MATHEMATICS SYLLABUS FOR TTCs

OPTION: LANGUAGE EDUCATION

YEAR 1, 2 & 3

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FOREWORD

Rwanda Education Board is honoured to avail the Mathematics Syllabus for Teacher Training Colleges (TTCs) in the LE option. This document serves as official guide to teaching and learning of Mathematics in TTCs, Pre-primary and Primary education.

The Rwandan education philosophy is to ensure that young people at every level of education achieve their full potential in terms of relevant knowledge, skills and appropriate attitudes that prepare them to be well integrated in society and exploit employment opportunities.

The ambition to develop a knowledge-based society and the growth of regional and global competition in the labor market has necessitated the shift from knowledge to competence based curriculum in TTCs. The TTC curriculum was revised to align it to the Competence-Based Curriculum for basic education to prepare teachers who are competent and confident to implement CBC in pre-primary and primary education. The rationale of the changes is to ensure that TTC leavers are qualified for job opportunities and further studies in Higher Education in different programs under education career advancement.

I wish to sincerely express my appreciation to the people who contributed towards the development of this syllabus, particularly, Consultants, REB staff, UR-CE Lecturers, TTC Tutors, Teachers from general education and experts from Local and international Organizations for their technical support. A word of gratitude goes to the Head Teachers and TTCs principals who availed their staff for various revision activities.

Special appreciation goes to the Development Partners such as UNICEF, USAID/Soma Umenye, Save the Children and Right To Play for their financial support.

Dr. MBARUSHIMANA Nelson

Director General

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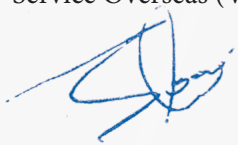
I wish to sincerely express my special appreciation to the people who played a major role in development of Mathematics syllabus in LE option. It would not have been successful without the support from different education stakeholders. My thanks first go to the leadership of UR-CE who started the review of the TTC curriculum in 2015.

I wish also to thank Rwanda Education Board (REB) leadership who continued and supervised the curriculum review process. I wish to extend my appreciation to Consultants, REB staff, Lecturers from UR-CE, TTC principals, TTC Directors of Studies deputy principals, tutors, teachers from secondary general Education and whose efforts during the revision process were much valuable.

Special thanks go to UNICEF who funded the development, designing finalization and printing of this syllabus.

I owe gratitude to different education partners more especially USAID-Soma Umenye, Save the Children, Right To Play, Help a Child, Aegis Trust,Humanity and Inclusion, Flemish Association for Development Cooperation and Technical Assistance (VVOB), Voluntary Service Overseas (VSO), Teach Rwanda and IEE for their technical support



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1. GENERAL INTRODUCTION

1.1. Rwanda Education Sector Objectives

The Education Sector objectives are the reference point for the inclusion of education issues into other Rwandan policy documents. These objectives are aligned with those recommended in the Eastern African Curriculum Framework proposals. The Government of Rwanda through law number 36/2018 of 29th June, 2018 determining the organization of education revised the objectives of the sector. They are to:

1. Provide Rwandans with adequate skills at all levels of general education as well as technical and vocational skills;
2. Offer quality courses and education at all levels;
3. Promote science, technology and research in order to equip many Rwandans with capacity to speed up national development;
4. Promote the culture of peace, tolerance, justice, respect for human rights, solidarity, democracy and that of avoiding any form of discrimination or favoritism;
5. Provide each Rwandan with an integrated education based on ethical values, science and social welfare and directed towards building a nation to ensure its sustainable development
6. Install into Rwandans the love of a job well done, the value of hard work, punctuality and promotion of competence
7. Train the Rwandan to have freedom of thought, be innovative, have abilities to acquire and be analytical towards other people's opinions and to communicate his or her own ideas, to be patriotic and encourage him or her to be updated on the situation prevailing elsewhere;
8. Eliminate all grounds and obstacles that hinder the development of girls and women education as well as of any other groups that need special attention.

These objectives and associated strategies are the backbone for developments in education including the curriculum and assessment policy and the curriculum framework.

1.2. Level Competences of Primary Teacher Education in the Republic of Rwanda

As stated earlier, Primary Teacher Education is under the responsibility of Rwanda Education Board. The following are the competences of Teacher Education. By the time a student teacher is exiting the college after three years he or she should:

- be a qualified teacher who can compete not only locally but regionally and internationally;

- have professional ethics and develop an inquiring mind for innovative education;
- be prepared adequately for efficiency in education, administration, management, evaluation and measurement;
- be competent, reliable, honest and responsible.
- be equipped with potentials that enable him/her to explore the learners‟ abilities and interests
- be able to develop the child's ability in critical thinking, free expression and ideas.

1.3. Background to curriculum review

This Mathematics syllabus is developed for TTC student-teachers in the options of Languages Education (LE) where Mathematics is a supplementary subjects.

The motive of reviewing the syllabus was to ensure that the syllabus is responsive to the needs of the student-teacher and to shift from objective and knowledge-based learning to competence-based learning. Another reason was to align the TTC curriculum to the CBC in general education. Emphasis in the review was put more on skills and competences as well as the coherence within the existing content by drawing on the previous syllabus and benchmarking with syllabi elsewhere with best practices.

The syllabus guides the interaction between the tutor and student -teachers in the learning processes and highlights the competences a student teacher should acquire during and at the end of each unit of learning. Student- teachers will have the opportunity to apply Mathematics in different contexts, and see its importance in daily life. Tutors help the student- teachers appreciate the relevance and benefits for studying Mathematics from pre/primary to tertiary levels.

The learning of student teacher is influenced by many factors such as curriculum relevancy, necessary and sufficient pedagogical approach by tutors, assessment strategies and sufficient instructional materials. With review of the Mathematics syllabus, these factors have been aligned with the competence-based curriculum for general education. This will lead to having qualified and competent teachers who are ready to implement the competence based curriculum for pre-primary and primary education. This implies equipping student teachers with relevant knowledge, skills, attitude and values necessary to make them competitive on local, regional and global job market. This revised syllabus will allow future teachers to contribute to the development of equity and quality education at pre-primary and primary levels and then it will enable student teachers to go for further studies.

1.4. Rationale of teaching and learning mathematics

Mathematics subject in the options of Languages Education (LE) is designed to provide mathematical concepts with statistical aspects and logics in order to help student-teachers to demonstrate critical thinking, problem solving and decision making skills.

The syllabus concentrates on mathematical concepts that are useful tools for a student-teacher who intends to: teach in primary school, collaborate with others to solve real life problems in knowledge based economy society and undertake further studies at higher education. Particularly, statistical skills are needed for primary teachers to help them elaborate students' school reports, interpret them and other statistical data from different reference books, journals and relevant scientific documents.

1.4.1. Mathematics and the society

Mathematics plays an important role in society through abstraction and logic, counting, calculation, measurement, classifying, systematic study of shapes and motion. It is also used in natural and applied sciences. The applied Mathematics like statistics and probability play an important role in different games of chance, in the national census process, in scientific research, etc. In addition, some cross-cutting issues such as financial education (awareness), environment and sustainability, comprehensive sexuality education, standardization culture, peace and value education, inclusive education are incorporated into some of Mathematics units to improve social and economic welfare of Rwandan society.

Moreover, Mathematics is key to the Rwanda education ambition of developing a knowledge-based and technology-led economy since it provides to student teachers all required knowledge and skills to be used in different learning areas. Therefore, Mathematics is an important subject as it supports other subjects. This TTC Mathematics-syllabus is intended to address gaps in the previous Mathematics syllabus which lacks of adequate and appropriate knowledge, skills, attitude and values.

1.4.2. Mathematics and student-teachers

Student-teachers in LE need to acquire basic mathematical competences to be effective members of Rwandan society with the ability to carry out researches, estimate, analyze, interpret statistical data and read the commonly used scientific representations and graphs.

Therefore, Mathematics content equips student-teachers with knowledge, skills and attitudes necessary to enable them to succeed in an era of rapid technological growth and socio-economic development. Mastery of Mathematical ideas makes student-teachers being innovative and confident in problem solving. It enables the student-teachers to be systematic, creative and self-confident in using mathematical

language and techniques to reason; think critically; develop imagination, initiative and flexibility of mind. In this regard, learning of Mathematics needs more practical problem-solving activities with opportunities for student-teachers to plan their own investigations and develop the scientific and mathematical competences and confidence.

As new technologies have had a dramatic impact on all aspects of life, wherever possible in Mathematics, student- teachers should gain experience of a range of ICT equipment and applications.

1.5. Professional standards and Competences

1.5.1. Competences

Competence is defined as the ability to perform a particular task successfully, resulting from having gained an appropriate combination of knowledge, skills, attitudes and values. The present syllabus provides the opportunity to student-teachers to develop different broad Mathematics competences as well as the generic competences.

Broad subject competences are highlighted and broken into key competences for each year, these are further broken into key unit competences which are finally split into learning objectives knowledge, skills, attitudes and values) in every learning unit.

Taking into account the rationale behind the overall TTC curriculum review as well as the parameters and constraints of the local context, student- teachers will be equiped with professional standards and generic competences. Professional standards are acquired through generic competences and professional practices that are emphasized and reflected in the learning process. The Mathematics tutors will ensure that student -teachers are exposed to tasks that help them acquire these competences.

1.5.2. Teaching professional standards

These refer to the characteristics that all teachers globally should have. All teachers in Rwanda should have the six characteristics listed below:

i) The teacher has knowledge of CBC and how to implement it.

The teacher has understanding of CBC and how it works. He/she has knowledge of basic and generic competences and is able to integrate the cross cutting issues within and across subject area.

ii) The teacher as an educator

The professional teacher enhances and stimulates cognitive, social-emotional, physical and moral development of the children.

He/She therefore needs to have a thorough understanding of the child's background, interests, motivations and problems and can adjust his/her actions and the learning environment according to the different needs of student-teachers.

A competent educator acts as a role model, displaying desired behaviors and values. She/he guides and coaches his/her studens to become social, self-confident, independent, responsible, open-minded and innovative person. In order to be educator, the student-teacher must be supported in developing cooperation, inter personal and life skills.

iii) The teacher as a subject expert

The professional teacher stimulates the student's critical thinking, problem solving and creativity. S/he uses teaching/learning methods and techniques that are appropriate in primary education; she/he plans lessons integrating play-based strategies in teaching/learning. The teacher in primary education has a thorough subject knowledge that enables him/her to develop the teaching/learning materials, lesson planning, to deliver the lesson and connect with his/her daily life activities in primary education using correctly the language of instruction. The teacher as expert in upper primary education stimulates English in the teaching/learning by considering the transition from Kinyarwanda to English as medium of Instruction in upper primary.

The teacher as expert knows and uses appropriate methods/techniques to assess students and give constructive feedback to the whole class. The teacher as expert is able to link the content of his/her subject with other subjects and connect it with real life situation. This enables student teacher to acquire critical and problem solving skills as well as the subject concepts and skills enabling him/her to pursue tertiary education easily**.**

iv) The teacher as a communicator

The professional teacher displays a good example in his/her way of expressing him/herself, stimulates and enhances positive and clear communication between him/herself and the students, between the students, college community and the wider society. A good communicator is open-minded and respects diversity within and around the college. This requires teacher to communicate in official languages.

v) The teacher as a guide and an organizer

The professional teacher facilitates the holistic development of all student teachers, taking into account the differences between them. S/he ensures that the learning environment (class, playground, etc.) is well maintained and conducive for expected learning outcomes. This requires a teacher to be equipped with managerial skills.

vi) The teacher as an innovator, researcher and reflective practitioner

The professional teacher looks at ways to improve his/her teaching, and the wellbeing and results of his/her students. S/he is a reflective practitioner and knows how to perform small-scale reflective action.

The acquisition of such skills will require student- teacher to update knowledge and skills with minimum external support and to cope with evolution of knowledge advances for personal fulfillment in areas that need improvement and development, thus becoming lifelong learners.

1.5.3. Broad Mathematics competences

At the end of three years in TTC, the student teacher from the LE option should be able to:

- Recognize and describe the role played by mathematics and appreciate its social and economic implications in daily life;
- Apply statistical skills to elaborate students' school reports, interpret them and any other statistical data from different reference books, journals and relevant scientific documents.
- Use acquired skills to express logical statements and take appropriate decisions.

1.5.4. Mathematics and developing competences

The national policy documents based on national aspirations identify some 'basic competences' alongside the 'generic competences" that will develop higher order thinking skills and help students learn subject content and promote application of acquired knowledge and skills.

Through observations, constructions, using symbols, applying and generalizing mathematical ideas, and presentation of information during the learning process, the student-teacher will not only develop deductive and inductive skills but also acquire cooperation and communication, critical thinking and problem solving skills. This will be realized when student-teachers make presentations leading to

inferences and conclusions at the end of each learning unit. This will be achieved through student teachers' group work and cooperative learning which in turn will promote interpersonal relations and teamwork.

The acquired knowledge in learning should develop a responsible citizen who adapts to scientific reasoning and attitudes and develops confidence in reasoning independently. The student-teacher should show concern of individual attitudes, environmental protection and comply with the scientific method of reasoning. The scientific method should be applied with the necessary rigor, intellectual honesty to promote critical thinking while systematically pursuing the line of thought.

2. PEDAGOGICAL APPROACH

The change to a competence-based curriculum is about transforming learning, ensuring that learning is deep, enjoyable and habit-forming.

2.1. Role of the student-teacher

In the competence-based syllabus, the student teacher is the principal actor of his/her education. He/she is not an empty bottle to fill. Taking into account the initial capacities and abilities of the student teacher, the syllabus suggests under each unit, some activities of the student teacher and they all reflect active participation in the learning process.

The teaching and learning processes will be tailored towards creating a student's friendly environment basing on the capabilities, needs, experience and interests.

The following are some of the roles or the expectations from the student teachers:

- Student teachers construct the knowledge either individually or in groups in an active way. From the learning theory, they move in their understanding from concrete through pictorial to abstract. Therefore, the opportunities should be given to student teachers to manipulate concrete objects and to use models.
- Student teachers are encouraged to use hand-held calculator or other ICT tools. This stimulates Mathematics as it is really used, both on job and in scientific applications.
- Student teachers work on one competence at a time to form concrete units with specific learning objectives (knowledge, skills and attitude).

- Student teachers will be encouraged to do research and present their findings through group work activities.
- A student teacher is cooperative: student teachers work in heterogeneous groups to increase tolerance and understanding.
- Student teachers are responsible for their own participation and ensure the effectiveness of their work.

2.2. Role of the tutor

In the competence-based syllabus, the tutor is a facilitator, organizer, advisor, a conflict solver, etc.

The specific duties of the tutor in a competence-based approach are the following:

Tutor is:

- A facilitator, his/her role is to provide opportunities for student-teachers to meet problems that interest and challenge them and that, with appropriate effort, they can solve. This requires an elaborated preparation to plan the activities, the place they will be carried and the required assistance;
- An organizer: his/her role is to organize the student-teachers in the classroom or outside and engage them through participatory and interactive methods through the learning processes as individuals, in pairs or in groups. To ensure that the learning is personalized, active, participative and co-operative, the teacher/tutor must identify the needs of the student-teachers, the nature of the learning to be done, and the means to shape learning experiences accordingly;
- An advisor: he/she provides counselling and guidance for student-teachers in need. He/she comforts and encourages student-teachers by valuing their contributions in the class activities;
- A conflict-solver: most of the activities are performed in groups. The members of a group may have problems such as attribution of tasks; they should find useful and constructive interventions of the teacher as a unifying element.
- Asked for help only when the whole group agrees to ask a question
- Ethical and preaches for examples by being impartial, a role-model, caring for individual needs, especially for slow student teachers and those with physical impairments, through a special assistance, by providing remedial activities or reinforcement activities.

2.3. Special Needs Education and Inclusive Education Approach

All Rwandans have the right to access education regardless of their different needs. The underpinnings of this provision would naturally hold that all citizens benefit from the same menu of educational programs. The possibility of this assumption is the focus of special needs

education. The critical issue is that we have student teachers who are totally different in their ways of living and learning as opposed to the majority. The difference can either be emotional, physical, sensory and intellectual learning challenged.

These student teachers equally have the right to benefit from the free and compulsory basic education in the nearby ordinary/mainstream colleges. Therefore, the college's role is to enroll them and also set strategies to provide relevant education to them. The tutor therefore is requested to consider each student teacher's needs during teaching and learning process. Assessment strategies and conditions should also be standardized to the needs of these student teachers. Detailed guidance for each category of student teachers with special education needs is provided for in the guidance for teachers. The tutor is advised to work closely with the tutor of special need education to provide appropriate support to any identified student -teacher's needs.

2.4. Skills Laboratory in Mathematics

Mathematics is a practical subject in which student teachers can learn and explore various mathematical concepts , verify different mathematical facts and theories using a variety of practical activities and material. The use of mathematics laboratory helps to integrate theory and practical work in mathematics teaching and learning where students develop competences and apply acquired skills. Skills lab ensures teachers are accountable to completing all the learning activities and projects as outlined in the syllabus.

The basic characteristics of Skills Lab are:

- Students work in small groups (manageable teams)
- Assessment takes place through portfolio activities
- Students talk more than teachers (10% tutor talk time and the rest is for the students)
- Students receive constructive feedback on their work (Tutor gives quality feedback on student presentations).
- Skills lab consists of three components: build, practice and present.

Skills Lab in Mathematics makes a moment in which the student is active, discusses and argues her/his own choices, builds meanings, learns to collect data and to compare them with the models. It is important for valorising the experience and knowledge of the students, the discovery and the collaborative learning. This learning must also be done through practice, discussion, exploration, development of thinking about the practice and way for building knowledge.

Practical activities to be done will help to reduce the abstract nature of the Mathematics subject and draw the students to participate in the classroom where the vague theories and imaginary objects of mathematics take real shape which facilitates students to understand and perform better.

Role of the tutor is to prepare practical activities, to set groups of learners and assign them their roles and responsibilities. The tutor has to explore students' works, to analyse how and why the same final answer or product can be the result of different process or constructions followed by students, to mark and provide feedback and remediation to students.

The tutor has also to guess strategies used by students when doing a given activity. This is the analysis of possible solutions for a problem given to students considering that students can present only the starting and the final steps. The tutor has to guess the difficulties and misconception that students may face when they apply such a procedure in such a situation.

Role of the student teacher is to read carefully instructions related to the activity, apply the mathematics process in doing practical activity as provided. This process includes: reasoning, communication and connection, application and modeling, production of mathematics teaching and learning materials, apply thinking skills and heuristics.

Mathematical reasoning: Analyse mathematical situations and construct logical arguments. It is the habit of mind to be developed through application of mathematics in different contexts.

Communication: use mathematics language to express mathematical ideas and arguments precisely, concisely and logically.

Connections: see and make linkages among mathematical ideas, between mathematics and other subjects, and between mathematics and the real world.

Applications and modeling: connect mathematics that have been leant to the real life situations, enhance understanding of key mathematical concepts and methods, as well as developing competences. Students will have opportunity to apply problem solving and reasoning skills to tackle a variety of problems: open-ended and real world problems. They will use mathematical models to represent and solve problems.

Thinking skills: skills used in thinking process: classifying, comparing, analyzing parts and whole, identifying patterns and relationships, induction, deduction, generalizing, and spatial visualization.

Heuristics: rules of thumb of what students can do to tackle a problem when the solution to the problem is not obvious such as using representation (drawing diagrams, tabulating), making a guess (trial and error, guess and check, making a supposition), walking through the process (acting it out, working backwards), and changing the problem (simplifying the problem or considering special cases).

Production of teaching and learning materials: Mathematics student teachers can be given practical activities of organizing or producing teaching materials by the use of local material available in their environment.

Therefore, when doing practical activities, students build the knowledge and understanding, practice acquired skills and present the findings from their researches.

The following are tasks for the students: group building, basic communication, get to know the community and learners, exploration and needs assessment, coaching and guidance on managing challenging situations, investigation, asking, finding problems and to work collaboratively with peers for solving them, self-development on observation and inquiry, using scientific method and scientific research, develop a sense of taking responsibility for one's own learning, represent and build models of relationships among objects and events, communicate and discuss, argue correctly, understand views and arguments of the others, perceive and explore fascinating relationships and structures found in nature and in the creations of the human being.

In this regard, skills lab activities are the time when students combine the competencies acquired to make learning more practical. Thus, in every unit, this syllabus suggests practical and learning activities that the teacher may adapt and give to students to ensure practical application of the competencies acquired.

3. ASSESSMENT APPROACH

Assessment is the process of evaluating the teaching and learning processes through collecting and interpreting evidence of individual student-teacher's progress in learning and to make a judgment about a student-teacher's achievements measured according to the defined standards. Assessment is an integral part of the teaching and learning process. In the new competence-based curriculum, the assessment must also be competence-based; whereby a student-teacher is given a complex situation related to his/her everyday life and asked to try to overcome the situation by applying what he/she learned.

3.1. Types of assessments

There are two major types of assessment namely formative and summative assessments. Any form of assessment should reflect the three domains of learning, which are Cognitive, Psychomotor and Affective.

- Knowledge and understanding: Does the student-teacher demonstrate an understanding of the Mathematics concepts? Has the student-teacher mastered the Mathematics concepts?
- **Indicators**: correctness of answers, coherence of ideas, logical reasoning, use correctly mathematical symbols and concepts, etc.

- Practical skills: How does the student-teacher perform on aptitude and practical tests? **Indicators**: accuracy, using appropriate methods, quality product, speed and efficiency, coherence.
- Attitude and values: How does the student-teacher respond to a task or a situation? What is the student-teacher's behaviour? How the student-teacher persists on solving a given problem?

3.1.1. Formative assessment

Formative assessment helps to check the efficiency of the process of learning. It is done within the teaching/learning process.

Continuous assessment involves formal and informal methods used by schools to check whether learning is taking place. When a tutor is planning his/her lesson, he/she should establish criteria for performance and behavior changes at the beginning of a lesson. Then, at the end of every unit, the tutor should ensure that all the student teachers have mastered the stated key unit competences basing on the criteria stated, before going to the next unit. The tutor will assess how well each student-teacher masters both the subject and the generic competences described in the syllabus as well as the professional practices. From this, the tutor will gain a picture of the all-round progress of the student-teacher. The tutor will use one or a combination of the following techniques: observation, pen and paper, and oral questioning.

3.1.2. Summative assessments

When assessment is used to record a judgment of a competence development or performance of the student-teacher, it serves a summative purpose. Summative assessment gives a picture of a student-teacher's competence or progress at any specific moment. The main purpose of summative assessment is to evaluate whether competences have been achieved, to use the results for ranking or grading of student-teachers, to decide on progression and to promote student-teachers to the next level of education and for certification. This assessment should have an integrative aspect whereby a student-teacher must be able to show mastery of all competences. It can be internal College based assessment or external assessment in the form of national examinations. College based summative assessment should take place once at the end of each term and once at the end of the year. College summative assessment average scores for the subjects which are examined at the national level will be weighted and included in the final national examinations grade. For the subjects that are not examined externally, the grade should be part of the continuous assessment reflected in the student's transcript.

3.2. Record keeping

This is gathering facts and evidence from assessment instruments and using them to judge the student's performance by assigning an indicator against the set criteria or standard. Whatever assessment procedures used generate data in the form of scores which will be carefully recorded and stored in a portfolio. The latter is used to decide remedial actions, alternative instructional strategy and as well as feed back to the student-teacher. The records also are important to parents to check the learning progress and to advice accordingly. Finally, the records are very essential to the final assessment of professional practice of the student-teacher at the end of the college.

This portfolio is a folder (or binder or even a digital collection) containing the student-teacher's work as well as the student-teacher's evaluation of the strengths and weaknesses of the work. Portfolios reflect not only work produced (such as papers and assignments), but also it is a record of the activities undertaken over time as part of student learning. Besides, it will serve as a verification tool for each student-teacher that he/she attended the whole learning before he/she undergoes the summative assessment for the subject.

3.3. Item writing in summative assessment

Before developing a question paper, a plan or specification of what is to be tested or examined must be elaborated to show the units or topics to be tested on, the number of questions in each level of revised Bloom's taxonomy and the marks allocation for each question.

In a competence-based curriculum, questions from higher levels of Bloom's taxonomy should be given more weight than those from knowledge and comprehension level.

Before developing a question paper, the item writer must ensure that the test or examination questions are tailored towards competence based assessment by doing the following:

- Identify topic areas to be tested on from the subject syllabus.
- Outline subject-matter content to be considered as the basis for the test.
- Identify learning outcomes to be measured by the test.
- Prepare a table of specifications.
- Ensure that the verbs used in the formulation of questions do not require memorization or recall answers only but also testing broad, subject and generic competences as stated in the syllabus.

4. RESOURCES

4.1. Materials needed for implementation

The following list shows the main materials/equipments needed in the learning and teaching process:

- Materials to encourage group work activities and presentations: Computers (XO laptops, Desktops & laptops) and projectors; Manila papers and markers, textbooks and handouts;
- Materials for drawing & measuring geometrical figures/shapes and graphs: Geometric instruments, ICT tools such as Geogebra or Microsoft student ENCARTA.
- Materials for enhancing research skills: Textbooks and internet (the list of the textbooks to consult is given in the reference at the end of the syllabus and those books can be found in printed or digital copies).
- Materials to encourage the development of Mathematical models: scientific calculators, Geogebra Software, Math type, Matlab, wall chart, different math mobile applications etc.
- Locally made materials.

The technology used in teaching and learning of Mathematics has to be regarded as tools to enhance the teaching and learning process and not to replace tutors.

4.2. Human resource

The effective implementation of this curriculum needs a joint collaboration of educators at all levels. Given the required material, tutors are expected to accomplish their noble role as stated above. The staff in charge of education at District and sector level should ensure overall support to TTCs for a successful implementation. On the other hand, TTC principles and TTC deputy principals are required to make a close follow-up and assess the teaching and learning of this subject due to their profiles in the schools. These combined efforts will ensure bright future careers and lives for student-teachers as well as the contemporary development of the country.

In a special way, the tutor of Mathematics at TTC level should have a firm of Technological Pedagogical Content Knowledge of teaching at primary and secondary levels. He/she should be qualified in Mathematics and have a firm ethical conduct. The tutor should possess the qualities of a good facilitator, organizer, problem solver, listener and adviser. He/she is required to have basic skills and competence of guidance and counseling because students may come to him or her for advice.

5. SYLLABUS UNITS

5.1. Mathematics units for year one

5.1.1. Key Competences at the end of year one

After completion of year one, Mathematics syllabus will help the learner to:

- Apply mathematical skills to solve simple real life problems.
- Use statistical skills to elaborate students' school reports, interpret them and any other statistical data with one variable from different reference books, journals and relevant scientific documents.

5.1.2. Syllabus units for year one

<table>
<tr><td colspan="2">Subject: Mathematics</td><td colspan="2">Year: One</td><td>Option: LE</td></tr>
<tr><td colspan="3">Topic Area: ALGEBRA</td><td colspan="2">Sub Topic: NUMBERS AND OPERATIONS</td></tr>
<tr><td colspan="4">Unit 1: ARITHMETICS</td><td>No. of periods: 24</td></tr>
<tr><td colspan="5">Key Unit competence: Use arithmetic operations to solve simple real life problems</td></tr>
<tr><td colspan="3">Learning objectives</td><td rowspan="2">Content</td><td rowspan="2">Learning Activities</td></tr>
<tr><td>Knowledge and understanding</td><td>Skills</td><td>Attitudes and values</td></tr>
<tr><td>– Define a fraction, decimal number, power, an exponential, a radical, decimal logarithm of a number and the absolute value of a real number.
– Determine a simple and compound interest in a given mathematical problem.</td><td>– Convert a fraction to a percentage and vice-versa;
– Determine the percentage that corresponds to a given decimal number;
– Illustrate properties of powers, a radicals, decimal logarithm, and absolute value of a real number.
– Transform a logarithmic expression to equivalent power or radical form and vice versa
– Use logarithm to model simple problems about compound interest, magnitude of an earthquake...</td><td>– Appreciate the importance and the use of properties of operations on real numbers;
– Show curiosity for the study of operations on real numbers.</td><td>– Basic arithmetic operations:
• fractions
• decimals
• percentages
• negative numbers
• absolute value
• powers and roots
• decimal logarithms
– Applications
• Simple and compound interest
• Final value of investment
• Arc of elasticity of demand.</td><td>– Make research in the library about Sets of numbers (natural numbers, integers, rational numbers and irrational numbers).
– Solve the provided variety of word problems that involve operations of real numbers: hire-purchase, simple interest and compound interest, money exchange, profit, loss and taxation, etc
– Use a bank loan related problem to calculate the compound interest.</td></tr>
<tr><td colspan="5">Links to other subjects: Entrepreneurship and Economics</td></tr>
<tr><td colspan="5">Assessment criteria: Think critically to understand and perform operations on the set of real numbers</td></tr>
<tr><td colspan="5">Materials: Graph papers, manila papers, digital technology including calculators,...</td></tr>
</table>

Subject: Mathematics	Year: One	Option: LE
Topic Area: ALGEBRA		Sub Topic: NUMBERS AND OPERATIONS
Unit 2: Equations and inequalities		No. of periods: 24

Key Unit competence: Apply equations and inequalities to solve problems related to daily life

Learning objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– List and clarify the steps in modeling a problem by linear equations and inequalities. – Give a formula for solving a quadratic equation.	– Solve graphically and algebraically linear equations and inequalities – Relate mathematical solutions to simultaneous linear equations to economic analysis. – Factorize and solve quadratic equation; – Set up and solve real life problems that involve quadratic equations.	– – Appreciate the importance of linear equations and inequalities in a given situation; – Show concern in solving real life problems involving linear equations and inequalities.	– Equations and inequalities in one unknown; – Simultaneous linear equations with two variables – Quadratic equations (factorization and use of discriminant) – Applications of linear and quadratic equations in economics and finance: Problems about supply and demand, finance, etc.	– In groups, student-teachers discuss on the importance and necessity of linear equations and inequalities and how it takes place in the buying and selling – In pairs, student-teachers solve linear equations and simultaneous equations – Student-teachers brainstorm the use of quadratic equations in their real life experiences.

Links to other subjects: *Economics...*

Assessment criteria: *Model and solve algebraically or graphically daily life problems using linear, quadratic equations or inequalities.*

Materials: *Geometric instruments (ruler, T-square, ...), Digital technology including calculator,...*

<table>
<tr><td colspan="2">Subject: Mathematics</td><td>Year: One</td><td colspan="2">Option: LE</td></tr>
<tr><td colspan="3">Topic Area: STATISTICS</td><td colspan="2">Sub Topic: DESCRIPTIVE STATISTICS</td></tr>
<tr><td colspan="4">Unit 3: Descriptive statistics</td><td>No. of periods: 24</td></tr>
<tr><td colspan="5">Key Unit competence: Analyze and interpret statistical data from daily life situations</td></tr>
<tr><td colspan="3">Learning objectives</td><td rowspan="2">Content</td><td rowspan="2">Learning Activities</td></tr>
<tr><td>Knowledge and understanding</td><td>Skills</td><td>Attitudes and values</td></tr>
<tr><td>– Read and interpret a diagram of statistical data.
– Identify mode, mean, median and range of statistical data
– Define mean, mode, meadian, the quartiles, variance, standard deviation and the coefficient of variation.</td><td>– Represent statistical information using: histogram, polygon, frequency distribution table and pie chart.
– Interpret statistical data by the use of measures of centre tendency and measures of dispersion.</td><td>– Appreciate how data collection, data representation and data interpretation can be used for solving real life situations.
– Appreciate the importance of measures of dispersion in the interpretation of data
– Show concern on how to use the standard deviation as measure of variability of data.</td><td>– Definition and type of data
– Data presentation
– Graph interpretation
– Measures of central tendencies: mode, mean, median, range
– Measures of dispersion: Quartiles, Variance , Standard deviation, Coefficient of variation
– Application: Collection, organization, presentation and interpretation of data and draw conclusions</td><td>– In group, learners will be given a data and be asked to:
• Determine the measures of dispersion, interpret them and represent their findings.
• Represent data on graph papers, interpret them and infer conclusion.
– Make a research on given problems arising from various situations in daily life, collect data, organize and investigate them statistically and represent the findings.</td></tr>
<tr><td colspan="5">Links to other subjects: Geography, Finance, Economics</td></tr>
<tr><td colspan="5">Assessment criteria: Extend understanding, analysis and interpretation of data arising from problems and questions in daily life to include the standard deviation.</td></tr>
<tr><td colspan="5">Materials: Manila papers, Graph Papers, ruler, digital technology including calculators …</td></tr>
</table>

5.2. Mathematics units for year 2

5.2.1. Key competences for end of year two

After completion of year two, the general science and Mathematics syllabus will help the learner to:

- Apply graphical representation of functions to model economical and financial problems
- Use logical statements to express appropriate decisions.

5.2.2. Syllabus units for year 2

Subject: Mathematics	**Year: Two**		**Option: LE**	
Topic Area: ANALYSIS			**Sub Topic: FUNCTIONS**	
Unit 1: Graphs and functions				**No. of periods: 24**
Key Unit competence: Apply graphical representation of functions in solving economics and financial models				
Learning objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Identify a function as a rule and recognize rules that are not functions. – Determine the domain and range of a function. – Find the even and odd parts of a function. – Perform operations on functions.	– Draw graphs that corresponds to linear, non-linear functions; – Find the slopes of linear functions and tangents to non-linear function by graphical analysis. – Use the slope of a linear demand function to calculate point elasticity – Analyze, model and solve problems involving linear or quadratic functions and interpret the results. – Interpret the meaning of functions with two independent variables: marginal revenue and marginal cost functions.	– Increase self-confidence and determination to appreciate and explain the importance of functions and how they are related or how are helpful to different event occurring in different domains.	– Generalities on numerical functions: • Definitions • Domain and range • Parity of a function (odd or even) – Graphical representation of linear and quadratic functions – Interpretation of functions in Economics and finance: • A linear demand functions and point elasticity. • marginal revenue, marginal cost functions and solutions to price discrimination and multi-plant monopoly problems.	– Study algebraically and graphically different simple functions. – Model or interpret the problems related to functions
Links to other subjects: *Economics (Use of polynomials to represent the cost of producing "x" units of a commodity, or marginal cost,)*				
Assessment criteria: *Use concepts and definitions of functions to determine the domain of Polynomial, Rational and Irrational functions and represent them graphically in simple cases…*				
Materials: *Graph Papers, ruler, Digital technology (including calculators,…)*				

Subject: Mathematics	Year: Two	Option: LE
Topic Area: ALGEBRA		Sub Topic: MATHEMATICAL LOGIC AND APPLICATIONS
Unit 2: Introduction to Logic		No. of periods: 24

Key Unit competence: Use mathematical logic as a tool of reasoning and decision making in daily life

Learning objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Convert into logical formula compound statement and vice versa – Draw the truth table of a compound statement; – define the most often used logical connectives and quantifiers; – give an example of hypothetical syllogism.	– Use mathematical logic to infer conclusion from given statement – Evaluate claims, issues and arguments, and identify mistakes in reasoning and prove the validity or invalidity of arguments in ordinary discourse. – Evaluate that a given logic statement is tautology or a contradiction.	– Show concern on the use of correct statements and well formulated decisions; – Observe situations and make appropriate decisions – Appreciate and act with thoughtfulness: grasp and demonstrate carefulness…	– Introduction and fundamental definitions • Logic • Statements and negation of statements (simple and compound) – Truth tables – Logical connectives and truth table • The Negation "**not**" • The Conjunction "**and**" • The Disjunction "**or**" • Conditional • Bi-conditional or Equivalence "**if and only if** " – Tautologies and Contradictions – Quantifiers and their negations • The universal quantifier "**for all**" • Existence "**there exists**" – Applications: • Hypothetical syllogism	– Practical: • Deduce if a given sentence is o or is not a statement; – Group investigation: • Make a research in advance in the library about syllogism and fallacy.

Assessment criteria: Use mathematical logic to organize scientific knowledge and as a tool of reasoning and argumentation in daily life

Links to other subjects: All languages

Resources: Manila paper, markers

<table>
<tr><td colspan="2">Subject: General Sciences and Mathematics</td><td colspan="2">Year: Two</td><td>Option: LE</td></tr>
<tr><td colspan="2">Topic Area: Geometry</td><td colspan="3">Sub Topic: Plane geometry</td></tr>
<tr><td colspan="4">Unit 3: Point, lines in 2D and geometric shapes</td><td>No. of periods: 24</td></tr>
<tr><td colspan="5">Key Unit competence: To be able to determine Algebraic representations Of lines and calculate the area of geometric shapes in 2D.</td></tr>
<tr><td colspan="3">Learning objectives</td><td rowspan="2">Content</td><td rowspan="2">Learning Activities</td></tr>
<tr><td>Knowledge and understanding</td><td>Skills</td><td>Attitudes and values</td></tr>
<tr><td>– Define the coordinate of a point in 2D.
– Define a straight line.
– List the geometric shapes in 2D</td><td>– Represent a point and a vector in 2D.
– Calculate the distance between two points in 2D and the mid - point of a segment in 2D.
– Determine the equations of a straight line (parametric equation, Cartesian equation).
– Perform operations to determine the intersection of lines.
– Calculate the area of geometric shapes in 2D.</td><td>- Appreciate that a point is a fixed position in a plane.
- Be accurate in representations and calculations.
- Manifest a satisfaction that geometric shapes are made by the intersection of lines in 2D.</td><td>– Points in 2D: Cartesian coordinates of a point, Distance between two points, Mid-points of a line segment.
– Lines in 2D:
– Parametric equation and Cartesian equation given:
• Direction vector.
• 2 points.
• Gradient
– Problems on points and straight lines in 2D: Positions, Angles, Distance.
– Geometric shapes in 2D.</td><td>– Group discussion: on the distance between two points.
– Making a representation of plane points and straight lines in a Cartesian.
– Making a representation on graph paper of some chosen points, lines and determine their parametric or Cartesian equations.
– Exercising the calculation of the area of geometric shapes in 2D.</td></tr>
<tr><td colspan="5">Assessment criteria: Represent lines and calculate the area in 2D.</td></tr>
<tr><td colspan="5">Links to other subjects: Social studies; Mathematics (primary level); construction.</td></tr>
<tr><td colspan="5">Resources: Manila paper, graph paper, geometric instruments, ruler, model of geometric shapes in 2D, digital technology including calculators, computer, projector and internet.</td></tr>
</table>

5.3. Mathematics syllabus units for year 3

5.3.1. Key competences for end of year 3

After completion of year three, the mathematics syllabus will help the student-teachers to:

- Use statistical skills to interpret students' school reports, statistical data with two variables from different reference books, journals and relevant scientific documents.
- Apply counting techniques and concepts of probability to determine the probability of possible outcomes of events occurring in real life.

5.3.2. Syllabus units for year 3

<table>
<tr><td colspan="2">Subject: Mathematics</td><td colspan="2">Year: Three</td><td>Option: LE</td></tr>
<tr><td colspan="4">Topic Area: STATISTICS AND PROBABILITY</td><td>Sub Topic: DESCRIPTIVE STATISTICS</td></tr>
<tr><td colspan="4">Unit 1: Bi-variate statistics</td><td>No. of periods: 24</td></tr>
<tr><td colspan="5">Key Unit competence: Extend understanding, analysis and interpretation of bivariate data to correlation coefficients and regression lines</td></tr>
<tr><td colspan="3">Learning objectives</td><td rowspan="2">Content</td><td rowspan="2">Learning Activities</td></tr>
<tr><td>Knowledge and understanding</td><td>Skills</td><td>Attitudes and values</td></tr>
<tr><td>– Define bi-variate data
– Draw scatter diagram
– Identify type of correlation on a scatter diagram
– Make a frequency distribution table of collected bivariate data
– Define the covariance, coefficient of correlation and regression lines.
– Determine the coefficient of correlation, covariance and regression lines of bivariate data of dispersion of a given statistical series.</td><td>– Interpret the scatter diagram for bivariate data.
– Analyze a scatter diagram and infer conclusion.
– Apply the coefficient of correlation and standard deviation as the more convenient measure of the variability in the interpretation of statistical data.
– Analyze, interpret data critically then infer conclusion</td><td>– Appreciate the importance of regression lines and coefficient of correlation
– Predict event e.g after analyzing the population growth of a given country, we can make a decision about the future generation.</td><td>– Bivariate data and Scatter diagram
– Types of correlation: Positive and negative correlations
– Covariance
– Correlation coefficient of bivariate data
– Regression lines
– Applications: Data analysis, interpretation and prediction problems in various areas (Business, Geography, Demography …)</td><td>– Learners discuss in groups, the correlation between class results and rank in school for example. They investigate them, they analyze the relationship between them, and check how the coefficient of correlation reflects the amount of variability that is shared between them and what they have in common. They finally infer conclusion.
– Learners plot visually data on scatter diagram or scatter plot to represent a correlation between two variable.
– Analyze the graph, infer conclusion using coefficient of correlation to make predictions about the variables studied.</td></tr>
<tr><td colspan="5">Links to other subjects: Geography (spatial statistics research, Air pollution in different year, Demography (Population growth,…)</td></tr>
<tr><td colspan="5">Assessment criteria: Extend understanding, analysis and interpretation of bivariate data to correlation coefficients and regression lines</td></tr>
<tr><td colspan="5">Materials: Geometric instruments (ruler, T-square, compass), graph papers, digital technology including calculators</td></tr>
</table>

<table>
<tr><td colspan="3">Subject: Mathematics</td><td>Year: Three</td><td>Option: LE</td></tr>
<tr><td colspan="3">Topic Area: STATISTICS AND PROBABILITY</td><td colspan="2">Sub Topic: PROBABILITY</td></tr>
<tr><td colspan="4">Unit 2: Elementary probability</td><td>No. of periods: 24</td></tr>
<tr><td colspan="5">Key Unit competence: Use counting techniques and concepts of probability to determine the probability of possible outcomes of events occurring under equally likely assumptions.</td></tr>
<tr><td colspan="3">Learning objectives</td><td>Content</td><td>Learning Activities</td></tr>
<tr><td></td><td>Skills</td><td>Attitudes and values</td><td></td><td></td></tr>
<tr><td>– Define the terms : probability, sample space and event,
– Give the formula of classical probability
– Explain the basic probability rules,
– Distinguish mutually exclusive and non-exclusive events.</td><td>– Determine and explain expectations from an experiment with possible outcomes;
– Use properties of probability to calculate the number of possible outcomes of occurring events under equally likely assumptions;
– Calculate the probability of an event</td><td>– Appreciate the use of probability as a measure of chance.
– Show concern for taking or not taking risk when engaged in games of chance such as card games, betting, slot machines or lotteries.</td><td>• Concepts of probability: Random experiment, Sample space, Event, Probability of event
• Counting techniques: Venn diagram, Tree diagrams, Contingency table, Multiplication principles, Arrangements with or without repetition Permutations with or without repetition, Combination
• Determination of the probability of events: formula and properties, probability of mutually exclusive or non exclusive events and the addition rule, probability of independent events and the multiplication rule.</td><td>– In groups, discuss the advantages and disadvantages of betting and present the findings to the class;
– Conducting the probability experiments (flipping a coin once, rolling one die once, toss two coins, answer a true or false question, rolling two dice, drawing one card from an ordinary deck of cards, gender of children for a family with 3 children, etc.) discuss possible outcomes/events.
– Using real life tasks (games, number of trials,…) , discuss and asked to determine the probability of having well described events.</td></tr>
<tr><td colspan="5">Assessment criteria: Apply concepts of probability in real life.</td></tr>
<tr><td colspan="5">Links to other subjects: All subjects</td></tr>
<tr><td colspan="5">Resources: Dice, coins, cards, Manila paper, graph paper, ruler, digital technology including calculators, videos for games, etc.</td></tr>
</table>

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ANNEXES

Annex 1: TTC Subjects and time allocation

SN	Subject	Number of Periods							
		ECLPE		SSE		SME		LE	
		Y1	**Y2 & 3**	Y1	Y2 & 3	Y1	Y2 & 3	Y1	Y2 & 3
1	Foundations of Education	6	6	6	5	6	5	6	5
2	English	5	5	5	4	5	4	7	7
3	Kinyarwanda	5	5	2	2	2	2	5	6
4	Mathematics	3	3	3	3	6	6	2	2
5	Integrated Science	4	4	1	1	11	0	1	1
6	Physics	0	0	0	0	0	5	0	0
7	Biology	0	0	0	0	0	5	0	0
8	Chemistry	0	0	0	0	0	5	0	0
9	Social Studies	4	4	11	0	2	2	2	2
10	History	0	0	0	5	0	0	0	0
11	Geography	0	0	0	5	0	0	0	0
12	Economics	0	0	0	5	0	0	0	0
13	Creative Performance (Music and Fine Arts)	4	4	4	4	2	2	4	4
14	Physical Education	1	1	2	1	1	1	1	1

15	Entrepreneurship	2	2	2	2	2	2	2	2
16	ICT	2	2	2	2	2	2	2	2
17	TMP	7	7	4	4	6	4	4	4
18	SNE	2	2	2	2	2	2	2	2
19	Religious Education	1	1	4	3	1	1	1	1
20	French	4	4	2	2	2	2	7	7
21	Kiswahili	1	1	1	1	1	1	5	5
22	Co-Curricular	1	1	1	1	1	1	1	1
23	Individual Study	8	8	8	8	8	8	8	8
24	School Attachment	Year 3 (first term)							
	TOTAL	60	60	60	60	60	60	60	60

Annex 2: MATHEMATICS Subject overview

TOPIC AREA	SUB-TOPC AREA	Competences		
		Y1	Y2	Y3
Algebra	Numbers and operations	Apply arithmetic operations to solve simple real life problems		
Algebra	Equations and inequalities	Model and solve daily life problems using linear, quadratic equations or inequalities		
Analysis	Functions		Apply graphical representation of function to model economical and financial problems	
Geometry	Plane geometry		Determine Algebraic representations of lines and calculate the area of geometric shapes in 2D.	
Algebra	Logics		Use logical statements to express appropriate decisions.	
Statistics and probability	Descriptive statistics	Analyze and interpret simple statistical data from daily life situations.		Extend understanding, analysis and interpretation of bi-variate data to correlation coefficients and regression lines.
Statistics and probability	Probability			Use counting techniques and concepts of probability to determine the probability of possible outcomes of events occurring in real life