from appropriate quarters and make sure to utilise them appropriately to benefit learners. They should monitor both teachers and learners and motivate them to be assiduous to their tasks and objectives through out the academic year.

### **To parents:**

Parents intend their children learn a trade that will enable become practitioners. They should appropriate competences consequent of the job market where employability is assured at the end of schooling. When children graduate and remain jobless still depending on their parents who spent sleepless periods on their sponsorships, parents become aggressive sometimes on children accusing them to have caused them parents waste money in meaningless education. Such conflicts at times end so fatal that some children leave home. Parents counselled to provide conducive environment and resources for children to practice at home. They should get acquaintance with teachers of their children and even study programs to have adaptive

information on the involvement and encouragement of practical activities of their siblings. Parents have to encourage children on entrepreneurial activities so as to detach from acute dependence on parents.

### **Limitations of study**

- The study has a limitation in that it was carried out only in Mfoundi division precisely to English high school science students and not all the schools were selected due to convenience sampling method used. As such only schools such as GBPHS Yaounde, GBHS Essos, GBHS Mendong and GBHS Etogbe. This makes the work to be biased, not generalised to the whole division but only to the schools studied.

- Another limitation was that not all the competences of English high school science students were taken into consideration. The competences were limited to fabrication of soaps, production of nutritive foods and manufacture of skin-care products and we could be bias in collection of data leaving out some essential details following human endeavour.
- There was also difficulty in accessing the content that is literature review in order to have authors or articles who have works that are related to this study.

### **Suggestion for further study**

- Another study could be carried out on this topic ‘Curriculum appropriation and problem-solving competences covering the seven sub divisions of Mfoundi.
- Studies could be carried out on the topic to furnish data on reasons for ineffective transfer and implementation of skills and competences to practice out of school.
- A study be done on techniques of teachers’ supervision of high school science students’ practical activities to enforce self-reliance out of school premises.
- The integration of ICT tools in the supervision of practical activities of high school science students in Mfoundi division and in Cameroon at large.

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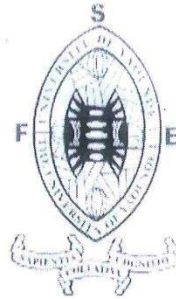
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# ANNEXES

## 1. Research authorisation

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



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

The Dean

N° 025 /24/UWI/FSE/CD

### AUTORISATION FOR RESEARCH

I the undersigned, **Professor BELA Cyrille Bienvenu**, Dean of the Faculty of Education of the University of Yaoundé I, hereby certify that **AYAMBA Maureen OJONG**, Matricule **22W3482**, is a student in Masters II in the Faculty of Education, Department: **CURRICULUM AND EVALUATION**, Specialty: **CURRICULUM DEVELOPMENT AND EVALUATION**.

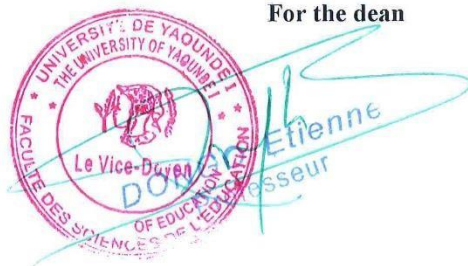
The concerned is carrying out a research work in view of preparing a Master's Degree, under the supervision of **Pr. MAINGARI Daouda**. Her work is titled: « *Curriculum Appropriation and Problem-Solving Competencies in High School Students in Mfoundi Division-Yaounde* ».

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

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

Done in Yaoundé, le... 30 JAN 2024...

For the dean



## 2. Questionnaires for students

Dear respondents,

The researcher is a student of master 2 in Yaoundé I university faculty of education, department of curriculum and evaluation, speciality curriculum development carrying out research on the topic curriculum appropriation and problem-solving competences in high school students in Mfoundi Division-Yaoundé. This study is essentially for academic purpose. Your responses or suggestions will help me and other academic stakeholders. All information you will give shall remain confidential.

Please indicate with a tick

Section A; Demographic information respondents

1) Sex

Male  Female

2) Age of respondent 14 – 16  17 – 19  20 – 22

3) Educational level. Upper sixth  Lower sixth

1. **Fabrication of soap.**

SN <sub>0</sub>	Items	Agree	Strongly agree	Disagree	Strongly disagree
1	Lessons taught by teachers in class provide me with theories to practice.				
2	Laboratory and workshops have the necessary equipment to carrying out fabrication of soap..				
3	I fabricate soap for personal and commercial purposes				
4	I make money from the sales of soap to solve my real-life problems.				
5	I have the ability to develop innovative solutions to overcome challenges encountered in soap fabrication.				

6	I am giving time to practice in groups or individually.				
7	There is follow up from my teachers for quality practice at home				
8	Teachers assign me to fabricate soap at home.				

## 2. Production of nutritive food

SN <sub>0</sub>	Items	Agree	Strongly agree	Disagree	Strongly disagree
1	There are enough equipment in the laboratory for production of nutritive food				
2	I validate my courses in the S3 series.				
3	I practice to produce nutritive food in groups or individually in the laboratory or work shops				
4	Teachers assign me to produce nutritive food at home.				
5	I use nutritive food at home for daily needs or commercial purposes.				
6	There are materials needed for the practice of nutritive food production.				
7	There is follow up by teachers to improve o quality production.				

### 3. Manufacture of skin care products

SN <sub>0</sub>	Items	Agree	Strongly agree	Disagree	Strongly disagree
1	Lessons taught by teachers in class provide me with Knowledge to solve problems.				
2	Laboratory and workshops have the necessary materials for me to practice.				
3	I have materials needed for practice at home.				
4	I can manufacture my own skin-care products.				
5	I use skin-care products for daily needs at home and for commerce.				
6	There is follow up by teachers to verify if I practice at home.				

### Problem-solving competences

SN <sub>0</sub>	Items	Agree	Strongly agree	Disagree	Strongly disagree
1	Developed analytical skills				
2	Developed creativity skills				
3	Working in a team				
4	Developed emotional intelligence and communication skills				
5	Adaptability and flexibility to adjust one's approach.				

### 3. Questionnaires for teachers

Dear respondents,

The researcher is a student of master 2 in Yaoundé I university faculty of education, department of curriculum and evaluation, speciality curriculum development carrying out research on the topic curriculum appropriation and problem-solving competences in high school students in Mfoundi Division-Yaoundé. This study is essentially for academic purpose. Your responses or suggestions will help me and other academic stakeholders. All information you will give shall remain confidential.

Please indicate with a tick

#### Section A: Demographic information respondents

4) Sex

Male [ ] Female [ ]

5) Age of respondent 25 – 35 [ ] 35 – 45 [ ] 45 – 60 [ ]

6) Grade A1 [ ] A2 [ ]

SN <sub>0</sub>	Items	Agree	Strongly agree	Disagree	Strongly disagree
1	I have covered the syllabuses or curriculum content of high school sciences both in theory and practical significantly.				
2	I employ teaching and learning methods that situate learners at the centre during lessons such as projectbased learning, flipped pedagogy and discovery learning.				
3	I associate teaching methods with teaching strategies such as assignments, exercises, questions both in school and at home.				

4	I usually carry out laboratory practices involving either fabrication of detergents like liquid soap or production of nutritive food as yogurt, or manufacture of skin-care product like rubbing oil.				
5	I monitor, evaluate, remediate, and provide feedback to theoretical and practical work assigned to students.				
6	My students have competences in fabrication of detergents, production of nutritive food, and manufacture of skin-care products.				
7	Students have been using what they produce in school and home to solve their problems.				

#### **4. Observation guide**

Topic: Curriculum appropriation and problem-solving competences in English Speaking high school science students in Mfoundi Division.

Venue of observation: Classrooms as workstations in GBPHS Yaounde, GBHS ESSOS, GBHS Mendong and GBHS Etoug Ebe.

Subjects observed: Students and teachers

Activities observed: Fabrication of soaps, production of nutritive foods and manufacture of skin care products.

Behaviour observed: Contribution of materials, participation, role of students and teachers in practical exercise, description of what shows that students appropriated curriculum concerning practical.

Outcome of products: Description of project and end products, appreciation of products

Utilisation of products: Narration

Repetition of practical for consolidation: Expression of skills and competences to solve real life problems or to produce products?

Practice out of school or at home: Relating the transition of practical from school to practice out of school, evidence of practice out of school (pictures, albums, etc.), real life problems solved through these projects.

Invitation of supervisors to supervise out of school: no or yes.

Organisation of practical: flipped tasks, collection of materials, Fate of students who do not the contribute materials, if any.

Number of students per workstation: Number of workstations, Number per station, description of station and activities, successes and challenges, role of teacher during practical, assessment of practical activities,

Supervision of work out of school: Students' production out of school (no, or yes), practical done out of school (number of times, quantity produced, function or usage of products), description of how teachers supervise practical in school and out of school, level of motivation of students to practice or not out of school, reason for teachers to supervise practice out of school.

## 5. Krejcie and Morgan Sample Size Table (1970)

Table 3.1									
<i>Table for Determining Sample Size of a Known Population</i>									
N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	100000	384
<i>Note: N is Population Size; S is Sample Size</i>					<i>Source: Krejcie &amp; Morgan, 1970</i>				

## 6. Pictures from observation of practical activities in retained schools

### FABRICATION OF LIQUID SOAP



Activity: Mixing soap



Mixing continues



Pouring soap to have a homogenous mixture



Final Product (liquid soap)

## Production of nutritive food (Yoghurt)



## Combining recipes



## Mixing recipes (content)



Yoghurt