

TEACHING METHODS AND PRACTICE OF MATHEMATICS FOR TTCs

TUTOR'S GUIDE

OPTIONS

- Science and Mathematics Education (**SME**)
- Early Childhood and Lower Primary Education (**ECLPE**)

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FOREWORD

Dear Tutor,

Rwanda Basic Education Board is honoured to present the tutor's guide which serves as a guide to competence-based teaching and learning to ensure consistency and coherence in the learning of the mathematics teaching methods and practices' content. The Rwandan educational philosophy is to ensure that learners achieve full potential at every level of education which will prepare them to be well integrated in society and exploit employment opportunities.

Specifically, TTC curriculum was reviewed to train quality teachers who will confidently and efficiently implement the Competence Based Curriculum 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.

In line with efforts to improve the quality of education, the government of Rwanda emphasizes the importance of aligning teaching and learning materials with the syllabus to facilitate their learning process. Many factors influence what they learn, how well they learn and the competences they acquire. Those factors include the relevance of the specific content, the quality of teachers' pedagogical approaches, the assessment strategies and the instructional materials.

The ambition to develop a knowledge-based society and the growth of regional and global competition in the jobs market has necessitated the shift to a competence-based curriculum. After a successful shift from knowledge to a competence based curriculum in general education, TTC textbooks also were revised to align them to the new curriculum. The aim is to prepare teachers who are competent and confident to implement CBC in pre-primary and primary education.

The book provides active teaching and learning techniques that engage student teachers to develop competences. In view of this, your role is to:

- Plan your lessons and prepare appropriate teaching materials.
- Organize group discussions for students considering the importance of social constructivism suggesting that learning occurs more effectively when the students works collaboratively with more knowledgeable and experienced people.

- Engage students through active learning methods such as inquiry methods, group discussions, research, investigative activities and group and individual work activities.
- Provide supervised opportunities for students to develop different competences by giving tasks which enhance critical thinking, problem solving, research, creativity and innovation, communication and cooperation.
- Support and facilitate the learning process by valuing students' contributions in the class activities.
- Guide students towards the harmonization of their findings.
- Encourage individual, peer and group evaluation of the work done in the classroom and use appropriate competence-based assessment approaches and methods.

To facilitate you in your teaching activities, the content of this book is self explanatory so that you can use it easily. It is divided in 2 parts:

The part 1 explains the structure of this book and gives you the methodological guidance;

The part 2 details the teaching guidance for each concept given in the student book.

Even though this Teacher's guide contains the guidance on solutions for all activities given in the learner's book, you are requested to work through each question before judging student's findings.

I wish to sincerely express my appreciation to the people who contributed towards the development of this book, particularly, 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 activities.

Dr. MBARUSHIMANA Nelson
Director General, REB

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Joan MURUNGI

Head of CTLR Department

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PART I. GENERAL INTRODUCTION

1.1 The structure of the guide

The tutor's guide of Mathematics teaching and practice is composed of two parts.

The Part 1 concerns general introduction that discusses methodological guidance on how best to teach and learn Mathematics teaching methods and practices (TMP), developing competences in teaching and learning, addressing cross-cutting issues in teaching and learning and Guidance on assessment.

Part 2 is about the structure of a unit and the structure of a lesson. This includes information related to the different components of the unit and these components are the same for all units. This part provides information and guidelines on how to facilitate student teachers while working on learning activities. All application activities from the textbook have answers in this part.

1.2 Methodological guidance

1.2.1 Developing competences

Since 2015 Rwanda shifted from a knowledge based to a competency-based curriculum for pre-primary, primary, secondary education and recently the TTC curriculum. This called for changing the way of learning by shifting from teacher centred to a learner centred approach. Teachers are not only responsible for knowledge transfer but also for fostering learners' learning achievement and creating safe and supportive learning environment. It implies also that learners have to demonstrate what they are able to transfer the acquired knowledge, skills, values and attitude to new situations.

The competence-based curriculum employs an approach of teaching and learning based on discrete skills rather than dwelling on only knowledge or the cognitive domain of learning. It focuses on what learner can do rather than what learner knows. Learners develop competences through subject unit with specific learning objectives broken down into knowledge, skills and attitudes through learning activities.

In addition to the competences related to Mathematics Teaching Methods and Practice, student teachers also develop generic competences which should promote the development of the higher order thinking skills and

professional skills in Mathematics teaching. Generic competences are developed throughout all units of TMP as follows:

Generic competences	Ways of developing generic competences
Critical thinking	All activities that require learners to convert, interpret, analyze, compare and contrast, etc have a common factor of developing critical thinking into learners
Creativity and innovation	All activities that require learners to plot a graph given algebraic data have a common character of developing creativity into learners
Research and problem solving	All activities that require learners to make a research and apply their knowledge to the real-life situation have a character of developing research and problem solving into learners.
Communication	During Mathematics class, all activities that require learners to discuss either in groups or in the whole class, present findings, debate ...have a common character of developing communication skills into learners.
Co-operation, interpersonal relations and life skills	All activities that require learners to work in pairs or in groups have character of developing cooperation and life skills among learners.
Lifelong learning	All activities that are connected with research have a common character of developing into learners a curiosity of applying the learnt knowledge in a range of situations. The purpose of such kind of activities is for enabling learners to become life-long learners who can adapt to the fast-changing world and the uncertain future by taking initiative to update knowledge and skills with minimum external support.
Professional skills	Specific instructional activities and procedures that a teacher may use in the class room to facilitate, directly or indirectly, pupils to be engaged in learning activities. These include a range of teaching skills: the skill of questioning, reinforcement, probing, explaining, stimulus variation, introducing a lesson; illustrating with examples, using blackboard, silence and non verbal cues, using audio – visual aids, recognizing attending behaviour and the skill of achieving closure.

The generic competences help learners deepen their understanding of Mathematics teaching methods and practice and apply their knowledge in a range of situations. As students develop generic competences they also acquire the set of skills that employers look for in their employees, and so the generic competences prepare students for the world of work.

1.2.2 Addressing cross cutting issues

Among the changes brought by the competence-based curriculum is the integration of cross cutting issues as an integral part of the teaching learning process-as they relate to and must be considered within all subjects to be appropriately addressed. The eight cross cutting issues identified in the national curriculum framework are: *Comprehensive Sexuality Education, Environment and Sustainability, Financial Education, Genocide studies, Gender, Inclusive Education, Peace and Values Education, and Standardization Culture.*

Some cross-cutting issues may seem specific to particular learning areas/ subjects but the teacher need to address all of them whenever an opportunity arises. In addition, learners should always be given an opportunity during the learning process to address these cross-cutting issues both within and out of the classroom.

Below are examples of how crosscutting issues can be addressed:

Cross-Cutting Issue	Ways of addressing cross-cutting issues
<p>Comprehensive Sexuality Education: The primary goal of introducing Comprehensive Sexuality Education program in schools is to equip children, adolescents, and young people with knowledge, skills and values in an age appropriate and culturally gender sensitive manner so as to enable them to make responsible choices about their sexual and social relationships, explain and clarify feelings, values and attitudes, and promote and sustain risk reducing behaviour.</p>	<p>Using different charts and their interpretation, TMP tutor should lead students to discuss the following situations: “Alcohol abuse and unwanted pregnancies” and advise student teachers on how they can instil learners to fight those abuses.</p>

<p>Environment and Sustainability: Integration of Environment, Climate Change and Sustainability in the curriculum focuses on and advocates for the need to balance economic growth, society well-being and ecological systems. Learners need basic knowledge from the natural sciences, social sciences, and humanities to understand to interpret principles of sustainability.</p>	<p>Using Real life models or students' experience, TMP Tutor should lead students to illustrate the situation of "population growth" and discuss its effects on the environment and sustainability.</p>
<p>Financial Education: The integration of Financial Education into the curriculum is aimed at a comprehensive Financial Education program as a precondition for achieving financial inclusion targets and improving the financial capability of Rwandans so that they can make appropriate financial decisions that best fit the circumstances of one's life.</p>	<p>Through different examples and calculations on interest rate problems, TMP Tutor can lead learners to discuss how to make appropriate financial decisions.</p>
<p>Gender: At school, gender will be understood as family complementarities, gender roles and responsibilities, the need for gender equality and equity, gender stereotypes, gender sensitivity, etc.</p>	<p>TMP Tutor should address gender as cross-cutting issue through assigning leading roles in the management of groups to both girls and boys and providing equal opportunity in the lesson participation and avoid any gender stereotype in the whole teaching and learning process.</p>
<p>Inclusive Education: Inclusion is based on the right of all learners to a quality and equitable education that meets their basic learning needs and understands the diversity of backgrounds and abilities as a learning opportunity.</p>	<p>Firstly, TMP Tutors need to identify/recognize students with special needs. Then by using adapted teaching and learning resources while conducting a lesson and setting appropriate tasks to the level of students, they can cater for students with special education needs. They must create opportunity where student teachers can discuss how to cater for learners with special educational needs.</p>

<p>Peace and Values Education: Peace and Values Education (PVE) is defined as education that promotes social cohesion, positive values, including pluralism and personal responsibility, empathy, critical thinking and action in order to build a more peaceful society.</p>	<p>Through a given lesson, a tutor should:</p> <p>Set a learning objective which is addressing attitudes and values,</p> <p>Encourage students to develop the culture of tolerance during discussion and to be able to instil it in pupils at primary school;</p> <p>Encourage learners to respect ideas for others.</p>
<p>Standardization Culture: Standardization Culture in Rwanda will be promoted through formal education and plays a vital role in terms of health improvement, economic growth, industrialization, trade and general welfare of the people through the effective implementation of Standardization, Quality Assurance, Metrology and Testing.</p>	<p>With different word problems related to the effective implementation of Standardization, Quality Assurance, Metrology and Testing, students can be motivated to be aware of health improvement, economic growth, industrialization, trade and general welfare of the people.</p>

1.2.3 Guidance on how to help learners with special education needs in classroom

In the classroom, students learn in different way depending to their learning pace, needs or any other special problem they might have. However, the teacher has the responsibility to know how to adopt his/her methodologies and approaches in order to meet the learning need of each student in the classroom. Also teachers need to understand that student with special needs, need to be taught differently or need some accommodations to enhance the learning environment. This will be done depending to the subject and the nature of the lesson.

In order to create a well-rounded learning atmosphere, teachers need to:

- Remember that learners learn in different ways so they have to offer a variety of activities (e.g. role-play, music and singing, word games and quizzes, and outdoor activities);
- Maintain an organized classroom and limits distraction. This will help learners with special needs to stay on track during lesson and follow instruction easily;

- Vary the pace of teaching to meet the needs of each child. Some learners process information and learn more slowly than others;
- Break down instructions into smaller, manageable tasks. Learners with special needs often have difficulty understanding long-winded or several instructions at once. It is better to use simple, concrete sentences in order to facilitate them understand what you are asking.
- Use clear consistent language to explain the meaning (and demonstrate or show pictures) if you introduce new words or concepts;
- Make full use of facial expressions, gestures and body language;
- Pair a learner who has a disability with a friend. Let them do things together and learn from each other. Make sure the friend is not over protective and does not do everything for the one with disability. Both learners will benefit from this strategy;
- Use multi-sensory strategies. As all learners learn in different ways, it is important to make every lesson as multi-sensory as possible. Learners with learning disabilities might have difficulty in one area, while they might excel in another. For example, use both visual and auditory cues.

Below are general strategies related to each main category of disabilities and how to deal with every situation that may arise in the classroom. However, the list is not exhaustive because each child is unique with different needs and that should be handled differently.

Strategy to help learners with developmental impairment:

- Use simple words and sentences when giving instructions;
- Use real objects that learners can feel and handle. Rather than just working abstractly with pen and paper;
- Break a task down into small steps or learning objectives. The learner should start with an activity that he/she can do already before moving on to something that is more difficult;
- Gradually give the learner less help;
- Let the learner with disability work in the same group with those without disability.

Strategy to help learners with visual impairment:

- Help learners to use their other senses (hearing, touch, smell and taste) and carry out activities that will promote their learning and development;
- Use simple, clear and consistent language;
- Use tactile objects to help explain a concept;
- If the learner has some sight, ask him/her what he/she can see;

- Make sure the learner has a group of friends who are helpful and who allow him/her to be as independent as possible;
- Plan activities so that learners work in pairs or groups whenever possible;

Strategy to help learners with hearing disabilities or communication difficulties

- Always get the learner’s attention before you begin to speak;
- Encourage the learner to look at your face;
- Use gestures, body language and facial expressions;
- Use pictures and objects as much as possible.
- Keep background noise to a minimum.

Strategies to help learners with physical disabilities or mobility difficulties:

- Adapt activities so that learners who use wheelchairs or other mobility aids, can participate.
- Ask parents/caregivers to assist with adapting furniture.

e.g: The height of a table may need to be changed to make it easier for a learner to reach it or fit their legs or wheelchair under.

- Encourage peer support when needed;
- Get advice from parents or a health professional about assistive devices if the learner has one.

Adaptation of assessment strategies:

At the end of each unit, the tutor is advised to provide additional activities to help students achieve the key unit competence. These assessment activities are for remedial, consolidation and extension designed to cater for the needs of all categories of students; slow, average and gifted students respectively. Therefore, the tutor is expected to do assessment that fits individual student.

Remedial activities	<p>After evaluation, slow students are provided with lower order thinking activities related to the learnt concepts to facilitate them in their learning.</p> <p>These activities can also be given to assist deepening knowledge acquired through the learning activities for slow students.</p>
Consolidation activities	<p>After introduction of any concept, a range number of activities can be provided to all students to enhance/ reinforce learning.</p>

Extended activities	After evaluation, gifted and talented students can be provided with high order thinking activities related to the concepts learnt to make them think deeply and critically. These activities can be assigned to gifted and talented students to keep them working while other students are getting up to required level of knowledge through the learning activity.
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1.2.4. Guidance on assessment

Assessment is an integral part of teaching and learning process. The main purpose of assessment is for improvement of learning outcomes. Assessment for learning/ Continuous/ formative assessment intends to improve students' learning and tutor's teaching whereas assessment of learning/ summative assessment intends to improve the entire school's performance and education system in general.

Continuous/ formative assessment

It is an on-going process that arises during the teaching and learning process. It includes lesson evaluation and end of sub unit assessment. This formative assessment should play a big role in teaching and learning process. The teacher should encourage individual, peer and group evaluation of the work done in the classroom and uses appropriate competence-based assessment approaches and methods.

Formative assessment is used to:

- Determine the extent to which learning objectives are being achieved and competences are being acquired and to identify which students need remedial interventions, reinforcement as well as extended activities. The application activities are developed in the learner book and they are designed to be given as remedial, reinforcement, end lesson assessment, homework or assignment
- Motivate students to learn and succeed by encouraging students to read, or learn more, revise, etc.
- Check effectiveness of teaching methods in terms of variety, appropriateness, relevance, or need for new approaches and strategies. TMP tutors need to consider various aspects of the instructional process including appropriate language levels, meaningful examples, suitable methods and teaching aids/ materials, etc.
- Help students to take control of their own learning.

In teaching TMP, formative or continuous assessment should compare performance against instructional objectives. Formative assessment should measure the student's ability with respect to a criterion or standard. For this reason, it is used to determine what students can do, rather than how much they know.

Summative assessment

The assessment can serve as summative and informative depending to its purpose. The end unit assessment will be considered summative when it is done at end of unit and want to start a new one.

It will be formative assessment, when it is done in order to give information on the progress of learners and from there decide what adjustments need to be done.

The assessment done at the end of the term, end of year, is considered as summative assessment so that the teacher, school and parents are informed of the achievement of educational objective and think of improvement strategies. There is also end of level/ cycle assessment in form of national examinations.

When carrying out assessment?

Assessment should be clearly visible in lesson, unit, term and yearly plans.

- Before learning (diagnostic): At the beginning of a new unit or a section of work; assessment can be organized to find out what students already know / can do, and to check whether the students are at the same level.
- During learning (formative/continuous): When students appear to be having difficulty with some of the work, by using on-going assessment (continuous). The assessment aims at giving students support and feedback.
- After learning (summative): At the end of a section of work or a learning unit, the TMP Tutor has to assess after the learning. This is also known as Assessment of Learning to establish and record overall progress of students towards full achievement. Summative assessment in Rwandan schools mainly takes the form of written tests at the end of a learning unit or end of the month, and examinations at the end of a term, school year or cycle.

Instruments used in assessment.

Observation: This is where the TMP tutor gathers information by watching students interacting, conversing, working, playing, etc. A tutor

can use observations to collect data on behaviours that are difficult to assess by other methods such as attitudes, values, and generic competences and intellectual skills. It is very important because it is used before the lesson begins and throughout the lesson since the tutor has to continue observing each and every activity.

- Questioning

- a) Oral questioning: a process which requires a student to respond verbally to questions
- b) Class activities/ exercise: tasks that are given during the learning/teaching process
- c) Short and informal questions usually asked during a lesson
- d) Homework and assignments: tasks assigned to students by their tutors to be completed outside of class.

Homework assignments, portfolio, project work, interview, debate, dramatic reading, science fair or science project, etc are also the different forms/instruments of assessment.

1.2.5. Teaching methods and techniques that promote active learning

The different learning styles mentioned above can be catered for, if the teacher uses active learning whereby learners are really engaged in the learning process.

The main teaching methods used in mathematics are the following:

- **Dogmatic method** (the teacher tells the students what to do? What to observe? How to attempt? How to conclude?)
- **Inductive-deductive method:** Inductive method is to move from specific examples to generalization and deductive method is to move from generalization to specific examples.
- **Analytic-synthetic method:** Analytic method proceeds from unknown to known, 'Analysis' means 'breaking up' of the problem in hand so that it ultimately gets connected with something obvious or already known. Synthetic method is the opposite of the analytic method. Here one proceeds from known to unknown.
- **Laboratory method:** Laboratory method is based on the maxim "learning by doing." It is a procedure for stimulating the activities of the students and to encourage them to make discoveries through practical activities.

• **Problem solving method, Project method and Seminar Method.**

The following are some active techniques to be used in Mathematics:

- Group work
- Research
- Probing questions
- Practical activities (drawing, plotting, interpreting graphs)
- Modelling
- Brainstorming
- Quiz Technique
- Discussion Technique
- Scenario building Technique

What is active learning?

Active learning is a pedagogical approach that engages learners in doing things and thinking about the things they are doing. Learners are key in the active learning process. They are not empty vessels to fill but people with ideas, capacity and skills to build on for effective learning. Thus, in active learning, learners are encouraged to bring their own experience and knowledge into the learning process.

The role of the teacher in active learning	The role of learners in active learning
<ul style="list-style-type: none"> - The teacher engages learners through active learning methods such as inquiry methods, group discussions, research, investigative activities, group and individual work activities. - He/she encourages individual, peer and group evaluation of the work done in the classroom and uses appropriate competence-based assessment approaches and methods. - He provides supervised opportunities for learners to develop different competences by giving tasks which enhance critical thinking, problem solving, research, creativity and innovation, communication and cooperation. - Teacher supports and facilitates the learning process by valuing learners' contributions in the class activities. 	<ul style="list-style-type: none"> - A learner engaged in active learning: - Communicates and shares relevant information with peers through presentations, discussions, group work and other learner-centred activities (role play, case studies, project work, research and investigation); - Actively participates and takes responsibility for his/her own learning; - Develops knowledge and skills in active ways; - Carries out research/ investigation by consulting print/online documents and resourceful people, and presents their findings; - Ensures the effective contribution of each group member in assigned tasks through clear explanation and arguments, critical thinking, responsibility and confidence in public speaking - Draws conclusions based on the findings from the learning activities.

Main steps for a lesson in active learning approach

All the principles and characteristics of the active learning process highlighted above are reflected in steps of a lesson as displayed below. Generally, the lesson is divided into three main parts whereby each one is divided into smaller steps to make sure that learners are involved in the learning process. Below are those main part and their small steps:

1) Introduction

Introduction is a part where the teacher makes connection between the current and previous lesson through appropriate technique. The teacher opens short discussions to encourage learners to think about the previous learning experience and connect it with the current instructional objective. The teacher reviews the prior knowledge, skills and attitudes which have a link with the new concepts to create good foundation and logical sequencings.

2) Development of the new lesson

The development of a lesson that introduces a new concept will go through the following small steps: discovery activities, presentation of learners' findings, exploitation, synthesis/summary and exercises/application activities.

• Discovery activity

Step 1

- The teacher discusses convincingly with learners to take responsibility of their learning
- He/she distributes the task/activity and gives instructions related to the tasks (working in groups, pairs, or individual to instigate collaborative learning, to discover knowledge to be learned)

Step 2

- The teacher let learners work collaboratively on the task;
- During this period the teacher refrains to intervene directly on the knowledge;
- He/she then monitors how the learners are progressing towards the knowledge to be learned and boosts those who are still behind (but without communicating to them the knowledge).

• Presentation of learners' findings/productions

- In this episode, the teacher invites representatives of groups to present their productions/findings.
- After three/four or an acceptable number of presentations, the teacher decides to engage the class into exploitation of learners' productions.

• Exploitation of learner's findings/ productions

- The teacher asks learners to evaluate the productions: which ones are correct, incomplete or false

- Then the teacher judges the logic of the learners' products, corrects those which are false, completes those which are incomplete, and confirms those which are correct.

• **Institutionalization or harmonization (summary/conclusion/ and examples)**

- The teacher summarizes the learned knowledge and gives examples which illustrate the learned content.

• **Application activities**

- Exercises of applying processes and products/objects related to learned unit/sub-unit

- Exercises in real life contexts

- Teacher guides learners to make the connection of what they learnt to real life situations. At this level, the role of teacher is to monitor the fixation of process and product/object being learned.

3) Assessment

In this step the teacher asks some questions to assess achievement of instructional objective. During assessment activity, learners work individually on the task/activity. The teacher avoids intervening directly. In fact, results from this assessment inform the teacher on next steps for the whole class and individuals. In some cases, the teacher can end with a homework/ assignment. Doing this will allow learners to relay their understanding on the concepts covered that day. Teacher leads them not to wait until the last minute for doing the homework as this often results in an incomplete homework set and/or an incomplete understanding of the concept.

PART II: UNIT DEVELOPMENT

1.1 Key unit competence

Explain the essence of teaching Mathematics in primary and how Mathematical skills are applied in everyday life.

1.2 Prerequisite

Students will perform well in this unit if they have a good background on: The importance of mathematics in daily life, Mathematics topics covered in primary level (P1 –P6), having the ability to work as a team, ability to search on a topic and to compile the findings.

1.3 Guidance on the introductory activity

- Let Student teachers use primary mathematics syllabus, internet or any other documents to carry out a research and discuss the rationale (importance) of learning and teaching mathematics in primary education through your support and guidance.
- Through questions, answers and presentation of findings, student teachers share what they discussed about the components of the primary syllabus and the role of each main part of the syllabus.
- Harmonize students' answers by correcting some misconceptions if any and try to arouse their curiosity on the main points that will be learnt in this unit.

Note:

Answers to be provided will be different depending on the student's background. As a tutor, you will verify whether each topic mentioned by students is taught in primary level.

1.4 List of lessons /Sub-topics

#	Lesson title	Learning objectives	Number of periods	
			SME	ECLPE
1	Rationale of teaching and learning Mathematics in basic education.	Explain the role of mathematics in real life and the importance of learning mathematics in primary levels.	2	1
2	Description and role of primary mathematics syllabus components.	<ul style="list-style-type: none"> - Describe the components of Mathematics syllabus for lower or upper primary and formulate the role of each component. - Show cooperative skills and display a teamwork spirit when carrying out different activities. 	2	1
	Assessment		1	1

1.5 Guidance on different lessons

Lesson 1: Rationale of teaching and learning Mathematics in basic education

a) Learning activities

Explain the role of mathematics in real life and the importance of learning mathematics in primary levels

b) Teaching resources

Lower and Upper Primary mathematics syllabus, student's books from P1 to P6, ICT tools including internet where applicable for exploring the rationale of teaching and learning mathematics in primary level.

c) Learning activities

- Form groups of students-teachers and give them instructions on how to do the *activity 1.1* where they have to carry out a research in the

library or on internet and discuss the rationale of learning and teaching mathematics in primary education.

- Visit each group and guide them to stay on the track and provide required instructions.
- Invite some group members to present their findings for a whole class discussion.
- Guide students to summarize the role of mathematics and the reason why we teach mathematics in primary education (see the summary content for student's book).

Possible answers for activities

Activity 1.1

Students can show the importance of mathematics in their real life situation leading to the following:

- Business and industry depends upon the knowledge of Mathematics; the change in the social structure with regards to the modern facilities like mode of transport, means of communication and progress in the field of science and technology is due to Mathematics as well;
- Mathematics teaching is very important for intellectual developments. Mathematics is one of the subjects which makes students' brain active;
- Mathematics helps to prepare students for technical and other vocations such as engineering, architecture, accountancy, banking, business, agriculture, tailoring, carpentry, surveying, office management related courses...
- Mathematics develops the skills of reflection.

This leads to the conclusion that life without any knowledge of calculation, computation or in other words mathematics can fail. Therefore, through CBC, Mathematics is being taught in all levels of Basic Education, from Pre-primary to Secondary education, for the ambition of developing a knowledge-based and technology-led economy in Rwanda, since it provides to students all required knowledge, skills and attitudes to be used in different learning areas and in real life situations.

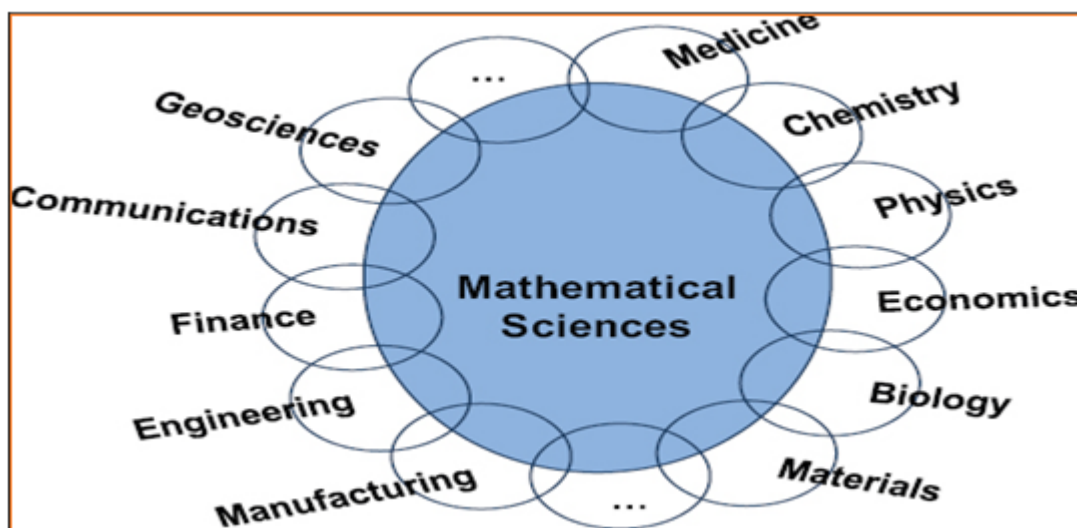
Application activity 1.1

1. Five examples where mathematics is useful for student teachers in everyday life:

In brief, simple Mathematics comes to play a role as almost everywhere we are, we do the simple calculations at the back of our mind.

Firstly, God used beautifully mathematics for creating the world from the first day to the seventh day. Besides the business analysts need to be competent in mathematics, we all require mathematics to calculate our targets, salaries, etc.

Mathematics is the language of science and engineering and it describes our understanding of all that we observe. It is used in physics extensively, in graphics structurally, in civil engineering practically. We require engineering mathematics in bridge construction, army, aeronautics, nuclear research work.



The above explanation can be extended. Student-teachers can be asked to interpret the above diagram and write a compiled document on the role of Mathematics.

Finally, Mathematics is more important because:

1. It is a powerful tool for solving problems within and beyond mathematics;
2. It is a significant part of the cultural heritage of many diverse societies;
3. Provides students with a powerful, precise and concise means of communication;
4. Supports concurrent learning in other key learning area,
5. Builds a sound foundation for further mathematics educators;
6. Mathematics 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 and in scientific research.

2. Using examples explain why Mathematics is important to the primary school learner:

Primary learners need mathematics as they must do different activities in their daily life that involve Mathematics: From getting up in early hours of the day to the ringing of an alarm, reading time on a watch, rounding a date on a calendar, picking up the phone, preparing a recipe in the kitchen, manage the money, travel to some place, to exchange currency at a ticket outlet while availing a public conveyance or checking up the mileage of a car, halting at the filling station, attending to a roll call at school, getting scores in the class exams, even to meet new friends they do the simple calculations for the time to spend there, etc.

The first and most obvious aim is for children to gain knowledge that is useful. To get the fullest benefit children should be:

- Learning basic Mathematics skills and numeracy and the ability to apply them in everyday situations such as shopping and the world of work;
- Learning to solve a wide range of problems, including practical problems;
- Understanding mathematical concepts as a basis for further study in mathematics and other subjects, including information technology;
- Learning to use mathematics as part of citizenship, as part of a critical understanding of society and the issues of social justice, the environment, etc. This involves being able to look critically at statistical claims and graphs in advertising, political claims, etc.
- Learning to successfully use their mathematical knowledge and skills in tests and examinations, to give them the qualifications they need for employment and further study and training.

These are already ambitious aims which go beyond the basic uses that many have in mind for mathematics. However, these skills are needed to prepare learners for the advanced post industrial world of the twenty first century and the social and environmental problems it will bring.

Second, we must aim for learners to gain and grow personally as individuals from the study of mathematics. Learners should be:

- Gaining confidence in their own mathematical skills and capabilities;
- Learning to be creative and express themselves through mathematics, including exploring and applying mathematics in their own hobbies, interests and projects.

3. Mathematics topics that are more important for primary school learners: students will give different answers but help them to conclude that all topics are very important as they have a major role to play in their life experience.

Lesson 2: Description and role of Primary Mathematics syllabus components

a) Learning objectives

- Describe the components of Mathematics syllabus for lower or upper primary and formulate the role of each component.
- Show cooperative skills and display a teamwork spirit when carrying out different activities.

b) Teaching resources

Lower or upper Primary mathematics syllabus, learner's books and teacher's guides from P1 to P6, Curriculum framework for general education.

c) Learning activities

- Form groups of student teachers and explain them the activity of the day, ask them to take learning materials and go through the *activity 1.2* where student teachers will identify main components of primary mathematics syllabus.
- Circulate in all groups and facilitate students to explore the syllabus by highlighting preliminary pages, the syllabus units and their components.
- Invite some students from each group to present their findings for whole class discussion.
- Guide student teachers to conclude on the role of the main components of the syllabus (Introduction, Pedagogical approach, Assessment approach, Resource, Syllabus units and References) and decide who uses the syllabi, when and how to use them it.
- Assign students to work out individually or in pairs the *application activity 1.2* for the assessment.

Possible answers for activities

Activity 1.2:

Check answers in the summary content for the student's book or in the syllabus for primary Mathematics.

Main components of lower or upper primary mathematics syllabus	
<ul style="list-style-type: none">• Foreword• Acknowledgement• Introduction• Pedagogical Approach	<ul style="list-style-type: none">• Assessment Approach• Resources• Syllabus Units• References

Main topic areas developed in the part of syllabus units are the following: *Number and operations, Fractions, decimals, and proportional reasoning, Metric measurements, Algebra, Geometry, Statistics and elementary probability (upper primary only).*

1.6 End unit assessment 1

Each component of the primary mathematics syllabus plays an important role at every step of the teaching and learning process.

- **Introductory part** of the syllabus provides all information related to: Background to curriculum review, Rationale of teaching and learning mathematics (Mathematics and society, Mathematics and learners), Competences (generic and broad subject competences). A primary mathematics teacher gains the rationale/ importance/ role of mathematics through this part of the syllabus.
- **Pedagogical approach** provides all information related to: the role of the learner, the role of the teacher, special needs education and inclusive approach while the teaching and learning mathematics. In this part, various teaching strategies and approaches such as direct instruction, discovery learning, investigation, guided discovery or other methods are incorporated. Also, in this pedagogical part, a list of generic and broad subject competences is presented so that a mathematics teacher can consider them while preparing and delivering mathematics lessons.
- **Assessment approach** provides information needed to formative assessment and summative assessments, record keeping, Item writing in summative assessment and reporting to parents
- **Resources:** This is the part of the syllabus which provides a non-exhaustive list of materials needed for implementation of Mathematics syllabus.
- **Syllabus units:** This part is composed by the following: Presentation of all units with the related key unit competence, learning objectives, the content and suggested activities.
- **References:** A part which shows books or source of information in terms of hard copy or soft copy that can be consulted in verifying the content for the syllabus.

1.7 Additional activities

The tutor can give to student-teachers other activities that are needed in the teaching activities at primary school.

Example:

Suppose that you are working as a primary teacher in a school year with 36 working weeks. Given the format below, prepare the content distribution for P3 or P5 Primary mathematics.

CONTENT DISTRIBUTION IN SCHOOL YEAR**SUBJECT: MATHEMATICS**

Class: Primary 5
week: 8 periods

Number of period per

Term 1 (... periods)

UNIT 1: Reading, writing, comparing and calculating whole numbers up to 1 000 000 (32 periods)		
Key unit Competence: To be able to read, write, compare and make calculations on whole numbers up to 1 000 000.		
Week	Content	Number of Periods
1	Introduction to the need of numbers from 100,000 to 1,000,000	1
	Reading and writing numbers up to 1,000,000 in words	2
	Reading and writing numbers up to 1,000,000 in figures	1
	Place Values of whole Numbers up to 7 digits	1
	Comparing Numbers using $<$, $>$ or $=$	2
	Addition of 3 or more whole numbers of 7 digits without carrying	1
2	...	
...	...	

2.1. Key unit competence

Differentiate available teaching and learning resources and produce more others required in the learning of Mathematics for primary school.

2.2 Prerequisite

Student-teachers will perform effectively in this unit if they have prior knowledge on the following:

Types of teaching and learning resources, importance of teaching and learning resources, importance of locally made materials and improvisation, source of learning materials, qualities of teaching and learning resources, management of teaching learning resources learnt in Foundation of Education, year one: unit7.

2.3 Guidance on the introductory activity

- Form groups of student-teachers and invite them to work on the introductory activity of unit 2 where they will discuss mathematics teaching and learning resources relating to their prerequisite learnt in Foundation of education;
- Allow student-teachers to present their findings in a whole class discussion;
- Use different questions to facilitate student teachers to give their predictions and ensure that you arouse their curiosity on what is going to be learnt in this unit basing on their experience, prior knowledge and abilities shown in answering the questions for this activity.

Possible answers to questions for the introductory activity:

Today is the age of science and technology where the process of teaching and learning depends upon the different types of equipments—available in or outside the classroom. When you are going to teach, you need different types of resources to be used in the lessons.

Different groups of students may give different answers for the questions but the types of mathematics teaching and learning resources, their importance, source of those materials, people who produce them, how they are produced and their management can be found in the content summary of the student's book.

Mathematics teaching and learning resources to be used are grouped into the following categories: Printed materials, non-printed materials including locally-made materials and Teaching multimedia (Visual aids, Audio - visual aids).

Some of these materials can be purchased, can be produced by teacher, students or parents and others can be improvised from the school environment.

People who are responsible to maintain these materials are: School administrators, teachers, learners, local government and parents.

2.4 List of lessons /Sub-topics

No	Lesson title	Learning objectives	Number of periods	
			SME	ECLPE
1	Exploration of mathematics primary textbooks and teacher's guide in the context of CBC	<ul style="list-style-type: none"> - Explain the role of mathematics books (pupil's book and teacher's guide) in the context of CBC; - Describe the structure of a good mathematics book; - Develop positive attitudes towards the use of mathematics books. 	2	1
2	Mathematics teaching and learning materials in primary	<ul style="list-style-type: none"> - Outline the appropriate materials used in mathematics teaching lessons. - Use local materials in making teaching and learning resources as a home grown solution in education. - Manifest a good will of producing teaching resources in local materials and effective management of all teaching resources. 	3	1
3	Assessment		1	1

2.5 Guidance on different lessons

Lesson 1: Exploration of primary mathematics textbooks and teacher's guide in the context of CBC

a) Learning objectives

- Explain the role of mathematics books (pupil's book and teacher's guide) in the context of CBC;
- Describe the structure of a good mathematics book;
- Develop positive attitudes towards the use of mathematics books.

b) Teaching resources

Different Mathematics books for lower or upper primary, Mathematics syllabus for lower or upper primary, Manila paper and the projector (where possible).

c) Learning activities

- Form groups of students, ask them to take the learning materials (textbooks) and attempt *activity 2.1* given in the student's book.
- Circulate in all groups and facilitate students to explore primary mathematics books, determine their structures (arrangement of units, topics/lessons and activities) and compare those books according to their structure.
- Invite each group to discuss the advantage of the textbooks and how they can use them in the context of CBC.
- Ask groups to present their findings to the whole class.
- Guide students to follow attentively, to interact about the findings and to take a short summary.
- Retake the same process when discussing the teachers' guides: their structure and how teachers can use them.
- Help students to conclude why text books and teachers' guides are complementary and decide who use them, where, when and how to use them.

Let students work out, individually or in pairs, the *application activity 2.1* for the assessment.

Possible answers for activities:

Activity 2.1

Check answers of this activity in the content summary highlighted in the student's book.

Application activity 2.1

1. The number of units, the learning activities and application activities depend on the textbooks that are being used. Verify whether students are able to separate the learning activities from application activities.
2. Textbooks bought from different publishers do not have the same structure but we emphasize the structure highlighted in the student's book as requested by CBC:

Mathematics textbook is written with the sequence of units where each unit has a key unit competence, introductory activity, different learning activities, examples and application activities.

3. Some of the available mathematics teacher's guides for lower or upper primary have the structure that needs to be adapted by the teacher:
 - Modify, develop, change, eliminate, or add something to the activities given;
 - Solve every exercise and compare the findings with book's answers before marking the learners' works.
 - Choose activities that will serve as warm-up activities, presentation activities, practice activities or consolidation activities.
4. The role of mathematics books is given in the students' book. As a tutor, you have to verify and complete students' answers provided to "Who use textbooks, when and how to use them" as answers may vary.

Lesson 2: Teaching and learning materials for Mathematics in primary school

a) Learning objectives

- Outline the appropriate materials used in mathematics teaching lessons.
- Use local materials in making teaching and learning resources as a home grown solution in education.
- Manifest a good will of producing teaching resources in local materials and effective management of all teaching resources.

b) Teaching and learning resources

Mathematics books, local materials, oranges, tomatoes, knives, rice sacs, boxes, sugarcane, pictures, pencils, working sheets, sheets of paper, manila paper and the projector (where possible), etc.

c) Learning activities

- Form pairs of students, give them instructions and assign each pair with a sheet on which there is a topic and instructions.
- Depending on the topic (concept) for each pair, ask them to do the activity 2.2: select appropriate teaching and learning materials to be used when teaching such topic; they must include locally made materials, printed and non-printed resources;
- Ask each pair to think about the use of ICT resources when teaching their topic.
- Invite 3 neighbouring pairs to share their findings in a group of 6 student teachers.

Ask every group to choose one topic, try to organize the selected materials and improvise some of them in available local materials.

- Invite every group to present their finding.
- As the tutor, harmonize the findings of students by guiding them to group the materials seen in: printed or not printed material, visual, audio or audio-visual material, purchased or locally made (improvised) materials.
- After the discussion, assign all students to do the *application activity 2.2* and give them the homework for summarizing the management of mathematics teaching and learning resources, the need for improvisation and how improvisation can be done by every teacher.

d) Possible answers for activities

Answer for activity 2.2:

- Teaching and learning materials for facilitating lesson on addition of fractions with the same denominator are the following: Manila paper with drawings of fractions, dot paper, grid paper, scissors, cartons, pencils, pens, sticks, modelling clay, oranges, tomatoes, sugar cane, etc.
- Among of those materials some are locally made materials others are printed or non-printed materials. Printed materials: are publications that one is sure to encounter by printing. For example flash card, charts containing fractions, etc. Non- printed materials: sticks, modelling

clay. Locally materials: cutting oranges into parts, sugar cane, cutting cartons into pieces, handmade charts containing fractions etc.

- c) It is possible to teach the lesson on addition of fractions with the same denominator by the use of ICT resources.

It is very important to use ICT for facilitating this lesson because:

- It increases the motivation of learners;
 - It increases the enjoyment of learning because teachers shift from the passive role of receiving knowledge to the more active role of becoming seekers of knowledge.
 - It increases retention from the enhanced engagement and participation of the learners.
 - ICT facilitates the understanding of fractions representation when they draw them using a computer.
- d) Learners with special educational needs can use the selected materials but depending on the impairment of a learner, the teacher must give them adapted materials and let them sit where they will be easily engaged in the lesson. For example: Learners with Visual impairment are given the appropriate manipulative materials and helped to sit next to other learners who can help them.

Answers to application activity 2.2:

1. Low cost and no cost materials are used in different mathematics lessons on addition of numbers in lower or upper primary:

No cost materials:

- **Use** soil in making operation signs such as addition, multiplication, division and subtraction.
- Stones are used in counting or in teaching operations, sticks used in counting and in operations such as multiplication or division, bottle tops used in counting.
- Boxes are also no cost materials which can be used to make small flash cards containing signs of operations, numbers, figures drawn on those flash cards and types of numbers.

Low cost: for example the rice sack is a low cost material on which you can write some operations such as addition, multiplication, subtraction and division. Plastic bottles can be used in number patterns where numbers are written on these bottles. Sheets of paper can be used to show different operations. Pens, fruits, vegetables, sugarcane are sometimes used in counting the numbers.

High cost: Computers and calculators are there for facilitating teachers to show operations signs or to show learners how to perform operation of different numbers.

All materials mentioned above are obtained in two ways: Teaching Learning Materials purchased from the market and teaching learning materials developed either by teacher or learners.

The following image shows manipulative materials that can be purchased in case they are produced in our country.



Source: (www.rainbowresource.com/proddtl?id=MIFGR1)

2. In order to produce relevant, age appropriate and low cost teaching and learning materials Primary mathematics teachers are recommended to produce teaching and learning materials which are appropriate to the level of learners:

- Search available materials in our environment , ask learners to ask parents to help them make and bring some from home, make materials which are readable, durable, not harmful to learners.
- Produce materials according to their accessibility in local community
- Make materials which are user friendly so that every learner can be able to manipulate them.
- Produce materials which will be used many times in teaching and learning process

2.6 Additional information

When teaching and learning resources are appropriately used in teaching and learning of mathematics, they **make learning more concrete, real, immediate and permanent**. Resources will help the teacher and learners to conceptualize the content in the learning environment and specific objectives will be achieved in the shortest possible time.

Reasons to use teaching and learning materials

Mathematics teachers in lower of upper primary should use teaching and learning Materials in classroom for the following reasons.

Teaching aids play a very important role in teaching and learning process of mathematics:

- **Motivation:** Teaching aids motivate the students when they are in mathematics lesson so that they can learn better and develop new competence. Teaching learning of Mathematics lessons becomes interesting and lively.
- **Clarification:** Through teaching aids, the teacher clarifies the subject matter more easily. Learners are relieved from anxiety, fear and boredom when they are studying mathematics lessons. Those materials help illustrate or reinforce a skill, fact or idea as student-teachers continue manipulation and use teaching and learning materials during and after mathematics lessons.
- **Discouragement of cramming:** Teaching aids can facilitate the proper understanding of mathematics lessons to the learners which discourage the act of cramming. Difficult concepts can be easily taught through the use of teaching and learning resources.
- **Arouse learners' curiosity on the new concept:** Teaching aids helps to guess the new concept to be introduced.
- **Saves time and money:** the use of teaching aids saves time that teacher may take during explanations for students understanding.
- **Avoids dullness:** This means the class becomes more active, lively and participatory. Learning becomes real, practical and fun for learners.
- **Direct experience:** Teaching aids provide direct experience to the students which make them learn easily. Learning is more effective and permanent/ longer retention of information.

2. 7 End unit assessment 7

a) Classify given materials:

Concrete-materials	Semi-concrete materials
Physical balance, pair of scissors, masking tape, Weight scale, measuring tape or scale, measuring cylinders, board, geometry box, rope or thread, paper and graph paper, Abacus model, beakers or graduated cups, 2D shapes or 3D objects, place value blocks (in wood), multi-link cubes or different-coloured counters (in wood), geo-board, tangram, etc.	Number cards, place value blocks drawn on a paper, multi-link cubes or different-coloured counters (in paper), dotted papers.

- b) Materials that can be used to teach and learn topics related to numbers and operations: Number cards, place value blocks, dotted papers, Abacus model, and pair of scissors. These materials can be used appropriately when exploring particular mathematical concepts.
- c) Materials that can be used to teach and learn topics related to geometry: 2D shapes or 3D objects, multi-link cubes, geometry box. Other materials can be used in facilitating lessons on geometry are small real objects like sticks, syringes and empty bottle of medicine, jerry cans, clocks, rulers, XO laptop and related mathematics software to calculate volume, area, etc.
- d) Materials that can be used to teach and learn topics related to measurements: Physical balance weighing scale, measuring tape or scale, measuring cylinders, beakers or graduated cups.

For example when you are going to teach capacity measurement you can ask to write down the number of litres that can fill a cylindrical container.

3.1 Key unit competence

Use a combination of teaching and assessment principles, methods and techniques to make mathematics lessons successful.

3.2 Prerequisite

To perform very well in this unit, student teachers must have the following prerequisite:

- Having the ability to apply different teaching techniques, referring to Foundation of Education subject learnt in Year one, unit 2.
- Be aware of general principles of teaching highlighting that teaching starts from simple to more complex, from concrete to abstract, general and end with specific.
- He/she must be able to interpret different assessment principles, be able to define the following term: contextualization, concretization, progression, generalization, and motivation taught in foundation of education.
- Student teachers may have a sense of critical thinking skills to analyze a given activity and suggest if it engages learners in the lesson.

3.3 Guidance on the introductory activity

- Invite student-teachers to form groups and work on the introductory activity of the third unit, where they will discuss on the statements and come up with their conclusion.
- While students are discussing in groups, try to go to each group and ask some questions to prompt some ideas leading to proper decision without eventual misconceptions;
- Invite student teachers to present their findings in a whole class discussion;
- Ensure that you arouse students' curiosity on what is going to be learnt in this unit basing on their experience, prior knowledge and abilities shown in answering the questions for this activity: Guide student teachers to know that the content of this unit will refer to general principles they studied in the FOE to determine teaching approaches and principles related to mathematics teaching.

Possible answers to questions for the introductory activity:

Answers to questions for the introductory activity may be different depending on individual interpretation of given statements. As a tutor, try to orient students and tell them that they are going to clarify them in details during next lessons of this unit.

3.4 List of lesson/sub-heading

#	Lesson title	Learning objectives	Number of periods	
			SME	ECLPE
1	Principles applied in mathematics lessons	Interpret the principles of mathematics teaching and learning	2	1
2	Assessment principles in Mathematics lessons	<ul style="list-style-type: none">- Explain different principles applied in mathematics skills assessment;- Differentiate general principles of mathematics teaching;- Show concern on the application of principles of teaching in different phases of learning mathematics.	2	1
3	Appropriate teaching methods in each of the following phases of learning mathematics: Readiness, Engagement and Mastery.	- Justify the appropriate teaching methods to be used in each phase of learning mathematics.	3	2
	Assessment		1	1

3.5 Guidance on different lessons

Lesson 1: General principles of mathematics teaching

a) Learning objectives

Interpret the principles of mathematics teaching and learning

b) Teaching resources

To work effectively in this lesson, students teachers should be aware of general principles of teaching learnt in Foundation of education, year one, unit 2. The summary notes of foundation of education are necessary.

They should be able to use library, ICT tools including internet, smart phone, dictionary programs (where applicable) to explore definitions and terminologies used in principles of teaching. The student's book for this subject, Primary mathematics book (SB and TG) TTC and other reference books related to principle of teaching are necessary.

c) Learning activities

Guide students to get clear instructions on how they are going to work in groups carrying out *activity 3.1*. Ask them to conduct a research in the library or using ICT tools including internet where applicable on 3 phases of learning mathematics and identify teaching and assessment approaches that are appropriate in each phase: students-teachers carry out a research in groups and share ideas,

- Invite one group to present their findings to the whole class and ask other groups' members to comment and supplement the group that presented.
- Assign to groups of student teachers the activities to be done and provide them with hand-outs with tasks to be done and answer the questions for *sub-question 2 of activity 3.1*.
- Invite all groups for a whole class discussion on their findings on sub-question 3.1. During this discussion, students will interact with comments and take the summary on teaching principles related to the contextualization, concretization, progression and generalization in mathematics lessons.

Possible answers to activities

Activity 3.1

1. As we know, different ways can be used to find the solution for a given work and get the same answer. The same, to the activity 3.1 these are various answers:

Semi-concretization of concept was used: as long as this activity has concrete materials to match with numbers;

Progression and generalization takes place as learners will count from small number to the greatest numbers, ordering numbers in increasing order for activity 3. The comparison of objects and their numbers implies generalization.

If this activity is done in groups, learners will be motivated because they have tangible, concrete objects as the teaching focuses on a real context. Therefore, effective teaching always starts with something tangible, existing, concrete and the teaching focuses on a real context.

The set A is grouped according to prime numbers, set B is grouped according to even numbers, the set C is grouped according to square numbers, and the set D is built on the combination of the first three adding the cubic numbers which are outside of the three sets (A, B,C). This shows that while teaching Mathematics in primary, it is very important to consider the progression of concepts and topics.

2. The activity 1, 2 and 3 are based on the involvement in action, which shows that every learner is at the task, as long as those activities require more critical thinking.

Activity 1, 2 and activity 3 show that the teacher respects the progression because there is a progression from the simplest to the complex.

Application activity 3.1

As activities are different in different books, the answers for questions in this activity vary from one group to another. As a tutor, you must check whether the answer provided by students is related to existing mathematics teaching principles as highlighted in the student's book.

Lesson 2: Assessment principles in mathematics lessons

a) Learning objectives

- Explain different principles applied in mathematics skills assessment;

- Differentiate general principles of mathematics teaching;
- Show concern on the application of principles of teaching in different phases of learning mathematics.

b) Teaching resources

Mathematics syllabus for primary, student's books, reference books including the book for FOE; Computers, internet and the projector (where applicable).

c) Learning activities

The task is to identify teaching and assessment approaches that are appropriate in each phase of learning.

- Form groups of student teachers and explain the activity of the day, ask them to take learning materials and go through the *activity 3.2* where student teachers identify which assessment principle inspires them mostly and why.
- Circulate in all groups and facilitate students to analyze positively the scenario given to them in order to conclude with the objective of the lesson.
- Invite some students from each group to present the results from their discussion,
- Harmonize the students' answers by orienting their findings to mathematics assessment principles: The content principle, the learning principle, the equity principle and the relevance and transferability principles.
- Assign students to do the *application activity 3.2* for consolidation and evaluation of competences.

Possible answers to activities:

Answers to activities 3.2:

Students will give different answers for this activity depending on their beliefs or their levels of understanding. As a tutor, check whether their justifications are relevant, related to assessment principle (The content principle, the learning principle, the equity principle and the relevance and transferability principles) and try to correct them accordingly.

Answers to application activity 3.2

Example of activity:

In the unit 10 of P5: Sequences that include whole numbers, fractions and decimals, we can choose one concept that is being assessed: Simple sequences that include decimals.

Activity from P5 learner's book

Discuss the sequence given below and discover the pattern used.

10, 10.5, 11, 11.5, 12, 12.5, ____, ____

Form your own sequences involving decimals. Make presentation to the class.

How is this activity supporting learning?

Answer:

- As this activity requires to discuss, it engages learners with more participation, this activity requires critical thinking skills, because learners will discover that the changing differences is now 0.5. By forming their own sequence, learners will apply acquired skill, become creative and make different sequences.
- Through presentation of their answer, all assessment principles will be considered.

After studying this activity, the knowledge transfer is constructed: The above activity can help learners to construct the culture of working on time, thinking critically, organizing everything depending on her/his daily routines. A learner can become a good planner for any activity which requires the knowledge of sequences.

Lesson 3: Appropriate teaching methods in each phase of mathematics learning

a) Learning objectives

Justify the appropriate teaching methods to be used in each phase of learning mathematics

b) Teaching resources

Mathematics syllabus for primary, reference books, internet where applicable, foundation of education textbooks, number grid, flash cards.

c) Learning activities

- Guide students to discuss *activity 3.3*; you can form groups, distribute handouts and give instructions on the way of working: Students analyze the activities on handout, find out and explain techniques and strategies used in teaching when the given activity on handout is assigned to learners.
- Invite students to present to the whole class the results from group discussions where each student is engaged to give his/her point of view or comment on the method of teaching.
- As tutor, help students to conclude on teaching techniques they suggested to be used when teaching the given topic using the activity provided on their handouts and highlight that various techniques can be used in each phase of learning:

Readiness; different methods can be used to verify whether learners are ready to learn the new concept where he/she must provide a motivating context.

Engagement; there are different teaching techniques that can be used to engage students in learning new concepts and skills such as Activity-based learning, teacher- directed inquiry and direct instruction are three techniques that support most of the mathematics teaching and learning in the classroom.

Mastery; There are different teaching techniques to be used by the teacher in the final phase of learning where teachers help students consolidate and extend their learning. Such techniques can be a **motivated practice**, **reflective review** or **an extended learning**.

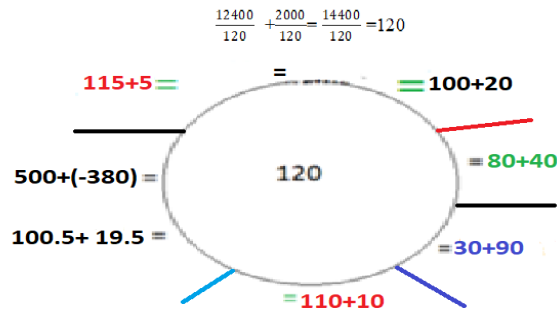
Possible answers for activities

Activity 3.3:

- Through MINGO game (activity 1), numbers are counted and recorded: this is a play based learning that can be used in the readiness phase of learning or in the engagement phase.
- Brainstorm and find out the two numbers (activity 2): This is a brain storming technique that can be used in all the three phases of learning depending on the level of learners (age and grade) and the objective of the lesson. This is because this activity intends to learn by applying, observing and guessing two numbers to add for getting 120.

Here the possible solutions are so many depending on the age of the learners. For lower primary, they can use small numbers because they

deal with positive numbers not greater than 1000 but in upper primary they can use larger numbers and all integers because they also deal with negative numbers, extension can go also to decimal and fraction numbers.



- Different mathematical concepts can be explored using the grid (activity 3): This is a group based activity that can be given in the mastery phase of learning, learners are asked to apply what they studied by selecting even and odd numbers, prime and composite numbers and share the common characteristics for each category of numbers as they previously learnt them.

Application activity 3.3:

Answers for this question will be different depending on the group of students and mathematics concepts they selected. As a tutor, refer to the principles of mathematics teaching or learning, verify and correct eventual students' misconception.

3.6 Additional information for the tutor

Use the textbook of Foundation of education and verify teaching techniques that can be applied in mathematics teaching. As a tutor, you can also search on internet to enrich your knowledge on mathematics teaching and learning.

Teachers can utilize different methods and techniques in their teaching of mathematics and get benefit out of them. There is no “best teaching approach”. However, there are some recognized teaching methods together with a range of learning theories and some principles for good practice in education. Being a reflective teacher and striving for excellence in teaching means considering each aspect of teaching approach to ensure that your approach is to facilitate student learning.

The following are the main points you can research on:

(i). Guidance in mathematics teaching:

- **Use Visuals:** learners do best when instruction is paired with a visual; using a visual as a stand-alone teaching device is not always effective. The teacher should vary the usage to keep learners engaged.
- **Make Connections:** To help learners make sense of concepts, provide them with connections to the real world or previously taught lessons. We should pay close attention to how learners react to the connections the teacher makes.
- **Use assessments:** Formative assessments, or informal assessments meant to check in on learner's learning and drive future instruction, should be used frequently.
- **Strategies and techniques:** When teaching, model several strategies for understanding and exploring a concept, encourage learners to apply high-level skills when given problems and focus on the thought process involved in the solution. Although mathematics usually has one right answer, being able to reason through the steps to find the answer is the most important part of being a successful mathematics learner.

(ii). Approaches in teaching mathematics:

Make a research on the Constructivist approach and the Discovery approach.

(iii). Methods applied in mathematics teaching:

Make a research on: Learner centered method, teacher centered methods, inductive and deductive methods, analytic method, synthetic method, problem solving method, laboratory method, project method.

(iv). Modern techniques of mathematics teaching:

Brainstorming, quiz technique, seminar method, discussion technique, scenario building technique.

3.7 End unit assessment 3

Different groups of students may give different answers on the given question. To correct their work, refer to the statement saying that there is no single suitable method to teach mathematics to emphasize mastery of knowledge and skills, critical and creative thinking, communication and problem solving. In the mathematics lesson, teachers adopt a combination of different teaching approaches to engage pupils in learning.

3.8 Additional activities

Briefly, the best mathematics teacher is one who uses both abstract, concretizations, builds on student's knowledge, takes cognizance of student's interests and experiences and engages them in active and reflective learning. Harness the use of ICT tools into mathematics teaching in lower or upper primary.

Answer:

The following ICT tools are very essential in the process of teaching and learning mathematics and help in practical work with manipulations in primary schools:

1. **XO Laptop programs:** the XO laptops has different programs like scratch activities where learners draw different geometric forms. In Turtle activities learners draw different geometric forms such as rectangle, circle and triangle and then they can calculate the area, perimeter etc.
2. **Some computer programs or software can be** used for finding the perimeter and area of basic two-dimensional figures, the surface area and volume of basic three-dimensional figures, including rectangle, parallelograms, trapezoids, squares, triangles, circles, prisms, and cylinders. By the use of different application software such as Geogebra, learners learn how to solve mathematics problems involving geometry where every concept can be illustrated in the learners' computers or projected using teacher's computer and the **projector** for the school.

Calculator: in calculation both teacher and learners need to calculate solution in numerical and give answers with the use of calculator. TIP: Do not use calculators when the goal of the activity is to assess students' ability to perform mathematical computations, allow the use of calculators when the goal of the activity is not to assess the computation skills of learners.

4.1 Key unit competence

To be able to prepare lessons on numbers and operations

4.2 Prerequisite

Student-teachers will perform well in this unit if they have a good background on Lesson planning (TTC year1:unit 8 in FOE) and all concepts related to numbers and operation of numbers learnt from P1 to P6: reading, writing and comparing whole numbers, mathematical operations on whole numbers, negative integers, addition, subtraction, multiplication and division of integers, classifying numbers by their properties, prime factorization and divisibility tests, multiplication and division of decimals, powers and indices, LCM and GCF.

4.3 Guidance on the introductory activity

- Form groups of student-teachers and invite them to work on the introductory activity of unit 4 where they will find out appropriate resources for facilitating related lessons using low cost materials and suggest how to produce them.
- In groups, student-teachers discuss the teaching techniques to facilitate lessons on the addition of numbers and multiplication of numbers and compare those techniques.
- Give them the time to present their findings for a whole class discussion;
- As a tutor, use different questions to facilitate students to give their expectations and ensure that you arouse their curiosity on what is going to be learnt in this unit basing on their experience, prior knowledge and abilities shown in answering the questions for this activity.

Possible answers to the questions of the introductory activity

(a) The acquisition of mathematical concepts and skills is very crucial for continuous learning and supporting other subjects as well as developing thinking, reasoning, communication, application and meta-cognitive skills through a mathematical approach to problem solving with operations.

Topics related to numbers and operations to be studied in primary schools are given in the Primary Mathematics Syllabi (lower or Upper Primary syllabus). As a Tutor use those 2 syllabi to confirm whether the topics said by students are taught in such a level.

(b) Teaching and learning materials to be used when teaching and learning numbers and operations can be acquired by producing or constructing them, by collecting them from the environment, by asking learners to prepare them, by requesting the school administration or parent to buy them, by borrowing or hiring them or through improvisation.

Some items that can be collected and used for improvisation include:

- a) **Clay soil:** Clay soil is a low cost material that can be used in forming operation signs out of the classroom: +, -, x.
- b) **Bottle tops:** In teaching and learning the number counting, learners can count bottle tops
- c) **Plastic bottles:** with the use of plastic bottles, learners can group them when learning the addition, subtraction or the multiplication of numbers.
- d) **Bean seeds:** use beans seeds to count or to form groups in mathematical operations for facilitating the learning on addition, subtraction, multiplication or division of numbers.

Materials that can be **bought** are for example: marbles, counters, counting rods, Abacus apparatus, etc.

(c) Different groups of students can give different answers for this question, as a tutor, try to ask students to explain their answers and arouse their curiosity to wait for more details in the content of this unit. Through practical activities, outdoor activities, peer teaching activities and investigation, learners can learn well lessons on addition of numbers as those techniques can be used to learn lessons related to multiplication. Depending on the level of learners teaching techniques to facilitate lessons on the addition of numbers and lessons related to multiplication of numbers can be different.

4.4 List of lessons/Sub-heading

No	Lesson title	Learning objectives	Number of periods	
			SME	ECLPE
1	Recall on concepts related to numbers and operations	Explain concepts related to the lessons on numbers and operations.	1	1
2	Production and organization of appropriate resources for the lessons related to numbers and operations using low cost materials.	Organize and make appropriate resources using low cost materials to be used in lessons related to numbers and operations.	1	1
3	Active teaching techniques and strategies for facilitating lessons related to numbers and operations.	Discuss techniques and strategies for facilitating lessons related to numbers and operations.	1	
4	Activities for developing generic competences and integration of cross-cutting issues in the lessons related to numbers and operations.	Use various techniques for developing generic competences and cross-cutting issues in the lesson plan for numbers and operations.	1	1
5	Assessment tasks in the lessons related to numbers and operations.	Discuss and set assessment tasks in lessons related to numbers and operations.		
6	Lesson plan on number and operations.	Develop lesson plans on topics related to numbers and operations.	2	1
	Assessment			

4.5 Guidance on different lessons

Lesson 1: Recall on concepts related to numbers and operations

a) Learning objective

Explain concepts related to the lessons on numbers and operations.

b) Teaching resources

Mathematics syllabus for lower or upper primary, different Mathematics books for lower or upper primary, manila paper and the projector (where possible).

c) Learning activities

- Form groups of student-teachers, ask them to take the learning materials (lower or upper primary syllabus, mathematics textbooks for lower or upper primary school): each group can take one level (Example P4, P3, P5, etc) and provide instructions leading them to attempt *activity 4.1* given in the student's book;
- Move around all groups and facilitate student-teachers to select different concepts related to numbers and operations in Mathematics books or the syllabus;
- Invite each group to present their findings to the whole class;
- Guide all student-teachers to follow attentively, to interact, to take a short summary and to write down a challenging topic.
- Help student-teachers to conclude on mathematics concepts related to numbers and operations learnt in lower or upper at primary school.
- Invite students to work in pairs on the application activity 4.1 for assessment.
- Assign each student-teacher to a peer-learning on the topics he/she found challenging.

Possible answers for activities

Answers to the learning activity 4.1

Check answers of this activity in the summary content found in the student's book and the syllabus.

Answers to application activity 4.1

During the lessons on the subtraction of numbers, lessons on multiplication of numbers, and lessons on the division of numbers, learners acquire different skills such as:

Problem solving Skills, logical thinking skill (learners learn to lay out their work logically), communication skills (they express their thoughts clearly by writing or orally), reason inductively by observing patterns, mathematical reasoning and critical thinking skills is developed with the ability of analyzing mathematical situations, cooperation is developed through working in groups and sharing ideas.

Lesson 2: Production and organization of appropriate teaching resources for the lessons related to numbers and operations

a) Learning objectives

Make appropriate resources using low cost materials to be used in lessons related to numbers and operations

b) Teaching and learning resources

Mathematics books, Abacus, local materials, counters, grids, oranges, tomatoes, rice sacs, markers, boxes, pictures, pencils, working sheets, sheets of paper, sticks, small stones etc.

c) Learning activities

- Form pairs of student-teachers, give them instructions and assign each pair with a sheet on which there is a lesson on numbers and operations and instructions;
- Ask student-teachers to organize appropriate teaching resources for facilitating that lesson;
- - Facilitate student-teachers in their groups in searching those resources.
- Invite each group representative to present their findings.
- Harmonize the student-teachers findings.
- Ask all groups to work on how those resources can be used while teaching and learning the selected topic.
- Invite every group to present their findings.
- As tutor, harmonize the work done by student-teachers on how to organize appropriate teaching resources for the lessons related to numbers and operations.

Possible answers for activities

Answers to Activity 4.2

Appropriate teaching resources can be used while teaching and learning the lesson on multiplication of numbers are grids, counters, etc.

For example we can use number grids in teaching multiplication of two numbers by taking the first number on the first row and multiply all numbers on first column, then take second number on first row multiply it with all numbers on the first column and the answers are written on third column, and continue the process.

This helps learners to complete the multiplication table as follows:

x	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
4	4	8	12	16	20	24	28	32	36	40
5	5	10	15	20	25	30	35	40	45	50
6	6	12	18	24	30	36	42	48	54	60
7	7	14	21	28	35	42	49	56	63	70
8	8	16	24	32	40	48	56	64	72	80
9	9	18	27	36	45	54	63	72	81	90
10	10	20	30	40	50	60	70	80	90	100

Answers to Application activity 4.2

Low cost materials related to the teaching and learning of numbers and their operations (addition, subtraction, multiplication and division) are for example: rice sack, number grids on manila papers, bottle tops, counters, small stones, beans seeds to count or to form groups in mathematical operations. (*check the content summary that follows the activity 4.2 in the student's book*).

Lesson 3: Active teaching techniques and strategies for facilitating lessons related to numbers and operations

a) Learning activities

Discuss techniques and strategies for facilitating lessons related to numbers and operations

b) Teaching and learning resources

Sheets of paper, charts, scissors, ruler, glue, pen/pencil, colors, manila papers, markers, the syllabus, textbooks, reference books, computer and the projector (where possible), etc.

c) Learning activities

- Form six groups of student-teachers in the classroom; give them instructions to be followed in group discussions.
- Ask student-teachers to do *activity 4.3* where they discuss what can make the lesson on “counting numbers” enjoyable to learners.
- Move around in the classroom and facilitate groups in their discussions;
- Give groups the opportunity to explain their findings where others can ask questions and suggest alternative teaching techniques.
- Skip to another step and ask the two first groups to argue on active teaching techniques and strategies that they think are the best for facilitating lessons related to “addition of numbers in P2 or P5”. Assign other two groups to argue on active teaching techniques and strategies that they think are the best for facilitating lessons related to Multiplication of numbers in P1 or P4. Ask other remaining groups to debate on active teaching techniques and strategies that they think are the best for facilitating lessons related to division of numbers in P3 or P6.
- During the group discussion, circulate in the classroom and ask students some questions to prompt other alternatives they must think about.
- Invite each group representative to present their findings.
- As tutor, harmonize the work done by student-teachers and guide them to conclude on active teaching techniques and strategies for facilitating lessons related to numbers and operations.

After the conclusion, provide instructions to students so that they can individually work on *application activity 4.3* for assessment.

Possible answers for activities

Answers to Activity 4.3

1. In order to make the lesson more enjoyable, the teacher can do the following:
 - Provide activities that require interaction among learners and which require more engagement of every learner than those in which learners could work effectively by themselves.
 - Use manipulative materials and other teaching and learning resources that motivate learners to learn: Audiovisual aids, illustrative software, etc.

- Plan activities that match with learners' capabilities, and probably reserve more interactive assignments and sufficient time periods to do them;
 - Involve learners in the process of teaching and learning and adapt the materials depending on differences among learners (differentiated learning).
2. Active teaching techniques and strategies for facilitating lessons related to addition of numbers.

Group work: learners work cooperatively when grouping manipulative materials to make addition, subtraction and multiplication of numbers where learners do more activities guided by the teacher.

Brainstorming: learners are given problems involving addition or subtraction, multiplication or division and they are asked to give their point of views orally.

Practical activities: learners are given practical activities to illustrate the concepts related to addition, subtraction or multiplication of integers by using real objects.

The following box shows the example of counting rods and number cards that can be used to illustrate operation of numbers.



Experience-based learning: Mathematical ideas are more likely to be remembered and used if they are based on students' experiences.

Problem-based learning: Using this strategy, the teacher can set a problem or a task for the class to solve. For example, 48 is the answer I have from multiplying certain numbers. How did I get the answer? This is the mathematics expression for that problem: ($\dots \times \dots = 48$).

Peer teaching and learning: This is organized as a partnership activity in which one student performs a task while the other observes and assists; making corrections and suggesting new ideas and changes. For example, one student decides to multiply three-digit numbers by two-digit numbers. The student who is observing should assist and make sure that all the steps are followed before the final answer is given. The teacher's role in this strategy is to observe and encourage positive interaction and effective communication through which the intended outcome can be achieved.

Mathematics games: There are a lot of Mathematics games students can play as part of their learning.

As a tutor, check more information on answers in student's book on activity 4.3 and assess student's answers.

Answers to application activity 4.3

Teaching techniques can be used to make the lesson on subtraction of fractions in P3 or P5 more active and participative.

Check answers from the content summary in the student's book on Teaching and learning strategies related to fractions, decimal numbers and proportional reasoning.

Lesson 4: Activities for developing generic competences and integration of cross-cutting issues in the lessons related to numbers and operations

a) Learning objectives

Use various techniques for developing generic competences and cross-cutting issues in the lesson plan for numbers and operations

b) Teaching and learning resources

Manila paper, flip chart, markers, flash cards, sheet of papers, play money, projector, computers (where possible), etc.

c) Learning activities

- Use Mingo game to form groups of student-teachers in classroom and give them instructions to be followed in group discussion.

- Ask student-teachers to observe and discuss the activity 4.4 where they determine competences to be developed by learners while performing a given the activity and crosscutting issues that can be addressed.
- Visit every group and facilitate the discussions by asking some questions and prompts to students as they are working with materials to assess understanding, encourage talk, extend thinking or consolidate learning.
- Invite each group representative to present their findings and motivate the whole class to participate actively by asking questions or by giving their point of view.
- As tutor, harmonize the work done by student-teachers and help them to conclude on competences to be developed by learners while performing a given the activity and crosscutting issues that can be addressed and how to make it happen.
- Let students work out individually or in pairs the *application activity 4.4* for assessment and evaluation.

Possible answers for activities

Activity 4.4:

1. Competences can be developed while performing the activity in 4.4:

Through forming the largest number and the smallest number, learners develop cooperation and communication skills, critical thinking, Mastering Math Facts, Mental Math Skills, Developing Proficiency with Operations, problem solving, representation skills, **lifelong learning skills etc**

2. This question can be given to P3 or P4 learners.

3. The financial education is addressed as students are going to calculate the money, make a list of priorities of what they can buy using that money and to explain their priorities.

Lesson 5: Assessment tasks in the lessons related to numbers and operations

a) Learning objectives

Discuss and set assessment tasks in lessons related to numbers and operations

b) Teaching and learning resources

Manila paper, markers, flash cards, pens, pencils, rice sacks, etc.

c) Learning activities

- Use different numbers by counting where student-teachers count numbers from one to five alternatively to form five groups.
- Distribute Mathematics textbook of P3, P4, P5 or P6 to student-teachers in their groups.
- Ask student-teachers to do *activity 4.5*: identify any activity related to the topic on numbers and operations (place value, addition, subtraction or multiplication of numbers).
- Invite student-teachers to analyze the activity in their respective groups and explain whether the action verbs used help to develop low, medium or high order thinking skills.
- Move around in the classroom and facilitate groups in their discussions by asking some questions and prompts to students as they are working to assess understanding, encourage talk, extend thinking or consolidate learning.
- Invite each group to present their findings.
- As tutor, harmonize the work done by student-teachers and help them to conclude. Highlight that when setting tasks and activities, teachers must use action verbs referring to levels of the revised bloom Taxonomy.

Possible answers for activities

Activity 4.5

Answers for this activity may be different. As a tutor, refer to the revised Bloom Taxonomy when verifying students' work. The following is an activity on number and operation for primary six learners:

Suppose a sum of 240,000Frw in pretend of 500Frw notes was given to learners by teachers. Share this money equally to 40 learners.

- Calculate the number of 500Frw notes each learner will get.
- Explain to the class the process of solving this problem.
- Investigate whether equal share is a good way we can emphasize in the society.
- Justify the importance of money.

The above activity has actions verbs such as: *Calculate, explain, investigate, justify*.

All these verbs express high levels of thinking skills. As a tutor, check the content summary in the student's book for more information.

Application activity 4.5

Answers for this activity may be different. As a tutor, refer to the revised Bloom Taxonomy when verifying students' work.

Lesson 6: Lesson plan on numbers and operations

a) Learning objectives

Develop lesson plans on topics related to numbers and operations

b) Teaching and learning resources

Manila paper, notebook, the syllabus and text books for primary mathematics, markers, flash cards, pencils, pens, etc.

c) Learning activities

- Use Mingo-Mingo game to form groups of student-teachers in classroom and give them instructions to be followed in group discussion when working on the *activity 4.6*.
- Distribute flash cards or handouts to student-teachers on which there is "*lesson on the meaning and classification of odd, even and prime numbers*"
- Ask student-teachers to set the instructional objectives of the lesson, organize teaching materials to be used in the lesson whose title was given to them, Formulate teacher's activities and learners' activities depending on the step of the lesson, Devise generic competences to be developed and crosscutting issues to be addressed depending on the step of the lesson and to Summarize the teaching and learning techniques to be followed in this lesson.
- Visit each group and facilitate them in their discussions by asking some questions and prompts to students as they are working to let them think about many ways, encourage talk and extend thinking.
- Invite groups to present their findings.
- As Tutor, harmonize the work done by student-teachers highlighting the component of a lesson plan and the characteristics of a good mathematics lesson plan, student-teachers should be motivated to write down the summary during the concluding remarks.

After the harmonization, ask students to refer to the example of the lesson plan given in the student's book and to prepare their own lesson using their findings from the activity 4.6.

Possible answers for activities

Answer to activity 4.6

Make reference to the content summary and the example of a planned lesson given in the student's book.

4.6 End unit assessment 4

Make reference to the content summary and the example of a planned lesson given in the student's book and verify the student's work on the lesson related to the additive inverse of numbers.

LESSONS RELATED TO FRACTIONS, DECIMALS AND PROPORTIONAL REASONING

UNIT 5

5.1 Key unit competence

Prepare active lessons related to fractions, decimals and proportional reasoning.

5.2 Prerequisite

To learn better the content of this unit, student teacher should have the following prerequisite:

- a) List concepts related to lessons of fraction, decimals and proportional reasoning (see P1-P6);
- b) Understand the terminologies used in fraction, decimals and proportions related to primary schools;
- c) Highlight the general teaching techniques and strategies (cfr foundation of education unit 4 in year one);
- d) Choose appropriate resources to be used in a lesson (Cfr Unit 7: Making and using educational material in foundation of education year one), she/he may put more effort on improvisation materials.
- e) Components of a competence based lesson plan (Foundation of education subject, TTC year one, Unit 8).

5.3 Guidance on the introductory activity

- Form groups of student-teachers and encourage them to read the introductory activity of unit 5 written on handouts and answer to related questions.
- Provide instructions on how to do the given activity: Ask them to highlight concepts related to fractions that are challenging to them and why; Tel them that they have to compile the teaching techniques and teaching resources that can be effective when facilitating lessons on fractions, decimals and proportional reasoning;
- In addition, encourage them discuss the importance of studying fractions, decimal numbers and proportional reasoning in primary schools.
- After group work, invite group representatives to present their findings in a whole class discussion.

- Summarize students' answers by arousing their curiosity telling them that what they were discussing in groups will be learnt in detail by next days in other topics of this unit.

However, you may have students who eventually highlighted the challenging concepts, give them assignment of doing the self study or peer learning to deepen their understanding on those concepts.

Possible answer for introductory activity

(a) Topics related to fraction, decimals and proportional reasoning to be studied in primary schools are given in the Primary Mathematics Syllabi (lower or Upper Primary syllabus). As a Tutor, use those 2 syllabi to confirm whether the topics said by students are taught in such a level.

(b) Teaching and learning materials to be used when teaching and learning fractions, decimals and proportional reasoning can be acquired by producing or constructing them, by collecting them from the environment, by asking learners to prepare them, by requesting the school administration or parent to buy them, by borrowing or hiring them or through improvisation.

Some items that can be collected and used for improvisation include:

(i) Concrete materials: cutting an orange, a tomato or folding a sheet of paper to show $\frac{1}{2}$, $\frac{1}{4}$ etc.

(ii) semi-concrete material on manila paper or a rice sack to illustrate division of a fraction by a whole number or different parts of a decimal number, relationship between fractions and decimal numbers on a number line or to develop proportional reasoning among students.

Materials that can be bought are for example: cubes, cuboids, counters, dices, etc.

(c) Answers on this question will be different; as a tutor, try to ask students to explain their answers and arouse their curiosity to wait for more details in the content summary for this unit. Through practical activities, outdoor activities, peer teaching activities and investigation, learners can learn well lessons on fractions, decimals and proportional reasoning. Depending on the level of learners teaching techniques to facilitate lessons on fractions and the ones to be used in the lesson on proportions can be different.

5.4 List of lessons/ sub-heading

#	Lesson title	Learning objectives	Number of periods	
			SME	ECLPE
1	Recall on concepts related to lessons on fraction, decimals and proportional reasoning.	Explain concepts related to the lessons on fraction, decimals and proportional reasoning.	2	1
2	Materials to be used in lessons on fraction, decimals and proportional reasoning	Make and organize appropriate resources using low cost materials to be used in lessons related to fraction, decimals and proportional reasoning.	1	1
3	Active teaching techniques and strategies for facilitating lessons related to fraction, decimals and proportional reasoning.	Discuss techniques and strategies for facilitating lessons related to fraction, decimals and proportional reasoning.	1	
4	Activities for developing generic competences and integrating crosscutting issues in lessons on fraction, decimals and proportional reasoning;	Use various techniques for developing generic competences and addressing cross-cutting issues in the lessons on fractions, decimals and proportional reasoning.	1	1
5	Appropriate tasks to assess competences in the lessons on fractions, decimals and proportional reasoning.	Discuss and set assessment tasks in lessons related to fractions, decimals and proportional reasoning.	1	
6	Lesson plan for lessons on fractions, decimals and proportional reasoning.	Develop lesson plans on topics related to fractions, decimals and proportional reasoning.	2	1

5.5 Guidance on different lessonstt

Lesson 1: Recall on concepts related to lessons on fractions, decimals and proportional reasoning

a) Learning objectives

Explain concepts related to the lessons on fraction, decimals and proportional reasoning

b) Teaching resources

Primary mathematics syllabi, Mathematics text books of primary level, manila papers, calculators, sheets of paper, markers, scissors and rulers.

c) Learning activities

Through groups, guide student-teachers discuss different concepts related to lessons on fractions, decimals and proportional reasoning by answering all questions for the *activity 5.1*.

- Join each group for a while to encourage their discussion about the concepts related to fractions, decimal and proportional reasoning;
- Use any approach like gallery walk which can help each group to share and have the same understanding. Use also plenary sessions for concluding and harmonizing their work related to fractions, decimal and proportional reasoning.
- Help student-teachers to conclude on concepts related to numbers and operations and assign them to do the *application activity 5.1*.
- If there are some challenging topics, they highlighted, ask them to do a self- study. They can use textbooks of the library, peer-learning or ask for help from the tutor or the teacher from the demonstration school.

Possible answers for activities

Activity 5.1:

Different groups may give different answers to questions for this activity. As tutor, try to use the syllabus and verify whether such a topic is taught in the level (grade) mentioned.

The importance of studying fractions, decimal numbers and proportional reasoning in primary schools:

By developing their own fraction kits, learners can explore a measurement model that illustrates the relationship of various fractional parts to a whole,

learners then create their own representations for a whole (by taking a strip of paper and leaving it uncut) and for halves, fourths, eighths, and sixteenths (by taking a strip of one colour and cutting it into two halves, taking a second strip of a different colour and cutting it into fourths, and so on). Learners can use these strips for a variety of fraction games and problem solving activities that focus on relationships between the fractional pieces and a whole.

Learners can explore area models of fractions by using pattern blocks. Learners explore the various fractional relationships between pattern blocks, using the yellow hexagon as the whole.

Later in their development of fraction concepts, students can explore more fractional relationships by using pattern blocks, with different blocks representing the whole.

Learners can explore the relationship between fractions and decimals by using a tenths grid, a hundredths grid, or base ten materials.

Answers to application activity 5.1:

As learners learn in different ways including, group discussion, self-study, question and answers, doing exercises, there are different ways of answering to this question. The following can be some skills to be acquired when learning fractions, decimal and proportional reasoning:

- Creative and innovation skills when cutting papers into fractional proportions.
- Problem solving skills, cooperation, etc.

Lesson 2: Materials to be used in lessons on fraction, decimals and proportional reasoning

a) Learning objectives

Organize and make appropriate resources using low cost materials to be used in lessons related to fraction, decimals and proportional reasoning.

b) Teaching resources

Mathematics syllabus for primary, existing primary mathematic books, Manila paper or a rice sack can be used for drawing semi-concrete portions of fractions, used papers, pencils, cartons, some wooden brocks, triplex, scissors, cartons, Plastic posters showing fraction, markers, coloured pencils, avocadoes, oranges, tomatoes, etc.

c) Learning activities

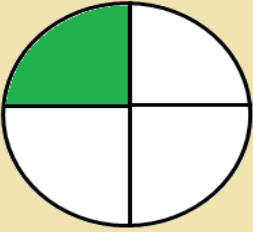
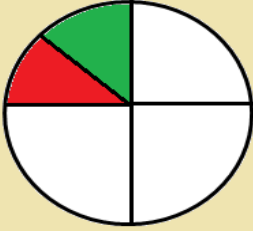
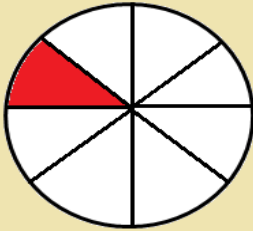
- Help the student teacher to form dynamic groups and guide them how to deal with *the activity 5.2* where they are asked to identify all materials they may need to make the teaching and learning of the division of a fraction by a whole number easier and more meaningful.
- Invite them to explain how those identified resources can be effectively used.
- While the students are working on their own, circulate throughout the room, making observations and providing guidance as needed. You need to observe how students are interacting, take note of the mathematical language students are using, and provide an extension to those who finish the task early.
- Invite each group representative to present their findings while others follow attentively and intervene with comments or supplement in case they find it necessary or at your request.
- Work together with students to harmonize their findings: students share ideas, solidify understandings, and make generalizations. You pull the whole class together at the meeting area and facilitate the discussion, inviting students to share the strategies they can use, asking if others used the same or different strategies, and adding to the strategy and word walls. During this phase, as a tutor, you must question and probe to assess students' understanding, to bring clarity to their findings, and to identify misconceptions.
- Assign students to the application activity 5.2 for assessment and evaluation of competences developed by students.

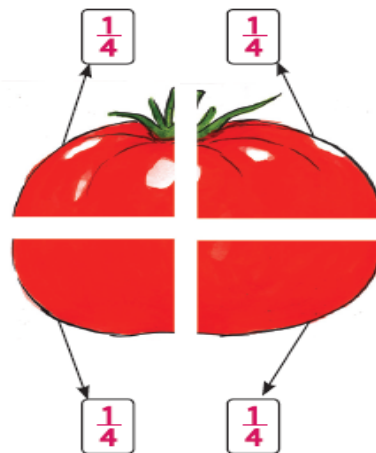
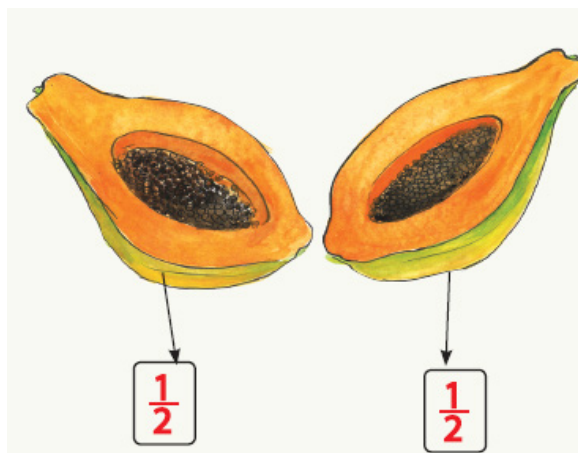
Possible answer for activities

Answers to Activity 5.2

Appropriate teaching resources can be used while teaching and learning the selected topic on fraction, decimal and proportional reasoning (example: equivalent fractions), dot paper, etc.

Student teachers can use dot paper for matching dots until they have meaningfully fraction representation. They can use sheets of paper for cutting into parts of fraction, compare them, add them to form the whole, divide them, and subtract some parts from the whole. This can also be done practically by manipulating concrete materials: cutting an orange, a tomato or folding a sheet of paper and use their parts such as $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$, etc.

$\frac{1}{4}$ of a whole 	$\frac{1}{4}$ of a whole divided into 2 equal parts 	All $\frac{1}{4}$ of a whole are divided into 2 equal parts 
<p>It is clear that divide each $\frac{1}{4}$ of a whole by 2 we get $\frac{1}{8}$ of a whole.</p> $\frac{1}{4} : 2 = \frac{1}{4} \times \frac{1}{2} = \frac{1 \times 1}{4 \times 2} = \frac{1}{8}$		



Answers to the application activity 5.2:

The teaching and learning of fraction, decimal and proportional reasoning (equivalent fraction, comparison of fractions, all operation on fractions,...) necessitates the use of low cost materials: semi concrete drawings on rice sack, on manila paper, posters help to teach fractional representation, operations on fractions. Used paper and manila paper can be used by cutting them into other parts of fractions. For more illustrations, you may check content summary that follows activity 5.2 in the student's book.

Lesson 3: Active teaching techniques and strategies for facilitating lessons related to fraction, decimals and proportional reasoning

a) Learning objectives

Discuss techniques and strategies for facilitating lessons related to fraction, decimals and proportional reasoning.

b) Teaching resources

Text book for Foundation of education in which general methods of teaching are described, syllabi and textbooks for primary mathematics, manila papers, sheets of paper, scissors, ruler pen/pencil, markers, etc

c) Learning activities

Use group discussion where student teachers are given instructions for how they are going to work on the *activity 5.3*;

- Ask student-teachers to refer to the question given by the teacher (in activity 5.3) and discuss appropriate technique(s) they may use to teach for example the topic “equivalent fraction” or any other topic related to fraction, decimal and proportional reasoning so that the lesson may be participative in which learners are more engaged.
- As students teachers are working, circulate throughout all groups, making observations and providing guidance as needed. You need to observe how students are interacting, takes note of the mathematical language students are using, and provide an extension to those who finish the task early. You must ask them some questions to prompt students’ understanding, to bring clarity to their findings, and verify whether students do have any misconception.
- Help them to present their work, highlighting what they think on the method used by that teacher and what they suggest to improve that method when teaching the lesson on fractions.
- Through learning sessions, each group explains to others how their technique is appropriate to teach that topic.
- Guide a plenary session for harmonizing the discussion and help students to take conclusion on the technique that is better than others for teaching fraction, decimal and proportional reasoning.
- Assign students to do the application activity 5.3 for assessment and evaluation of competences developed in the lesson.

Possible solutions to activities:

Activity 5.3

1. Different groups of students may give different answers depending on individual interpretation of the activity the P5 teacher set to his/her learners. They can use sticks, rope, cartons, sugar cane, or any other real objects that can be used to make cut-outs.
2. Concerning other teaching techniques, refer to the content summary that follows the activity 5.3 in the student's book and advise student teachers to suggest the combinations of different approaches.

Application activity 5.3

Teaching techniques you can use to make the lesson on **application of direct proportion in P5** more active and participative.

To introduce proportions to learners, the teacher may start by giving them *tables of equivalent rates* to fill in, such as the one below.

This will help them learn *proportional reasoning*.

Distance in km	45	90									
Hours	1	2	3	4	5						

Work with these tables (first using easy numbers) until the learners get used to them. You can tie in some of them with real-life situations. For example, you can take a situation from a proportion word problem in your math curriculum and make an equivalent rate table from it.

As you advance, give learners tables of equivalent rates to fill in where the “givens” are in the middle:

Dollars				36	45						
Hours	1	2	3	4	5						

Of course learners should notice that it is easy to fill in the table if you first figure out the unit rate then find the other amounts.

The next step is the use proportion problems and thinking: After studying tables of equivalent rates, learners are ready to tackle word problems from learners' real life experience: deal with unequal share based on double, triple, etc.

The teacher can choose simple ones at first, and let them think. They might very well come up with an answer on their own by making a table or by figuring out the unit rate.

A proportion is an equation where two ratios are equal. For example, “3 dollars per gallon” *equals* “6 dollars per two gallons”. Or, 2 teachers per 20

pupils equals 3 teachers per 30 students. Or, $\frac{3 \text{ litters}}{48 \text{ square meters}} = \frac{10 \text{ liters}}{160 \text{ square meters}}$

Of course, for it to be a *problem*, you need to make one of those four numbers to be an unknown.

When teaching, the teacher has to guide learners to explain the term proportion, define direct and inverse proportion to the class. Help learners understand that for direct proportion, if one quantity increases, the other quantity also increases,

Comparatively, in inverse proportion, if one quantity increases, the other quantity decreases.

Lesson 4: Activities for developing generic competences and integrating crosscutting issues in lessons on fraction, decimals and proportional reasoning

a) Learning objectives

Use various techniques for developing generic competences and addressing cross-cutting issues in the lessons on fractions, decimals and proportional reasoning.

b) Teaching resource

The syllabus and text books for primary levels, manila papers, calculators, sheets of paper, markers, scissor, etc.

c) Learning activities

- Use numbers game to form groups of student-teachers in classroom and give them instructions to be followed in group discussion: when you need 5 groups, you can ask them to count from 1 to 5, one to five, and so on and then you find groups of ones, twos, threes, fours and fives.
- Ask student teachers to analyze and discuss on the given word problems on activity 5.4
- Move around in the classroom and help the student teachers to understanding the task that was given to learners and then ask students

to identify the competences to be developed and cross-cutting issues to be addressed while performing such task.

- Invite student-teachers to present their findings.
- As tutor, harmonize the work done by student-teachers and help them to conclude on competences that can be developed in lessons on fraction, decimals and proportional reasoning and how a teacher can address related cross-cutting issues.

Possible answers for activities

Activity 5.4:

Competences that can be developed when learners are doing the given activity:

1. Critical thinking will be developed through analyzing and understanding the given word problem by writing out the *given*, the *unknown* and elaborating the procedure to follow including formulas if any.
2. Communication through discussion and sharing constructive ideas between group members.
3. Cooperation and interpersonal skills through working together in order to take positive agreement.
4. Problem solving: through applying the concepts including diagrams if any, formulas learnt and apply them for getting final solutions to that proportional reasoning word problem.
5. Interpretation skills when they are comparing goats and chickens.

The main cross-cutting issues that can be addressed when learners are doing the given activity is the financial education addressed when children are discussing how the farmer is going to get money for school fees by selling his goats or chickens.

You can use the content summary that follows the activity 5.4 to see, in general, the competences to be developed and crosscutting issues that can be addressed while learning fractions, decimals and proportional reasoning.

Lesson 5: Appropriate tasks to assess competences in the lessons on fractions, decimals and proportional reasoning

a) Learning objectives

Discuss and set assessment tasks in lessons related to fractions, decimals and proportional reasoning.

b) Teaching and learning resources

Syllabus and textbooks for primary mathematics, Manila paper, markers, pens, pencils, rice sack, revised bloom taxonomy table, etc.

c) Learning activities

- Help student teacher to form groups by mixing them according to their ability of understanding (talented students can help others);
- Distribute learning materials and Mathematics textbooks to student-teachers in their groups and give them instructions to do the activity 5.5: Ask student-teachers to identify any activity related to the topic on fractions, decimal numbers or direct proportions (place value of decimals up to 2 decimal places, direct proportion in context, percentages and ratios).
- Invite student-teachers to analyze the activity related to fractions, decimal and proportional reasoning included in those book in their respective groups.
- Ask student-teachers to explain whether the action verbs used in the activities used in the textbooks develop low, medium or high order thinking skills: they can use the revised bloom taxonomy table.
- As students are working, move around in the classroom and facilitate each group in their discussion.
- As tutor, harmonize the work done by student-teachers and help them to conclude on how to set tasks in the lesson related to fractions, decimals and proportional reasoning.
- Assign students to do the application activity 5.5 for assessment and evaluation.

Possible Answers for activities

Activity 5. 5

Answer to this activity will depend on questions selected. As a tutor, refer to the revised Bloom Taxonomy when verifying students' work.

Example: This is an activity found in P5 student book, unit 6:

Activity 6.3

- Give three books to each volunteer.
- Now, have 2 volunteers put their books together. How many books do they have?
- Have four volunteers put their books together. How many books do they have?
- Divide: $\frac{\text{number of books}}{\text{number of volunteers}}$. This is the book to volunteer ratio.
- Count the number of boys and girls in your group. What ratio is it?
- Explain your findings.
- Discuss situations where ratios are used in daily life.

In this activity, volunteers (who are learners) are asked to: add, count, divide, explain, and discuss. Count helps develop the low level thinking skill, Add and divide are developing the medium level thinking skills while explain and discuss are developing high level thinking skills.

Application activity 5.5:

This activity is related to equivalent fractions. The learners will write what fraction is represented by boxes (shaded part of the whole). The action verb *write* used in the question 1 is on medium level of ability as it requires making comparison.

On the question 2, the verbs *read and write* are developing the lower level of thinking skills.

In question 3, the verb *compare, explain and find* help develop high level thinking skills because they require learners to think critically, analyze and compare givens in a word problem. But there are other verbs which can be used in different levels of thinking, therefore help the student teachers to explain that the role of an action verb depends on the context the question is set for.

Lesson 6: Lesson plan on fractions, decimals and proportional reasoning

a) Learning objectives

Develop lesson plans on topics related to fractions, decimals and proportional reasoning

b) Teaching and learning resources

Manila paper, markers, flash cards, pencils, pens, lesson plan preparation notebook, foundation of education textbook, lesson plan template.

c) Learning activities

- Form groups of student-teachers in classroom and give them instructions to be followed in group discussion when working on the activity 5.6.
- As there are many topics related equivalent fractions, give one topic written on a flash cards to each group: Ask student-teachers to set the instructional objectives of the lesson, Organize teaching materials to be used in the lesson whose title was given (e.g converting fraction into decimal and vice versa, Formulate teacher's activities and learners' activities depending on the step of the lesson, Elaborate generic competences to be developed and crosscutting issues to be addressed depending on the step of the lesson and Summarize the teaching and learning techniques to be followed in this lesson.
- Visit each group and facilitate them in their discussions by asking some questions and prompts to students as they are working to let them think about many ways, encourage talk and extend thinking.
- Invite groups to present their findings.
- As Tutor, harmonize the work done by student-teachers highlighting the component of a lesson plan and the characteristics of a good mathematics lesson plan; student teachers should be motivated to write down the summary during the concluding remarks.

After the harmonization, ask students to refer to example of the lesson plan given in the student's book after the *activity 5.6* and to prepare their own lesson plan using their findings for the *activity 5.6*.

Possible answers for activities

Answer for activity 5.6

Make reference to content summary and the example of a planned lesson given in the student's book to judge students' answers on questions for this activity.

5.6 Additional information to the tutor

Five instructional strategies for developing proportional reasoning:

Helping learners develop the ability to reason proportionally requires diligence and patience. It is important to note that learners do not develop proportional reasoning in one or two lessons, a chapter, unit, or even a year. It is a process that begins in late primary school and continues into secondary school. As a result, instruction should nurture and provide numerous opportunities for this type of thinking slowly and overtime. Expecting learners to develop a solid understanding of proportionality too quickly is counterproductive. There are instructional strategies that can help learners develop proportional reasoning.

(1). Use a variety of proportion-type problems and sequence accordingly

There are four different proportion problem types - rate, part-part whole, associated sets and growth. Rate problems involve well-known measurements such as speed or cost per item. Part-part-whole problems involve a subset of a whole as it is compared to its complement, such as boys with girls or the number of boys as compared to the number of learners in the whole class. Associated set problems pertain to quantities specific to a given situation such as pencils and learners or people and candy. Growth problems, otherwise known as “stretcher” and “shirker” problems, require scaling up or scaling down and involve a relationship between two linear quantities such as height, length, or width. Scaling up and scaling down also cause changes in the area of plane figures or volume of solid figures when the dimensions are changed. Instruction should include a balance of all four semantic types. Textbooks are often weighted heavily in favor of only one or two problem types instead of a balance of all four; consequently, supplemental problems may need to be used. Early in their development of proportional reasoning, learners perform best on associated set problems because they can use pre-existing knowledge of patterns, counting, and matching techniques.

Learners usually find growth problems the most difficult because of a tendency to apply additive strategies rather than multiplicative ones. As a result, sequencing instruction should begin with associated sets or part-part-whole type of questions before moving on to growth problems.

(2). Choose tasks that have multiple solution strategies and a variety of contexts

Using a variety of contexts gives learners exposure to the variety of situations and the types of scenarios that apply to multiplicative relationships. While learners may not be able to recognize a multiplicative relationship in one situation, they might be able to in a different situation. Using a variety of tasks also elicits different solution strategies. Learners can respond to the questions in different ways depending on their level of understanding.

(3). Build upon learners' intuitive knowledge

Through experience in daily life and exposure to ideas through their school work, learners possess prior knowledge that can be used while solving proportion problems. Learning that allows learners to use their prior knowledge and intuition is important because it allows for the development of personal sense-making strategies. Learners need time to develop strategies on their own. High-level cognitive tasks require time for learners to grapple and explore their ideas. When teachers jump in too early and begin providing assistance by offering shortcuts or procedures, the complexity of the task is greatly reduced. Learners have remarkable meta-cognitive abilities to monitor and judge the reliability of their thinking without direct instruction; therefore, instruction should be designed to take advantage of learners' invented strategies. When rules and procedures are not learned with connections and meaning, learners will forget or will not understand when or why to use them.

(4). Utilize multiple representations to develop fluency in proportional reasoning

Manipulatives, pictures, and diagrams are important tools that help represent proportional situations. The availability of manipulatives, especially early on, helps with sense-making and encourages informal problem solving strategies. Cubes assist with regrouping quantities or in unitizing, especially in associated-sets and part-part-whole problems. Ratio tables are a record-keeping tool that helps display the building up or scaling down of quantities in proportional situations. Building ratio tables provide learners with opportunities to discuss and present construction strategies. Early on, problems should be situational and solved using objects and pictures. Gradually instruction can build up to more complex problems and methods of solving.

(5). Informal strategies before cross-multiplication procedures

Many traditional mathematics curricula focus on a limited number of proportion-type problems and use the cross-products procedure for solving proportions, without ever helping learners develop a reason for why the strategy works. Instruction should not promote specific strategies. Learners who are encouraged to use their own strategy rather than a single algorithm are generally more successful in developing proportional reasoning. As a result, symbolic algebra and the cross-products method should only be introduced after learners have had an opportunity to develop their informal strategies.

5. 7 End unit assessment 5

Make reference to content summary and the example of a planned lesson given in the student's book and verify the student's work of preparing a lesson on "application of direct proportion in real life situations".

6.1 Key unit competence

Prepare active lessons related to metric measurement

6.2 Prerequisite

Students will perform well in this unit if they have a good background on different concepts related to metric measurement as they learnt them in Primary (P1-P6): Length measurements, capacity measurements, mass measurements, area and land measurements, time measurement, money and its financial application, solving problems involving measurements of length, capacity and mass, solving problems involving time intervals, relationship between volume, capacity and mass, speed, distance and time, simple interest and problems involving saving.

6.3. Guidance on the introductory activity

- Form groups of student-teachers and invite them to work on the introductory activity of unit 6 ;
- Distribute the syllabi and textbooks for lower or upper primary mathematics to student-teachers;
- Ask student-teachers to identify all topics related to metric measurement in those books;
- Request student-teachers to find out appropriate resources for facilitating those lessons using low cost materials and suggest how to produce them.
- In groups, student-teachers discuss the teaching techniques to facilitate lessons related to metric measurement and explain how they can be used.
- Invite groups to present their findings in a whole class discussion.
- Use different questions to facilitate learners to give their expectation and ensure that you arouse their curiosity on what is going to be learnt in this unit basing on their experience, prior knowledge and the abilities shown in answering the questions for this activity.

Possible answers to the questions of the introductory activity

- The acquisition of mathematical concepts and skills is very crucial for continuous learning and supporting other subjects as well as developing thinking, reasoning, communication, application and meta-cognitive skills through geometrical concept and numerical concepts.

Topics related to metric measurement to be studied in primary schools are given in the Primary Mathematics Syllabi (lower or Upper Primary syllabus). As a Tutor, use those 2 syllabi to confirm whether the topics said by students are taught in such a level.

- Through practical activities, outdoor activities, peer teaching activities and investigatory learners can learn well lessons of metric measurement.
- Teaching and learning materials to be used when teaching and learning lessons related to metric measurement can be acquired by producing or constructing them, by collecting them from the environment, by asking learners to prepare them, by requesting the school administration or parent to buy them, by borrowing or hiring them or through improvisation.

Some materials are: small real objects like sticks, pens and tables, use some containers whose capacity is graduated like cup, syringes and empty bottle of medicine, metric pyramid, ruler and other measuring devices, use protractor, T-square and related improvised materials to measure angles, XO laptop and related mathematics software to calculate volume, area, etc.

6.4 List of lessons/Sub-heading

No	Lesson title	Learning objectives	Number of periods	
			SME	ECLPE
1	Recall on concepts related to metric measurement.	Identify different concepts related to metric measurement.	1	1
2	Production and organization of appropriate resources for the lessons related to metric measurement.	Use local materials to produce materials to be used in lessons related to metric measurement.	1	1
3	Active teaching techniques and strategies for facilitating lessons related to metric measurements	Describe techniques and strategies for facilitating lessons related to metric measurement.	1	

4	Activities for developing generic competences and integration of cross-cutting issues in the lessons related to metric measurement.	Use various techniques of teaching and learning to set activities that develop competences in the lessons related to metric measurement.	1	1
5	Assessment tasks related to lessons of metric measurement.	Set up assessment tasks related to metric measurements		
6	Lesson plan on metric measurements.	Develop lesson plan related to the teaching of metric measurement.	2	1
	Assessment			

6.5 Guidance on different lessons

Lesson 1: Recall on concepts related to metric measurement

a) Learning objectives

Identify different concepts related to metric measurement

b) Teaching resources

Different Mathematics books for lower or upper primary, Mathematics syllabus for lower or upper primary, manila papers, markers, pencils, real objects like sticks, pens and tables, containers, jerry cans, ruler and other measuring devices to measure the length of objects, computers, XO laptops and related mathematics software to calculate volume, area, etc.

c) Learning activities

- Form groups of student-teachers, ask them to take the learning materials (lower or upper primary syllabus, mathematics textbooks for lower or upper primary school) and attempt activity 6.1 given in the student's book.
- Ask student-teachers to select different concepts related to metric measurement in those given books.
- Ask student-teachers to identify the challenging topics from selected topics ;
- Facilitate student-teachers in their self-study on the challenging topics;

- Invite student-teachers to ask for support to their classmates or tutor on challenging topics.
- Request student-teacher to present their findings to the whole class
- Guide all student-teachers to follow attentively and to participate actively in the presentation and to take a summary.
- Help student-teachers to conclude on concepts related to metric measurement taught in primary schools.

Possible answers for activities

Answers to the learning activity 6.1

In primary school, concepts related to metric measurement are length measurements, capacity measurements, mass measurements, area and land measurements, time, money and its financial application, volume, speed, distance, and temperature.

Measuring specific attributes of objects help in early discovery, exploration and comparisons of different activities related to metric measurement. Such comparisons should proceed from direct to indirect.

(Check additional answers of this activity in the content summary as detailed in the student's book).

Answers to application activity 6.1

In the process of teaching and learning lesson on addition and subtraction of capacity measurements, learners acquire and develop different skills such as:

- Ability of selecting the appropriate type of unit for a given measurement situation, such as the unit for length, unit for volume, unit for mass and measure a convenient size for similar situations.
- Skills of converting units from one unit to another unit;
- Through problem solving, learners learn to lay out their work logically, communicate their thoughts clearly both in writing or orally;
- Mathematical reasoning increased to the ability of analyzing mathematical situations for measuring, cooperation developed through working in groups and learners develop critical thinking skills.
- Distinguish a unit model of measurement from another unit.
- Sorting objects by size, observe, measure, reading and writing measurement and manipulate them by using everyday activities and experiments with real objects.

(Read more in the content summary given in the student's book).

Lesson 2: Production and organization of appropriate resources for the lessons related to metric measurement

a) Learning objective

Use local materials to produce materials to be used in lessons related to metric measurement

b) Teaching and learning resources

Mathematics books and syllabus for lower or upper primary, local materials, rice sacs, rulers, markers, manila papers, flash cards, different instruments of measurement.

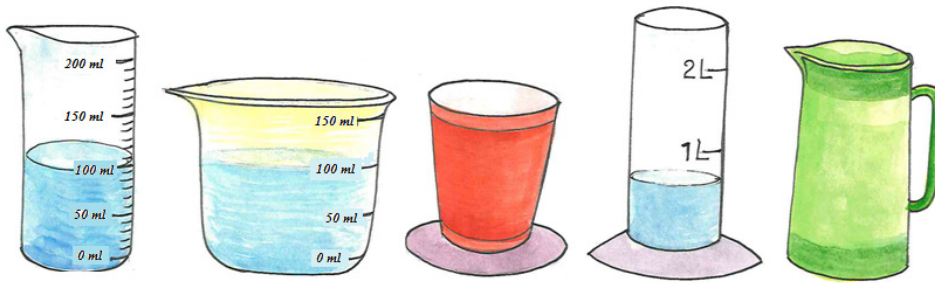
c) Learning activities

- Use numbers game to form groups of student-teachers in the classroom and provide instructions to be followed in group discussion: when you need 5 groups, you can ask them to count from 1 to 5, 1 to 5 and so on and then you find groups of ones, twos, threes, fours and fives.
- Distribute teaching resources including mathematics and syllabus of lower or upper primary.
- Ask student-teachers to choose one lesson on metric measurement and to organize appropriate teaching resources for facilitating the lesson chosen;
- Move around in the classroom by guiding student-teachers in their groups.
- Invite groups to present their findings and harmonize their answers from presentation highlighting how to produce and how to organize appropriate resources to be used when teaching the lessons related to metric measurement.

Possible answers for activities

Answers to Activity 6.2

Appropriate teaching resources can be used while teaching and learning topics on metric measurement. For example, the following resources can be used in the lesson on addition and subtraction of measurement of capacity: graduated cup or graduated Jug, jerry cans, measuring cylinder, water, etc.



We can use for example water and graduated jug or cup. Put water in graduated jug, read numbers of milliliter and put the water in non-graduated object like jerry can.

Continue to do this by adding in jerry can till you get the number of milliliters that can fill it. At the end, you can change these milliliters in centiliters.

(Find more information in the content summary from student's book).

Answers to the application activity 6.2

By the use low cost materials such as rice sack, manila paper or used papers you can produce materials related to the teaching and learning of operations and conversion of metric measurement (length, mass, capacity, area, angle measurements, time, money and temperature) units and explain how they can be used in lessons. In the teaching and learning process, teacher use rice sac, manila papers and papers on which there are different concepts on metric measurement, formulas, exercises and metric tables of units' conversion. We can also make flash cards to be used in groups by the use of manila papers.

(Check more information in the content summary given in the student's book).

Lesson 3: Active teaching techniques and strategies for facilitating lessons related to metric measurements

a) Learning objective

Describe techniques and strategies for facilitating lessons related to metric measurement

b) Teaching and learning resources

Manila papers, markers, flash cards, jerry can, graduated cups or jugs, rice sack, balance, ruler, sticks, ropes, decametre or measuring tape, etc.

c) Learning activities

- Form groups of student-teachers in the classroom; give them instructions to be followed in group discussion.
- Ask student-teachers to do the activity 6.3 discussing what can make the lesson on “conversion of capacity measurements” enjoyable,
- Move around in the classroom and facilitate groups in their discussions;
- Give student-teachers the opportunity of presenting their findings.
- Ask the two first groups to discuss on active teaching techniques and strategies that they think are the best for facilitating conversion of capacity measurements lesson in P3 or P4.
- Ask other two groups to discuss active teaching techniques and strategies that they think are the best for facilitating reading and writing measurements lesson in P3 or P4.
- Circulate in the classroom by guiding student-teachers in their discussion.
- Invite each group representative to present findings from their groups.
- As tutor, harmonize the work done by student-teachers and help them to conclude on active teaching techniques and strategies for facilitating lessons related to metric measurements.

Possible answers for activities

Answers to activity 6.3

- (a). The teacher can do the following in order to make lesson more enjoyable:
- Give learners more opportunities to manipulate given real objects to be used in teaching and learning metric measurement.
 - With provided activities, the teacher gives enough time for interaction by joining their efforts and capabilities in solving problems;
 - Use good strategies that engage all learners in teaching and learning with manipulative objects.
 - Motivate learners during the process of teaching and learning.

(b). Possible teaching techniques and strategies for facilitating the lesson on the conversion of measurements for capacity:

Group work: distribute real materials like graduated cup or jug, jerry can. Through the use of these materials learners work cooperatively in groups by measuring the volume of water that can fill other objects from ones which are graduated.

Brainstorming: In open discussion, the teacher asks the question about conversion of capacity measurements and learners are given time to brainstorm on it.

Gallery walk: One exercise is given to learners in groups, after discussion and answer the exercise they hang the work on wall then with rotation one group read the work done by others so that they can add or learner new concepts on conversion of capacity measurements.

(Check more active techniques to facilitate lessons on capacity in the content summary given in the student's book).

Answers to application activity 6.3

Teaching techniques that can be used to make the lessons on measuring the length and perimeter of various objects in different units more active and participative:

- **Outdoor activities:** Learners go outside of the classroom to measure the perimeter of the school compound, length of the ground, measure the area of a tiled floor by counting the number of tiles it is made up before being given the formula for multiplying the number of tiles found on the length and those on the width.
- **Practical activity:** learners do more practice independently, in pairs or in groups when they are in measuring or converting measurements units.
- **Group work:** learners work together in measuring, estimating and converting units of measurement. This technique helps learners to be motivated, encourage active learning, and develop key critical thinking, communication, and decision-making skills when they are in discussion on the given activity.
- **Group questions:** Organize learners into small groups. Ask them to use the textbook or their notes to write three questions about metric measurements for another group to answer. They could also write the answers on the back of the paper. Then the groups should exchange papers and try to answer the questions.

(Check more active techniques to facilitate lessons on metric measurements in the content summary given in the student's book).

Lesson 4: Activities for developing generic competences and integration of cross-cutting issues in the lessons related to metric measurement

a) Learning objectives

Use various techniques of teaching and learning to set activities that develop competences in the lessons related to metric measurement.

b) Teaching and learning resources

Mathematics syllabus and textbooks for primary, manila papers, markers, flash cards, rice sack, different materials for measuring, etc.

c) Learning activities

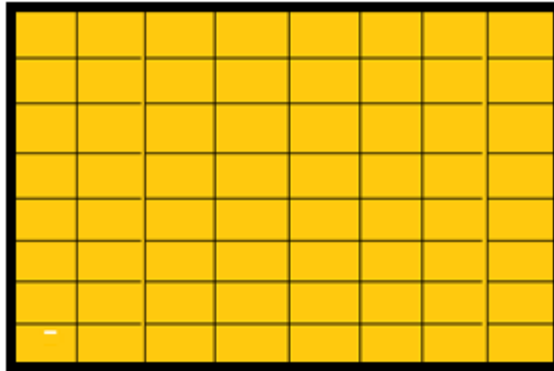
- Form groups of student-teachers in the classroom, give them instructions to be followed in group discussion and guide them how to do the activity 6.4 in the students' book.
- Ask student-teachers to identify and explain the competences to be developed while performing activity 6.4.
- Guide student-teachers to find out cross-cutting issues that can be addressed in performing activity 6.4
- Move around in the classroom and motivate the engagement for every student during their discussions.
- Give student-teachers the opportunity of presenting their findings.

As tutor, harmonize the work done by student-teachers and help them to conclude on the status of activities for developing generic competences while addressing cross-cutting issues in the lessons related to metric measurement.

Possible answers for activities

Answers to Activity 6.4

1. The determination of the number of tiles depends on the number of tiles which are on the length of the floor for the house: For example the following floor has 8 tiles at each side.



The total number of tiles can be determined by calculating the area of the floor: area that the tiles will cover during the construction: This is: $A = L \times L$.

In our example we have: $8 \times 8 = 64$ tiles

1. Competences to be developed while performing activity 6.4 in student's book. *Problem-solving* developed through the application of concepts learnt in mathematics by thinking how to determine the number of tiles and the perimeter. Through measuring the length and area of the house learners develop *critical thinking*.
2. **Cooperation** developed through working in groups, the spirit of working together and sharing ideas on their work.
3. The given activity is developing the medium level thinking skills (on the application level of bloom taxonomy). Learners of primary four, five and six can do this activity.
4. Cross-cutting issues that can be addressed while performing activity 6.4 in student's book: Apart from gender and inclusive education that can be addressed depending on the way the teacher organized the groups of learners, the activity does not highlight any other crosscutting issue. However, this activity can be adapted to address the **financial education** by including the cost of needed tiles for finishing the house and asking to guess how such amount of money can be obtained.

(Check more information in the content summary given in the student's book)

Lesson 5: Assessment tasks in the lessons related to metric measurements

a) Learning objective

Set up assessment tasks related to metric measurements.

b) Teaching and learning resources

Textbook for primary mathematics, manila papers, markers, flash cards, rice sack, different materials for measuring, etc...

c) Learning activities

- Form groups of student-teachers in the classroom, give them instructions to be followed in group discussion, distribute syllabus and mathematics books for lower or upper primary and ask student-teachers to do activity 6.5: identify an activity related to the addition of metric measurement, analyze it and explain whether the action verbs used in that activity develop low, medium or high order thinking skills.
- Move around in the classroom and facilitate groups in their discussions by asking some questions to prompt the new ideas and to engage all students.
- Invite student-teachers to present their findings for the whole class discussion;
- As tutor, harmonize the discussion and the findings for students helping them to conclude on how to set assessment tasks in the lessons related to metric measurements. Highlight that when setting tasks and activities, teachers must use action verbs referring to all levels of the revised Bloom Taxonomy.

Possible answers for activities

Answers to Activity 6.5

Answers for this activity may be different. As a tutor, refer to the revised Bloom Taxonomy when verifying students' work.

The following are examples of two activities on metric measurement for primary five learners:

1. Discuss different ways an individual, family and schools can get money.
2. Explain how money can help individuals, the family and the school to solve problems.

The above activities have actions verbs such as: *discuss and explain*.

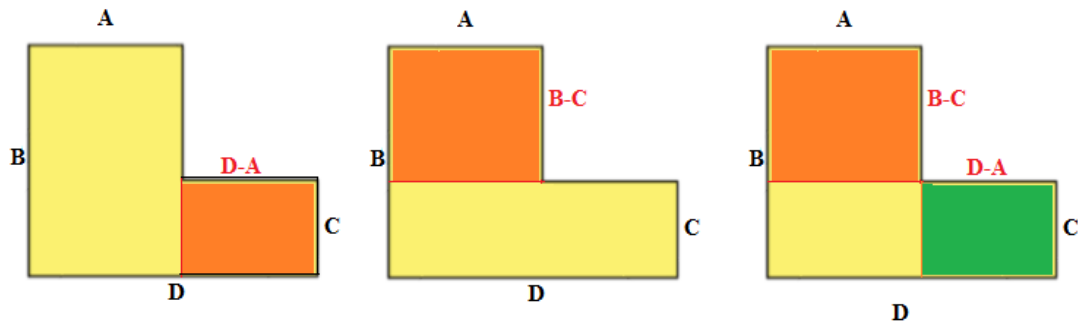
All these verbs express high levels of thinking skills. As a tutor, check the content summary in student's book for more information and get ready to advise student teachers for every activity chosen by their groups.

(Follow these steps above on other activities in mathematics from primary 1 to primary 6).

Answers to application activity 6.5

During this activity, learners will: discuss, exchange ideas, measure the length for all sides using instruments of measurement, think critically before action of reorganizing the surface by cutting it into more sections, calculate the area, and make the sum.

This ground can be organized in three different ways:



The first way consists of two rectangles with area: $(A \times B) + [(D-A) \times C]$.

The second consists of two rectangles with area: $[A \times (B-C)] + (D \times C)$.

The third way considers 3 rectangles with the area: $[A \times (B-C)] + (C \times A) + [(D-A) \times C]$.

Through these, learners will be developing the following skills: cooperation, critical thinking, cognitive skills, problem solving skills, decision making skill, interpretation skills, etc.

This activity can be done only by P4 learners with high order thinking skills but it is related to P5 learners where they study the area of composite figures.

Lesson 6: Lesson plan on metric measurements

a) Learning objectives

Develop lesson plan related to the teaching of metric measurement

b) Teaching and learning resources

Syllabus and textbooks for primary mathematics, manila paper, markers, flash cards, pencils, pens, etc.

c) Learning activities

- Use numbers game to form groups of student-teachers in the classroom and provide instructions to be followed in group discussion: when you need 5 groups, you can ask them to count from 1 to 5, 1 to 5, and so on and then you find groups of ones, twos, threes, fours and fives.
- Give students instructions to be followed in group discussion when working on the *activity 6.6*.
- Distribute flash cards or handouts to student-teachers on which there is the title of the *lesson on conversion of mass measurements*.
- Ask student-teachers to set the instructional objectives of the lesson, organize teaching materials to be used in the lesson whose title was given to them, formulate teacher's activities and learners' activities depending on the step of the lesson, Devise generic competences to be developed and crosscutting issues to be addressed depending on the step of the lesson and to Summarize the teaching and learning techniques to be followed in this lesson.
- Move around in every group and facilitate them in their discussions by asking some questions and prompts to students as they are working to let them think about many ways, encourage talk and extend their thinking.
- Invite groups to present their findings.
- As Tutor, harmonize the work done by student-teachers highlighting the component of a lesson plan and the characteristics of a good mathematics lesson plan. Student teachers should be motivated to write down the summary during the concluding remarks.
- After the harmonization, ask students to refer to the example of the given prepared lesson and prepare their own lesson plan using their findings from the activity 6.6.

Possible answers for activities

Answer to activity 6.6

Make reference to content summary and the example of a prepared lesson given in the student's book.

6.6 End unit assessment 6

Make reference to the content summary and the example of prepared lessons given in the student's book and verify students' work.

7.1 Key unit competence

Prepare active lessons related to algebra

7.2 Prerequisite

To perform very well in this unit, the student teachers must have a good background on the following:

- Algebra related content learnt in P3-P6: Number Patterns, filling in missing numbers, sequences that include whole numbers, fractions and decimals, equivalent expressions and number sequences, Solving simple algebraic equations and inequalities.
- Lesson planning and general methods of teaching from foundation of education (TTC year 1)

7.3 Guidance on the introductory activity

- Form groups of student-teachers and invite them to work on the introductory activity of unit 7 where they will find out all units related to algebra, make a list of all appropriate resources for facilitating related lessons and suggest how to produce some of them using locally or low cost materials.
- In groups, student-teachers discuss the teaching techniques to facilitate lessons on algebra (number patterns and sequences, fill in the missing number, simple equations and inequalities) and compare those techniques.
- Give them the time to present their findings for a whole class discussion;
- As a tutor, use different questions to facilitate students to give their expectations and ensure that you arouse their curiosity on what is going to be learnt in this unit basing on their experience, prior knowledge and abilities shown in answering the questions for the introductory activity.
- To well perform this activity, help student- teachers to use mathematics textbook and syllabus of lower or upper primary.

Possible answers to the questions of the introductory activity

- Topics related to Algebra to be studied in upper primary schools are given in the Primary Mathematics Syllabi. As a Tutor, use them to compare whether the topics said by students are appropriate.
- You can have different answers for the question related to similarity of some units developing algebra depending on the level of understanding

for student teachers. As a tutor, try to ask them to compare those units and help them to conclude that they will study how to teach patterns where a hint needs to be discovered to find the missing number, to find the next number in a number sequence or to solve a simple algebraic equation or inequalities.

- Through practical activities, outdoor activities, observations, exploration and investigation, brainstorming, questioning techniques, peer teaching activities, learners can learn well lessons on algebra (number patterns, number sequences, simple algebraic equations or inequalities). Depending on the level of learners, one can use various teaching techniques to facilitate any lesson on algebra.
- Teaching and learning materials to be used when teaching and learning algebra can be acquired by producing or constructing them, by collecting them from the environment, by asking learners to prepare them, by requesting the school administration or parents to buy them, by borrowing or hiring them or through improvisation.

Some items that can be collected and used for improvisation include:

- Plastic bottles or bottle tops on which there are numbers sequences: arithmetic or geometric progressions,
- Flash cards on numbers cards
- Arithmagons drawn on rice sack or on manila paper
- Number grid on a rice sack or manila paper with numbers sequences in colours
- Sticks to make patterns and generate new number sequences
- Drawings, pictures or diagrams and tables on manila paper or rice sack showing patterns and number sequences.

Conclude the lesson by arousing the curiosity of students on what will be learnt in this unit.

7.4 List of lessons/Sub-heading

No	Lesson title	Learning objectives	Number of periods	
			SME	ECLPE
1	Recall on concepts related to algebra taught in primary.	Explain different concepts related to algebra.	1	1
2	Appropriate teaching and learning resources to be used in algebra lessons.	<ul style="list-style-type: none"> - Choose appropriate resources to be used in lessons related to algebra. - Use local materials or low cost materials to make teaching aids related to algebra lessons. 	1	
3	Techniques and strategies for facilitating lessons related algebra	Select and discuss techniques and strategies for facilitating lessons related to algebraic concepts	1	1
4	Activities for developing generic competences and activities for addressing crosscutting issues in algebra lessons.	Set up activities that help to develop generic and determine various techniques for addressing cross-cutting issues in the lessons related to algebra.	1	
5	Assessment tasks related to lessons of algebra.	Discuss assessment tasks for facilitating lessons related to algebra lessons.	1	1
6	Writing lesson plan for algebra lessons.	Prepare lesson plans on algebra taught at primary.	2	1
	Assessment			

7.5 Guidance on different lessons

Lesson 1: Recall on concepts related to Algebra

a) Learning objectives

Explain different concepts related to algebra

b) Teaching resources

Different Mathematics books for primary, Mathematics syllabus for primary, manila papers, rice sacks, scissors and markers to prepare charts and posters, flash cards or number cards, plastic bottles or bottle tops, sticks, XO laptop, mathematics software like Geogebra to plot some simple mathematics functions related to equations and inequalities.

c) Learning activities

- Form groups of student-teachers, ask them to take the learning materials (P2-P6 Mathematics syllabus and textbooks) and attempt activity 7.1 given in the student-teachers' book.
- Guide all student-teachers to follow attentively, to interact: use the syllabus and select different concepts related to algebra; they will write down topics they find challenging;
- Invite each group to present their findings to the whole class
- Help student-teachers to conclude on mathematics concepts related to algebra learnt in lower or upper primary schools.
- Assign each student-teacher to a peer-learning on the topics he/she finds challenging;
- Invite student- teachers to work in pairs the application activity 7.1 for assessment of the lesson.

Possible answers for activities

Answers to the learning activity 7.1

Check answers of this activity in the summary content found in the student's book and the syllabus.

Answers to application activity 7.1

In the process of teaching and learning “Sequences that include whole numbers, fractions and decimals”, learners should acquire different skills such as:

- Problem solving Skills, logical thinking skills, analysis skills and critical thinking skills: Sorting and arranging numbers in ascending or descending order, mathematical reasoning increased through analyzing a given number sequence and deducing if it is arithmetic or geometric progression, finding the missing number or any term of a number sequence.
- Cooperation developed through working in groups and sharing ideas;
- Critical thinking skills though applying some operations (addition, subtraction), to generate or construct logical sequence.
- Communication skills are developed through discussion in groups, presentation and explanation of the work done.

Lesson 2: Production and organization of appropriate resources for the lessons related to Algebra

a) Learning objectives

- Choose appropriate resources to be used in lessons related to algebra.
- Use local materials or low cost materials to make teaching aids related to algebra lessons

b) Teaching and learning resources

Mathematics books and syllabus for lower or upper primary, local materials, rice sacs, rulers, markers, manila papers, flash cards, grid numbers, graph papers, plastic bottles or bottle tops on which there are numbers sequences, flash cards on numbers cards, number grid on a rice sack, sticks, drawings, pictures or diagrams and tables on manila paper or rice sack showing patterns and number sequences.

c) Learning activities

- Ask student-teachers to write down any topic related to Algebra (P1-P6) you can teach using the given grid number.
- Give them instructions to follow, for having productive work.
- Form pairs of student-teachers, give them instructions and assign each pair with teaching resources including grid numbers, manila papers and syllabus of upper primary and mathematics pupil's book.
- Ask student-teachers to attempt the activity, organize appropriate teaching resources for facilitating lesson on arithmetic progression and explain how to use those resources.
- Invite each group representative to present their findings and give student teachers time to discuss and share ideas about the use of the

number grid aligned with the classification of numbers according to the common properties.

- As a tutor, harmonize the work done by student-teachers.

Possible answers to activities

Answers to Activity 7.2

The number grid can be used when teaching and learning algebraic concepts like : arranging whole numbers in ascending and descending order (P4), arithmetic or geometric progression (odd numbers, even numbers, square numbers in P4), extending number patterns to sequence in P5, linear sequence or number sequence with general term in P6.

From the number grid, it is easier to observe that:

- 1, 3, 5, 7, 9, 11, 13, etc is an arithmetic progression made by odd numbers and the constant or common difference or pattern is 1
- 2, 4, 6, 8, 10, 12, etc is an arithmetic progression made by even numbers and the constant or common difference or pattern is 2
- 1, 4, 9, 16, 25, 36, 49, 64, 81, etc is a sequence with the general term n^2 , with n an element of the set of natural numbers.

Answers to Application activity 7.2

Low cost materials related to the teaching and learning of number patterns; number sequences; algebraic expressions, equations or inequalities are for example: rice sack, number grids on manila papers, plastic bottles, bottle tops, flash cards, number cards containing numbers to be sorted out or classified following a certain pattern or common characteristics. Lower or upper primary learners can better understand the concept of number pattern or number sequence from observing, manipulating and investigating the relationship between numbers.

(For more explanation check the content summary that follows the activity 7.2 in the student-teacher's book).

Lesson 3: Active teaching techniques and strategies for facilitating lessons related to Algebra

a) Learning objective

Select and discuss techniques and strategies for facilitating lessons related to algebraic concepts.

b) Teaching and learning resources

Chart paper, sheets of paper, handout of scenarios, glue, colours, manila papers, markers, the syllabus, textbooks, Reference books, Computer and the projector (where possible), etc...

c) Learning activities

- Form six groups of student-teachers in the classroom, give them instructions to be followed in group discussion
- Ask student-teachers to discuss the two scenarios A and B and find out the teaching techniques used in each scenario. Let them describe the teaching techniques used in each scenario and advise the best teacher from the two scenarios, and explain why ?
- Move around in the classroom and facilitate groups in their discussions
- Provide student-teachers the opportunity of presenting their findings.
- Ask each group to discuss active teaching techniques and strategies that they think are the best for facilitating a lesson on arithmetic progression
- Move in the classroom by guiding student-teachers in their discussion
- Request each group representative to present findings from their groups.
- As tutor, harmonize the work done by student-teachers and help them to conclude.
- After the conclusion, provide instructions to student-teachers so that they can individually or in pairs work on *application activity 7.3* for assessment of the lesson.

Answers to Activity 7.3

After analyzing two scenarios, different suggestions will be raised up by student-teachers. As tutor, facilitate them to realize that the first scenario is the best, because the teacher A is using strategies or techniques that are encouraging learners through observation, exploration, investigation and practice (group work and group discussions, exploration of materials, analysis of the activity, presentation of findings through gallery walk, harmonization of students' works, and brainstorming). The teacher A develops a tangible understanding of arithmetic progression by using concrete and semi concrete materials (plastic bottles with number sequences, coloured number grid on a rice sack, flash cards containing number sequences).

In the second scenario, let student-teachers find out that expository, question and answer techniques were used by the teacher B. *Check answers from*

content summary in the student's book on Teaching and learning strategies related algebra.

Lesson 4: Activities for developing generic competences and integration of cross-cutting issues in the lessons related to algebra

a) Learning objectives

Set up activities that help to develop generic and determine various techniques for addressing cross-cutting issues in the lessons related to algebra.

b) Teaching and learning resources

Manila papers, markers, rice sack, pens, sticks, plastic bottles, flash cards, number cards, number grid, the syllabus, textbooks, Reference books, Computer and the projector

c) Learning activities

- Form groups of student-teachers in classroom and give them instructions to be followed in group discussion.
- Ask student-teachers to read through the **activity 7.4** in student's book.
- Ask student-teachers to identify and explain the competences to be developed as well as the cross-cutting issues to be addressed while performing **activity 7.4**.
- Move around in the classroom and facilitate groups in their discussions.
- Let student-teachers present their findings and allow the whole class to discuss the findings.
- Remember to summarize and give conclusion on the tasks performed by your student teachers.
- Let students work out individually or in pairs the *application activity 7.4* for assessment and evaluation.

Answers for activities

Activity 7.4:

1. Competences can be developed while performing the activity in 7.4
2. Through finding the value of x using properties of rectangle, learners develop cooperation and communication skills, critical thinking, mastering Math Facts, proficiency with operations, problem solving through substituting the value of x to find the length of rectangle, representation skills, etc

3. This activity can be given to P6 learners.
4. The inclusive education is addressed as learners should work in groups to discuss and share ideas. The activity is providing to all learners opportunities of attempting it by starting to simple tasks (observation and exploration) to complex tasks (establishing relationships and generating the next numbers of the sequence).

Gender is addressed as learners should work in groups to discuss and share ideas. The activity is availing opportunities to both boys and girls while working in groups.

Finally, peace and value education are addressed as learners should work in groups to discuss and share ideas and respect each other in a peaceful manner.

Lesson 5: Assessment tasks in the lessons related to Algebra.

a) Learning objective

Discuss assessment tasks for facilitating lessons related to algebra lessons.

b) Teaching and learning resources

Manila papers, markers, numbers on flash cards, arithmagon drawn on rice sack and on papers, bloom taxonomy check list, the syllabus, textbooks, reference books, computer and the projector.

c) Learning activities

- Use different numbers by counting where student-teachers count numbers from one to five alternatively to form five different groups. Student who counted 1 will form group 1, student who counted 2 will form group 2, etc.
- Distribute Mathematics textbook of P2- P6 to student-teachers in their groups.
- Ask student-teachers to do *activity 7.5*: identify any activity related to the topic on algebra (Fill in the missing number, geometric progression, general term of a number sequence).
- Invite student-teachers to analyze the activity in their respective groups and explain whether the action verbs used help to develop low, medium or high order thinking skills.
- Move around in the classroom and facilitate groups in their discussions by asking some questions to prompt student-teachers as they are working to assess understanding, encourage talk, extend thinking or consolidate learning.

- Invite each group to present their findings.
- As tutor, harmonize the work done by student-teachers and help them to conclude. Highlight that when setting tasks and activities, teachers must use action verbs referring to list of action verbs classified in different levels of bloom Taxonomy.

Answers for activities

Activity 7.5

Answers for this activity may be different. As a tutor, refer to the revised Bloom Taxonomy when verifying students' work. The following are activities on number sequence for primary five learners:

1. Observe the following number sequence $\frac{1}{2}, \frac{5}{2}, \frac{7}{2}, \frac{9}{2}, \frac{11}{2}$ and re-write them on number cards.
2. Observe the following number sequence $\frac{1}{2}, \frac{5}{2}, \frac{7}{2}, \dots$ write more 3 numbers on flash cards with a pattern that follows "plus 2 on the previous number"
3. Find the next numbers in the sequence below:
5, 5.5, 6, 6.5, 7, 7.5, ____, ____
4. Discuss the sequence given below and discover the pattern used.
10, 10.5, 11, 11.5, 12, 12.5, ____, ____ Form your own sequences involving decimals and make presentation to the class.
5. Study the sequence: 2, 3, 5, 7, 11, ____, ____ Explain the rule used in finding the sequence and make a presentation.

The above activities have actions verbs such as:

- *Observe and re-write develop lower thinking skills*
- *Observe and write, find develop medium thinking skills;*
- *Discuss and discover, form, study and explain, make presentation are all action verbs which develop higher thinking skills.*

Answer to application activity 7.5

Answers for this activity may be different. As a tutor, refer to the revised Bloom Taxonomy when verifying students' work.

Lesson 6: Lesson plan on algebra

a) Learning activities

Prepare lesson plans on algebra taught at primary school.

b) Teaching and learning resources

Manila paper, lesson plan notebook, markers, flash cards, pencils, pens, ruler

c) Learning activities

- Form groups of student-teachers in classroom and give them instructions to be followed in group discussion when working on the activity 7.6.
- Distribute handouts to student-teachers on which there is “*lesson on arithmetic sequences or progressions*”
- Ask student-teachers to read carefully the sample lesson plan on arithmetic progression, analyze the instructional objectives of the lesson, organize teaching materials to be used in the lesson whose title was given to them, re-formulate teacher’s activities and learners’ activities depending on the step of the lesson, devise generic competences to be developed and crosscutting issues to be addressed depending on the step of the lesson and re-summarize the teaching and learning techniques to be followed in this lesson.
- Visit each group and facilitate them in their discussions by asking some questions and prompts student-teachers as they are working to let them think about many ways, encourage talk and extend thinking.
- Invite groups to present their findings.
- As Tutor, harmonize the work done by student-teachers highlighting the component of a lesson plan and the characteristics of a good mathematics lesson plan, students- teachers should be motivated to write down the summary during the concluding remarks.
- After the harmonization, ask students to refer to the example of the given lesson plan and to prepare their own using their findings from the activity 7.6.

d) Answer for activities

Activity 7.6

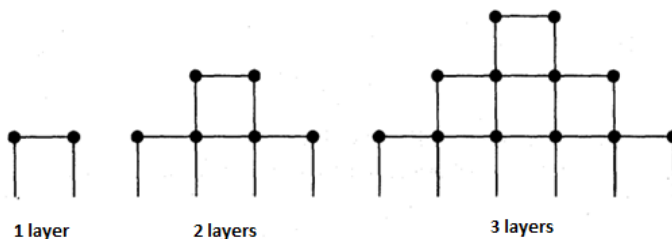
Make reference to the example of a planned lesson given in the student’s book, assess students’ work and provide relevant feedback.

7.6 Additional information

You may ask your student teachers to make the grid number or any other teaching aid which may be used to teach and learn arithmetic progressions.

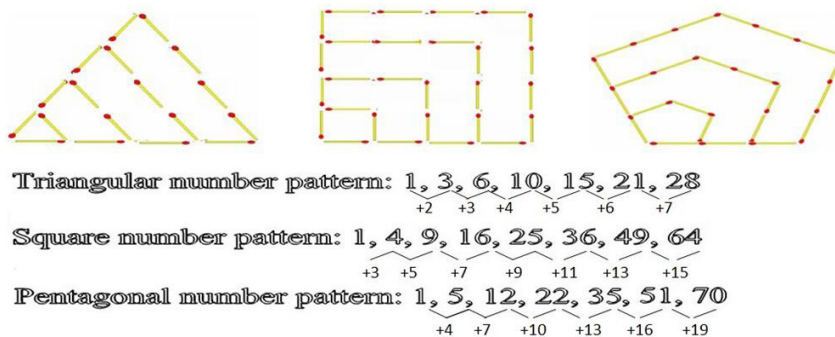
Refer to the following examples:

- The situation: The primary learners were playing a game. In there, they have to use the matchsticks to make the flowering pyramids with different towers as shown in the figure.



To become a winner, they tried to build the tower with 1000 layers. However, how many the matchsticks will be used to rank the podium and how many match sticks are needed for the flowering pyramids. Can you help them to calculate the number of matchsticks?

- Different patterns to show how triangular, square and pentagonal number patterns are build.



- Posters on manila paper to show example of geometric progression

Geometric Sequence

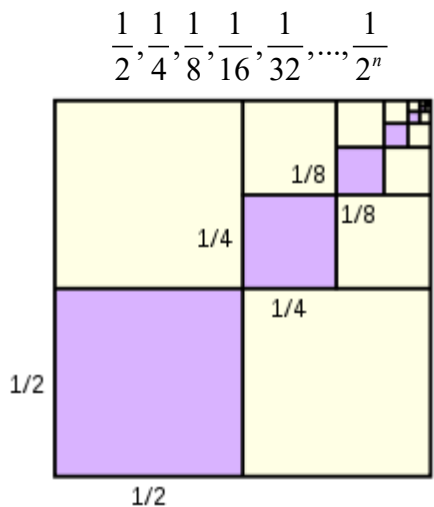
A geometric sequence is one where to get from one term to the next you multiply by the same number each time. This number is called the **common ratio, r** .

Eg

1	2	3	4	
2,	10,	50,	250 ...	
	$\times 5$	$\times 5$	$\times 5$	$r=5$

$\frac{10}{2}=5$	$\frac{50}{10}=5$	$\frac{250}{50}=5$
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4. Folding A4 paper to show example of geometric progression :



7.7 End unit assessment 7

Make reference to the example of a planned lesson given in the student-teacher's book unit 7 and guidelines of a good lesson plan (as developed in FOE), assess mathematics lesson prepared by student teachers.

8.1 Key unit competence

Prepare active lessons related to geometry

8.2 Prerequisite

Student-teachers will work effectively in this unit if they have a good background on Lesson planning learnt in Foundation of Education in TTC year one, Unit 8 and all concepts related to geometry learnt from Primary one (P1) to primary six (P6).

8.3. Guidance on the introductory activity

- Use one technique in forming groups of student-teachers and invite them to work on the introductory activity of unit 8 in student's book. Give them the syllabi and textbooks for lower or upper primary mathematics in their respective groups.
- Provide instruction on what to do: identify all topics related to metric geometry, find out appropriate resources for facilitating lessons related to geometry and suggest how to produce them and they will summarize the techniques to use in teaching and learning lesson related to geometry taught in primary schools.
- Invite groups to present their findings in a whole class discussion.
- Use different questions to arouse their curiosity on what is going to be learnt in this unit basing on their experience, prior knowledge and abilities shown in answering the questions for this introductory activity.

Possible answers to the questions of the introductory activity

- Topics related to geometry to be studied in primary schools are given in the Primary Mathematics Syllabus of lower or Upper Primary. As a Tutor use those 2 syllabi to confirm whether the topics said by student-teachers are taught in such a level.
- Each topic of geometry taught in primary school needs appropriate resources for facilitating the lesson. For example:
 - a) **Sticks used in** constructing geometric shapes like triangles, squares, rectangle, pentagon, hexagon, etc...
 - b) **Plastic bottles:** in teaching and learning lessons on geometric shapes learners cut plastic bottles in form of cylinders.

- c) **Sheet of Paper:** by folding paper and cut edges, continue folding paper in many times by cutting the edges you will get the polygon of n sides which tends to be a circle. This is a good kind of low cost materials for teaching different polygons.
- d) **Geometer's Sketchpad:** learners explore transformations such as (reflections, translations, and rotations); construct polygons in a variety of ways; make tiling patterns; determine the relationship between perimeter and area and construct regular polygons given the perimeter or area.

ICT tools used in teaching and learning lessons related to geometry such as XO laptops, calculators, etc...

- Answer for the question on teaching techniques; as tutor try to ask student-teachers to explain their answers and arouse their curiosity to wait for more details in the summary content of unit 8. Through practical activities, outdoor activities, peer teaching activities and investigatory learners can learn well lessons on the types of lines as those techniques can be used to learn lessons related to the types of angles. Depending on the level of learners, teaching techniques to facilitate lessons on the types of lines and lessons related to the types of angles can be different.

8.4 List of lessons/Sub-headings

No	Lesson title	Learning objectives	Number of periods	
			SME	ECLPE
1	Recall on concepts related to geometry taught in primary levels	Explain different concepts related to geometry taught in primary.	1	1
2	Production and organization of appropriate resources for the lessons related geometry	Organize and use local materials to make teaching resources to be used in geometry lessons.	1	1

3	Active teaching techniques and strategies for facilitating lessons related to geometry	Select appropriate techniques and strategies for facilitating lessons related to geometry in primary	1	1
4	Activities for developing generic competences and integration of cross-cutting issues in the lessons related to geometry	Use various techniques to set activities that develop competences in the lessons related to geometry	1	
5	Assessment tasks related to lessons of geometry	Develop and discuss assessment tasks for facilitating lessons related to geometry.		
6	Lesson plan on a concept related to geometry	Prepare lesson related to geometry for primary school.	2	1
	Assessment			

8.5 Guidance on different lessons

Lesson 1: Recall on concepts related to geometry taught in primary levels

a) Learning objectives

Explain different concepts related to geometry taught in primary.

b) Teaching resources:

Syllabus and Mathematics books for lower or upper primary, Manila papers, markers, pencils, real objects, geometric figures, XO laptop and related mathematics software.

c) Learning activities

- Form groups of student-teachers, ask them to take the learning materials (lower or upper primary syllabus, mathematics textbooks for lower or upper primary school) and do activity 8.1 given in the student's book.
- Ask student-teachers to select different concepts related to geometry from primary textbooks (Each group take one level such as P1, P2, P3, P4, P5 or P6).

- Ask student-teachers to identify the challenging topics from selected topics in geometry
- Facilitate student-teachers in their self-study on the challenging topics
- Invite student-teachers to ask support to their classmates or tutor on topic they find more challenging.
- Request student-teacher to present their findings to the whole class;
- Guide all student-teachers to follow attentively and to participate actively in presentation and to take a short summary.
- Help student-teachers to conclude on concepts related to geometry.

Possible answers for activities

Answers to activity 8.1

Different concepts related to geometry are provided in the syllabus for primary school. The fundamental geometrical concepts taught in primary school depend on 4 basic concepts: point, line, plane and space.

However, these terms will not be precisely defined; their meanings will be explained through examples of their elements or subsets. (*Check addition answers of this activity in the summary content in student's book.* Highlight that a student teacher has to be able to do all activities found in the primary mathematics books. Assign every student to ask for help (form colleagues or the tutor) if there is any challenging topic.

Answers to application activity 8.1

For each of lessons on the types of lines, lesson on angles formed by intersecting lines and lesson on the determination of the volume for a cylinder, Learners acquire and develop the following skills:

During the process of teaching and learning the lesson said above, learners become Creative when they are producing materials to be used on various lessons related to geometry. This leads learners to critical thinking through creativity as they become good decision-maker.

Through group discussion and peer learning, learners develop a skill of problem-solving as they relate what they discussed in groups with real life situations. Self-management of learners appears in solving given problem by respecting provided time and show the curiosity of working with others in group discussion. Thinking skills developed through spatial visualization

Lesson 2: Production and organization of appropriate resources for the lessons related geometry

a) Learning activities

Organize and use local materials to make teaching resources to be used in geometry lessons.

b) Teaching and learning resources:

Mathematics books and syllabus for lower or upper primary, local materials, rice sacs, rulers, markers, manila papers, flash cards, geometric figures.

c) Learning activities

- Form groups of student-teachers using numbers and give them instructions to follow in carrying out the activity 8.2: To get resources such as the syllabus and Mathematics books for lower or upper primary, choose one lesson on geometry (e.g. lesson on types of angles), organize appropriate teaching resources and explain how they can be used.
- Ask student-teachers in their respective groups to find out some teaching resources they can use to teach geometric concepts, and how they can produce some of them using local materials.
- Use gallery walk and ask student-teachers to hang on the wall their work; other groups will turn around to verify what others have done and add or supplement their ideas.
- Circulate in the classroom to guide student-teachers and ask them some questions to orient their discussions.
- Invite groups to present their findings and as a tutor, harmonize their answers and help them to conclude on the production and organization of appropriate resources for the lessons related geometry.

Possible answers for activities

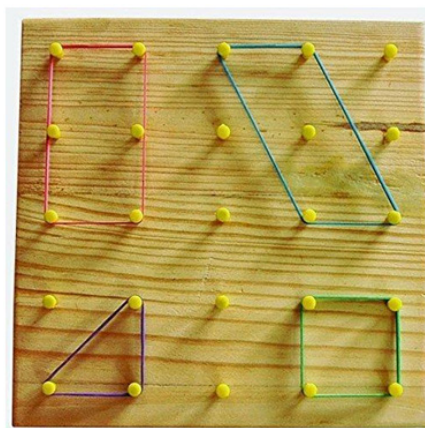
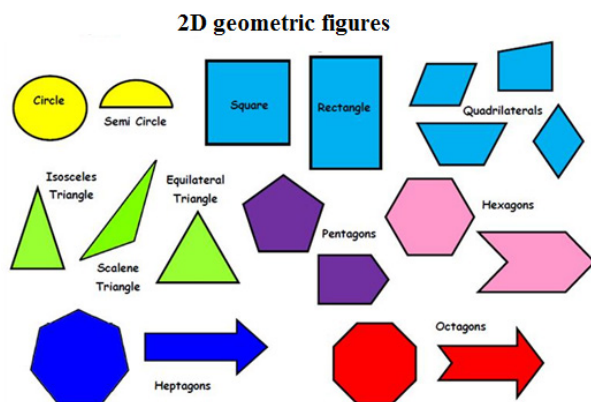
Answers to Activity 8.2

Students may give different answers in this activity. However, appropriate teaching resources can be used while teaching and learning the selected topic (e.g. lesson on types of angles).

- On Manila paper, you can draw different types of angles and their characteristics/properties.
- Protractor made in wooden can be used to measure different angles so that learners can classify them after recognizing the measures of every angle.

Other materials

- Wall charts of 2D geometric figures can be bought by the school or made by the teacher:



On the right hand figure, there is an equidistant interval between two consecutive nails (pins) of a geoboard; with different nails fixed on the soil or a wooden block, learners can make different 2D figures referring to the given examples.

- 3-D geometric Solids: some of 3D geometric solids are from market while others are human made materials. Take a used paper and form a box (cube), cuboids and cone. Use plastic bottles to form different shapes like cylinders.

The following image shows geometric solids made in woods:



- Use of Geogebra in teaching the concepts of angles in primary school.

(Find more information in summary content from student's book).

Answers to Application activity 8.2

Low cost materials related to the teaching and learning of geometry (surface area of cuboids) are for example: rice sack, geometric figures drawn on flash

cards, nets of boxes (cuboids), XO laptops, rulers, meters, real objects which have the shape of cuboids, etc. (*check the content summary in the student's book and make your own research to complete the list*).

Lesson 3: Active teaching techniques and strategies for facilitating lessons related to geometry

a) Learning objectives

Select appropriate techniques and strategies for facilitating lessons related to geometry in primary.

b) Teaching and learning resources

Manila papers, markers, flash cards, rulers, meter, protractor, etc.

c) Learning activities

- Give students instructions to be followed in group discussions: Guide them on learning materials to be used, invite them to discuss on what can make enjoyable the lesson on “Types of angles” in geometry,
- Some groups can discuss active teaching techniques and strategies that can be best for facilitating the lesson on “*types of triangles*” in P3, “*area of a triangle*” in P4, while others discuss on active teaching techniques and strategies that can be best for facilitating the lesson on “*angle sum of the triangle*” in P5.
- Check if they are doing the activities and guide them for any clarification in group discussions.
- Invite groups to present their findings for the whole class discussion.
- As tutor, harmonize the work done by student-teachers and help them to conclude on active teaching techniques and strategies for facilitating lessons related to geometry.

Possible answer for activities

Activity 8.3

Students may give different ways to make the lesson on geometry more enjoyable, as the tutor, analyze students' answers accordingly.

- Give learners more opportunities to manipulate given real objects to be used in teaching and learning lessons related to geometry in general;
- Provide enough time for interaction in group discussion by encouraging them to make connection their capabilities with real life situations;
- Engage all learners to use different manipulative learning materials: ...

Application activity 8.3

Lesson on area of a triangle and angle sum of triangle become more active when you use active techniques and strategies. The following are some of the techniques that can be used:

- *Use of Van Hiele levels in teaching geometry.*
- *Group work:* Distribute real materials like papers, boxes, protractor, ruler and other materials that have the form of triangle. From the distributed materials learners can draw or make a triangle. Ask learners to manipulate them and discuss how to measure sides of a rectangle that can be divided in two to find the area of related triangle. Use a protractor to measure angles of different triangles, calculate the angle sum for each triangle and compare the results for each triangle.
- *Brainstorming:* In open discussion, teacher ask the question about area of triangle and learners are given the time to brainstorm how to calculate the area of triangle.
- *Outdoor activities:* Learners go outside of the classroom to observe different objects which have the form of geometric shapes. For example, learners observe garden in the form of triangle or rectangle, rooftop of the house in the form of triangle then suggest how they can find the area, and the angle sum of such type of triangle.

(Check more active techniques to facilitate lessons on geometry in content summary).

Lesson 4: Activities for developing generic competences and integration of cross-cutting issues in the lessons related to geometry

a) Learning objective

Use various techniques to set activities that develop competences in the lessons related geometry.

b) Teaching and learning resources

Manila papers, markers, protractor, flash cards with Right angled triangle, rice sack, geometric shapes or figures, etc.

c) Learning activities

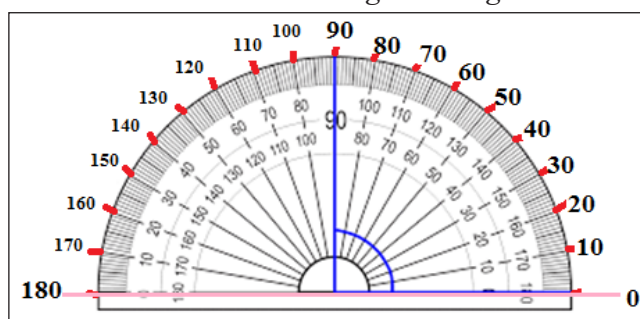
- Give to student-teachers instructions to be followed in group discussions: ask student-teachers to read through and discuss the activity 8.4 where they determine competences to be developed by learners and crosscutting issues that can be addressed when performing that activity;

- Guide student-teachers in their group discussions by providing questions that guide them to find the needed answers.
- Give student-teachers the opportunity of presenting and sharing their findings.
- As tutor, harmonize the work done by student-teachers and help them to conclude on the types of activities for developing generic competences and integration of cross-cutting issues in the lessons related to geometry.

Possible answers for activities

Answers to Activity 8.4

If there is only one protractor in class, teacher encourages learners to have the culture of sharing where one learner uses the protractor and lends it to his or her colleague to do the same work. With the improvisation, the teacher can invite learners to draw protractors on the sheets of Manila paper and cut them for use in measuring the angles.



Protractor drawn on a sheet of paper

Some competences to be developed while performing the activity 8.4 are the following:

Critical thinking developed while drawing right angled by using protractor and ruler.

Cooperation developed through working in groups, learners develop the spirit of working together and sharing ideas on their work.

Communication developed when learners are explaining clearly their working steps to the class members on drawing right angle by using a protractor and a ruler,

Creativity and innovation: through drawing and making protractor with the manila paper or sheet of paper, learners use imagination beyond knowledge provided to generate new ideas to enrich learning. From that creativity learners will solve related problems in real life situations.

Cross-cutting issues that can be addressed while performing activity 8.4 in student's book

Gender addressed when all learners work together for both girls and boys.

Inclusive Education: during the process of teaching and learning inclusive education is addressed when each learner is involved in the learning process by catering the eventual special needs for some learners.

(Check in the content summary for more information on competences and cross-cutting issues to be addressed).

Lesson 5: Assessment tasks related to lessons of geometry

a) Learning objectives

Develop and discuss assessment tasks for facilitating lessons related to geometry.

b) Teaching and learning resources

Manila papers, markers, protractor, flash cards, rice sack, geometric shapes or figures, etc...

c) Learning activities

- Form groups of student-teachers in the class room; give them instructions to be followed in their group discussions when doing the activity 8.5: to explain whether the action verbs used in setting questions of the given activity develop low, medium or high order thinking skills.
- Move around in the classroom and facilitate groups in their discussions.
- Invite student-teachers to present their findings to the whole class where other learners are invited to comment on the presentations.
- As tutor, harmonize the work done by student-teachers and help them to conclude on how to set assessment tasks in the lessons of geometry. Highlight that when setting tasks and activities, teachers must use action verbs referring to levels of the revised bloom Taxonomy.

Possible answers for activities

Answers to Activity 8.5

Different groups of students may give different answers for this activity. As a tutor, refer to the revised Bloom Taxonomy when verifying students' work.

The action verbs used in the activity 8.5 in student's books are: Prepare a net, open the cubes, form a cube, present, etc.

The two verbs: *make* and *present* express both high levels of thinking skills. *Fold* can express the medium level skills. As a tutor, check the content summary in student's book and use revised bloom's taxonomy for more information.

(Check the content summary given in the student's book and refer to bloom's taxonomy learnt in foundation of education for more information).

Answers to application activity 8.5

During the performance of the activity 8.5 planned in students' book, learners develop different skills such as: critical thinking and decision-making skills through their deep emphasizing on the calculation made on the problem so that they become good decision-maker.

Through group discussion and peer learning, learners develop a skill of problem-solving as they relate what they discussed in groups with real life situations.

This activity is for P4 learners. Students may give different reasons.

Lesson 6: Lesson plan on concepts related to geometry

a) Learning objective

Prepare lesson related to geometry for primary school.

b) Teaching and learning resources

Textbooks and the syllabus for primary mathematics, manila paper, markers, flash cards, pencils, pens, rice sack, geometric figures, textbook for foundation of education etc.

c) Learning activities

- Form groups of student-teachers and give them instructions to be followed in group discussions when working on the *activity 8.6*;
- Distribute flash cards or handouts to student-teachers on which there is "*lesson on area of rectangle*";
- Ask student-teachers to set the instructional objectives of the lesson, organize teaching materials to be used in the lesson whose title was given to them, Formulate teacher's activities and learners' activities depending on the step of the lesson, Devise generic competences to be developed and

crosscutting issues to be addressed depending on the steps of the lesson and they must summarize the teaching and learning techniques to be followed in this lesson “*area of rectangle*”

- Move around in every group and facilitate them in their discussions by asking some questions and prompts to students as they are working to let them think about many ways, encourage talk and extend thinking.
- Invite groups to present their findings.
- As Tutor, harmonize the work done by student-teachers highlighting the components of a lesson plan and the characteristics of a good mathematics lesson plan, students teachers should be motivated to write down the summary during the concluding remarks.
- After the harmonization, ask student-teachers to refer to the example of the given lesson plan and to prepare their own lesson plan using their findings from the activity 8.6.

Possible answers to activities

Answer to activity 8.6 and the application activity 8.6

Make reference to the content summary and the example of planned lessons given in the student’s book and assess the students’ work accordingly.

8.6 End unit assessment 8

Make reference to the content summary and the example of planned lessons given in the student’s book and assess the student’s work related to the lessons on “the use of cut outs to determine the perimeter /or the area of a composite figure”.

Note: Students of ECLPE will consider the question related to the perimeter of a composite figure taught in lower primary but those in SME will consider the area of a composite figure.

This unit is to be learnt only by student teachers who are studying SME.

9.1 Key unit competence

Prepare active lessons related to statistics and elementary probability

9.2 Prerequisite

Student-teachers will perform well in this unit if they make a short revision on all concepts related to statistics and elementary probability learnt in primary school and the lesson planning learnt in Foundation of Education in TTC year one, Unit 8.

9.3 Guidance on the introductory activity

- Form groups of student-teachers, give them the syllabus and textbooks for upper primary mathematics and provide instructions on how to work on the introductory activity of unit 9 in the student's book where they will use the syllabus for primary and identify all topics related to statistics and elementary probability, find out appropriate resources for facilitating lessons related to statistics and probability and suggest how to produce them. Analysis of teaching techniques used in such lessons will also be done.
- Invite groups to present their findings for a whole class discussion.
- Use different questions to facilitate students to give their expectations from this unit and ensure that you arouse their curiosity on what is going to be learnt in this unit basing on their experience, prior knowledge and abilities shown in answering the questions for this activity.

Possible answers to the questions of the introductory activity

All topics related to probability and statistics that are taught in primary schools are given in the Primary Mathematics Syllabus of Upper Primary. As a Tutor, use that syllabus to confirm whether the topics said by student-teachers are taught in such a level. Try to help student teachers be able to explain why these topics are taught in primary school.

Some materials can be used in facilitating lessons related to statistics and probability are: different coins used in Rwanda, dices, playing cards, photos for football games, manila papers, markers, illustration of some statistical graphs (bar graph, pie charts, scatter diagram, histogram, Line graphs, Scatter plot, Stem and plot, frequency polygon and frequency curve), rice sacks on which snakes and ladders game are drawn.

ICT tools can also be used when facilitating lessons related to statistics and probability to visualize some complex diagrams, videos of different games, etc.

Answers on techniques to be used when teaching statistics and probability in primary will be different, as tutor try to ask student-teachers to explain their answers and arouse their curiosity to wait for more details in the summary content of unit 9. Learners can learn well lessons through practical activities, outdoor activities, peer teaching activities and investigation,

9.4 List of lessons/Sub-heading

No	Lesson title	Learning objectives	PERIODS	
			SME	ECLPE
1	Recall on concepts related to statistics and elementary probability	Identify and explain the concepts related to statistics and elementary probability for primary.	1	NA
2	Appropriate resources to be used in the teaching and learning of statistics and elementary probability:	- Organize and make learning and teaching materials to be used in the teaching and learning of statistics and elementary probability at primary school	1	NA
3	Techniques and strategies for facilitating lessons related statistics and elementary probability;	Explain the teaching and learning techniques to be applied in lessons related to statistics and elementary probability.	1	NA
4	Activities for developing generic competences and integrating crosscutting issues in lessons related to statistics and elementary probability;	Use various techniques to set activities that develop competences in the lesson plan for statistics and elementary probability.	1	NA

5	Assessment tasks in the lessons of statistics and elementary probability	Show the curiosity of setting up assessment tasks in the lesson of statistics and elementary probability.		NA
6	Lesson plan of statistics and elementary probability.	Prepare a lesson plan related to statistics and elementary probability.	2	NA
	Assessment			

9.5 Guidance on different lessons

Lesson1: Recall on concepts related to statistics and probability

a) Learning objective

Identify and explain the concepts related to statistics and elementary probability for primary.

b) Teaching resources

Different Mathematics books for upper primary, Mathematics syllabus for upper primary, markers, pencils, manila papers, real objects like playing cards, dice, Rwandan coins, bottle tops, rulers, calculators, computers for navigating spreadsheet in order to plot some diagrams, like pie chart, histogram, they may use Geogebra for sketching other graphs like scatter plot, XO laptops where they can use Abi word and spreadsheet for creating data stored in tables.

c) Learning activities

- Form groups of student-teachers and distribute learning materials in their groups (Upper primary syllabus, mathematics textbooks for upper primary school), Ask student-teachers to attempt activity 9.1 in which student-teachers will write down different concepts related to statistics and probability in those given books (Each group take one level such as P4, P5, etc...);
- Ask student-teachers to identify the challenging topics from selected topics and justify why;
- Request student-teachers to ask support to their classmates or from the tutor on topics they find challenging.
- Request student-teacher to present their findings to the whole class;

- Guide all student-teachers to follow attentively and to participate actively in presentation by providing comments or their points of view and to take a short summary.
- Help student-teachers to conclude on concepts related to statistics and probability taught at primary school.

Possible Answers to the activities

Activity 9.1

Concepts related to statistics and elementary probability are: Data collection using tables, Quantitative and qualitative data, Representing information using tables and bar graphs, **play games of chance**, Collect quantitative data distinguishing whether it is discrete or continuous, Record data in tables and represent as a bar chart, Interpret bar charts and line graphs to draw a conclusion. , Vocabulary of chance (impossible, certain, equally likely, evens chance, unlikely, likely, conduct experiments to decide how likely something is to happen, collecting the data to investigate a question, Interpreting the data in frequency table, Representing the data in a bar chart, Representing data in Pie Chart and draw conclusion, Using data to decide how likely something is to happen.

Check more information on answers of this activity in the summary content given in student's book or in the syllabus.

Answers to application activity 9.1

In every lesson on statistics and elementary probability for P4, P5 and P6, learners acquire and develop the following skills: Creative skills when they are producing materials to be used related lessons. This leads them to critical thinking through creativity as they become good decision-maker.

Through group discussion and peer learning, learners develop problem-solving skills as they relate what they discussed in groups with real life situations.

Self-management skills can appear in solving given problem by respecting provided time and show the curiosity of working with others in group discussion.

Problem-solving skills through answering word problem related to statistics and elementary probability, Cooperation developed through working in groups and critical thinking skills though playing some game of chance, and playing cards to generate new ideas.

Check additional information on this activity in the content summary given in the student's book.

Lesson 2: Production and organization of appropriate resources for the lessons related to statistics and elementary probability

a) Learning objectives

Organize and make learning and teaching materials to be used in the teaching and learning of statistics and elementary probability at primary school.

b) Teaching and learning resources

Mathematics books and syllabus for upper primary, dice, snakes and ladders game drawn on manila papers or rice sacks, rulers, markers, flash cards, coins, bottle tops, calculator, graph papers, illustration of charts or diagrams on manila papers (posters), playing cards, etc.

c) Learning activities

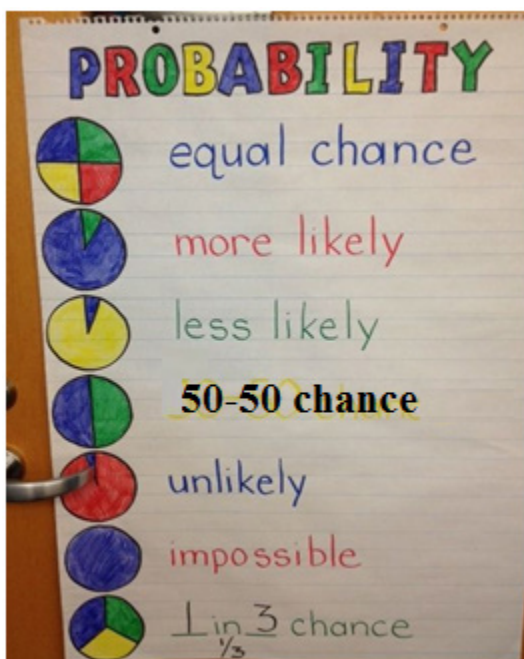
- Start with a warm up game and form six groups by counting from 1 to 6. Distribute upper primary mathematics syllabus and mathematics textbooks for P4, P5 and P6 where they choose one lesson on statistics or elementary probability.
- Ask student-teachers to identify all materials needed to make more active and participative the teaching and learning of the selected topic. Hence, explain how those resources can be used while teaching and learning the identified topics related to statistics and probability.
- Move around in the classroom for guiding student-teachers during their group discussions.
- Invite groups to present their findings and as a Tutor, harmonize their answers from presentations enhancing how to produce or organize appropriate resources to be used in lessons related to statistics and elementary probability.

Possible answers for activities

Answers to Activity 9.2

Some of the teaching resources that can be used when teaching and learning statistics and elementary probability:

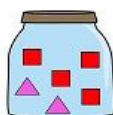
- Flash cards can be used to facilitate quick memorization of number in playing game of chance, provide opportunities for learners to interact each other and allow individualization learning.
- Snakes and ladders games, coins or bottle tops, playing cards (standard deck), dice for learning some terminologies used in probability (to toss, rolling, shuffle cards) and apply them in learning by practice.
- The illustrations for some statistical graphs (bar graph, pie charts, scatter diagram, histogram, Line graphs, Scatter plot, replace by: stem and leaf, frequency polygon and frequency curve) can be used as semi concrete resources.
- Some wall charts can be used:



Name _____

Probability

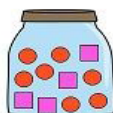
Directions: Circle the correct answer.



How likely are you to grab a ▲?
More likely Less likely



How likely are you to grab a ♥?
More likely Less likely

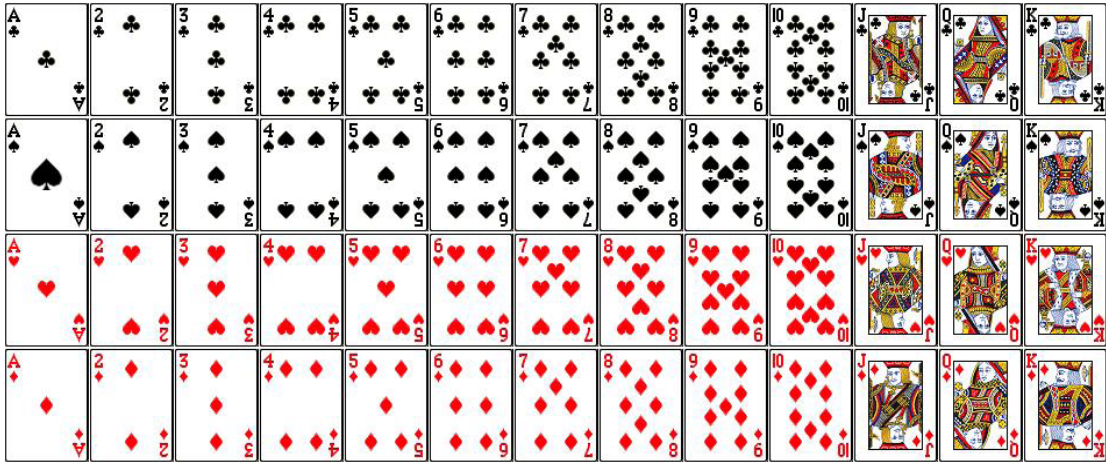


How likely are you to grab a ●?
More likely Less likely

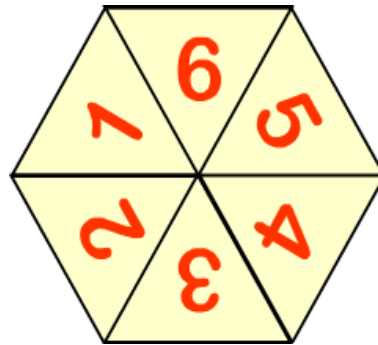


How likely are you to grab a ▲?
More likely Less likely

- Playing cards are sometimes used in probability: The game of playing cards consists of 52 cards technically designated and became international because of their worldwide popularity: known in English as *spades*, *hearts*, *diamonds* and *clubs*. The 52 cards are divided into four suits, each containing 13 ranks, so that each card is uniquely identifiable by suit and rank. The suit-marks used internationally indicate two black and two red suits: spades, clubs, hearts, and diamonds respectively. Ranks are indicated by numerals from 1 to 10 on “spot cards.” In addition, there are an Ace marked as A and three court cards designated Jack (formerly knave), Queen, and King notionally equivalent to 11, 12, and 13, respectively, though actually marked J, Q, K.



- In probability, they frequently use dice: a small cube with each side having a different number of spots on it, ranging from one to six, thrown and used in gambling and other games involving chance.



Check additional information in the content summary provided in the student's book.

Answer to application activity 9.2

Answers for this activity may be different. As tutor, refer to the content summary in student's book and check whether the selected materials are appropriate for facilitating lessons related to statistics and probability then conclude on how these materials can be used in those lessons. *Check additional information in the content summary given in the student's book.*

Lesson 3: Techniques and strategies for facilitating lessons related to statistics and elementary probability

a) Learning objectives

Explain the teaching and learning techniques to be applied in lessons related to statistics and elementary probability.

b) Teaching and learning resources

Manila papers, markers, flash cards, rice sack, grid number for plotting some statistical graphs like scatter plot, pencils and pens as drawing tools, calculators for quick calculations, textbook for foundation of education subject.

c) Learning activities

- Form groups of student-teachers and distribute flash cards respectively in their groups such that every group gets one flash card with one technique of teaching and guide them how to do the activity 9.3: discuss teaching techniques by writing the benefits and the challenges of using it in the teaching and learning of topics related to statistics and elementary probability.
- Move around group by group to facilitate student-teachers in their discussions.
- Offer student-teachers the opportunity of presenting their findings.
- As tutor, harmonize the work done by student-teachers and help them to conclude on techniques and strategies for facilitating lessons related to statistics and elementary probability.

Possible answers to questions for activities

Answers to Activity 9.3

Here you may know that different groups of students can give different answers. Don't forget to inform them that there is no single suitable method to teach mathematics to emphasize mastery of knowledge and skills, critical and creative thinking, communication and problem solving. For teaching and learning mathematics, teachers should adopt a combination of different teaching approaches to engage students in learning. For more information, please check more active techniques and resources used to teach the lessons in the student's book on activity 9.3.

Answers to application Activity

As indicated in the application activity 9.3, that topic is taught in Primary five, Let your student teachers explore it, and guide them to specify the

techniques used for teaching that topic. For extending clear answer, the content summary can be your direct reference.

Lesson 4: Activities for developing generic competences and integration of cross-cutting issues in the lessons related to statistics and elementary probability

a) Learning objectives

Use various techniques to set activities that develop competences in the lesson plan for statistics and elementary probability.

b) Teaching and learning resources

Manila papers, markers, rice sack, pens, coins, dice, playing cards, snakes and ladders, graph papers, makers, bottle tops.

c) Learning activities

- Form groups of student-teachers depending on the number of student you have and give them instructions to be followed when doing **activity 9.4** in the student's book: identify and explain the competences to be developed by learners while doing the question given in **activity 9.4**.
- Move around in the classroom and guide student-teachers in their group to find out cross-cutting issues that can be addressed when learners are doing the highlighted question.
- Give student-teachers the opportunity of presenting their findings in a whole class discussion.
- As a tutor, help student to conclude on how to set activities for developing generic competences and integrating cross-cutting issues in the lessons related to statistics and elementary probability.

Possible answers for activities

Activity 9.4

In the given activity, the generic competences that can be developed are the following:

Critical thinking skills can be developed when matching the week with kg of beans

Communication skills are developed through group discussions while working to compare the tally bars with number of kilograms.

Cooperation and interpersonal skills are developed through teamwork, working in pairs for taking common understanding which help them to become decision makers.

Cross-cutting issues that can be addressed during the lessons related to statistics and elementary probability:

Cross-cutting issues that can be addressed while performing activity 9.4 in student's book are so many; you may refer to the following:

Gender is addressed through assigning the same roles for all males and females in teaching and learning process equally.

Inclusive education is addressed through activities that should cater for different ability of students, teaching and learning materials that are adapted to different special education needs,

Peace and value education is addressed through teaching techniques and strategies that are adapted to different attitudes of students, activities that should develop positive values among students like conflict resolution in groups and avoiding self-regarding.

Lesson 5: Assessment tasks in the lessons related to statistics and probability

a) Learning objective

Show the curiosity of setting up assessment tasks in the lesson of statistics and elementary probability

b) Teaching and learning resources

Manila papers, markers, dice, coin, bottle tops, revised bloom taxonomy check list.

c) Learning activities

- Form groups of student-teachers in the classroom and give them learning materials and explain instructions to be followed when doing activity 9.5: identify an activity related to probability in student mathematics primary book, explain whether the action verbs used in that activity develop low, medium or high order thinking skills.
- If student teachers need a help, please support them.
- Assist student-teachers in their groups to present findings.

- As tutor, harmonize the work done by student-teachers and help them to conclude on how to set assessment tasks in the lessons related to statistics and elementary probability . You will highlight that when setting tasks and activities, teachers must use action verbs that are appropriate to all levels of thinking with reference to the revised bloom Taxonomy.


Possible answers for activities

Answers to Activity 9.5


Answers for this activity may be different, as a Tutor, refer to the revised Bloom Taxonomy when verifying students’ work. This is one among the topics related to probability in primary five, refer to it and perform others.

Activity 15.5

Take a bottle top and throw it twenty times. Record the results.



Face up



Face down

Throw	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Face up																					
Face down																					

Compare your results with the rest of the class.

Discuss the following:

- Does the bottle top behave the same way as the coin?
- Why does it behave that way? Explain.

The verbs in the above activity are: **record, compare, discuss, and explain.**

Record is on lower level because it looks like write what the student teacher observed after doing an experiment of tossing, the only work is to know the terminologies used like “face up and face down” which are simple as well to differentiate.

Compare is on high level of understanding, because after doing an experiment and recording findings, the student teacher will analyze the data from others, also comparing experiment done using coin and bottle tops, require the student teachers to be familiar with both which require to high thinking skills and more practice.

Discuss and explain are also on high level of understanding, because they require to have more skills like Reasoning, listening and communicating for convincing other and time Management to respect.

Answer to application activity 9.5

Collect data: a verb that can develop low order thinking skills.

Activity 14.2

1. **Question:** How many brothers and sisters do you have?

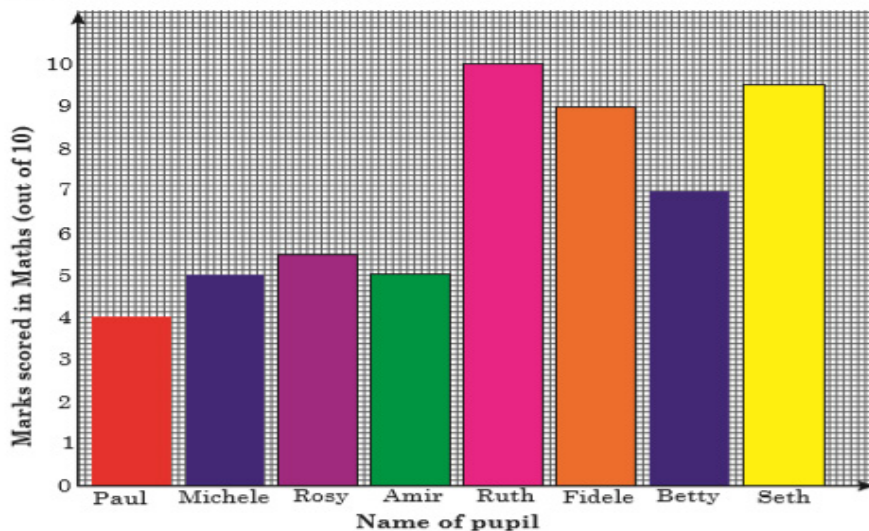
Steps:

- (i) In groups, make a chart below. State and record your number of sisters and brothers.

Pupil's name	Number of sisters	Number of brothers

Present data: action verb that can develop medium order thinking skills

2. Study the bar chart below.



- (a) What is the bar chart about?
(b) How many pupils did the mathematics activity?
(c) What is the highest score?
(d) Who scored the lowest mark?
(e) Which pupils scored the same mark?
(f) Who scored the highest mark?
(g) How many more marks did Ruth score than Rosy?
(h) What score did Seth get?

Interpret statistical graph: Action verb that can develop high order thinking skills.

Lesson 6: Lesson plan on statistics and elementary probability

a) Learning objective

Prepare a lesson plan related to statistics and elementary probability.

b) Teaching and learning resources

Manila paper, markers, flash cards, pencils, pens, ruler, lesson plan notebook

c) Learning activities

- Tell your student teachers to count from 1 to 7 and ask ones to form their group, twos their group and so forth. Give them instructions to be followed in group discussion when working on the **activity 9.6**.
- Ask student-teachers to set the instructional objectives of the lesson titled “Collecting quantitative and qualitative data”, they must verify and required teaching and learning resources and complete them where necessary, formulate teacher’s activities and learners’ activities depending on the step of the lesson, Devise generic competences to be developed and crosscutting issues to be addressed depending on the step of the lesson and to Summarize the teaching and learning techniques to be followed in this lesson.
- This can be done to complete or adjust the lesson plan provided referring to what has been learn in the foundation of education and other lessons previously prepared.
- Interchange with every group and facilitate them in their discussions by asking some questions and prompts to students as they are working to let them think about many ways, encourage talk and extend thinking.
- Invite groups to present their findings.
- As Tutor, harmonize the work done by student-teachers highlighting the component of a lesson plan and the characteristics of a good mathematics lesson plan.

Possible answer for activities

Application activity 9.6

Refer to the quality of a good lesson plan and advise student teachers to improve the lesson they are going to submit.

9.6 End unit assessment 9

Refer to the quality of a good lesson plan and advise student teachers to improve the lesson titled “Qualitative and Quantitative data” they are going to submit.

10.1 Key unit competence

Prepare active lessons related to word problems

10.2 Prerequisite

Student-teachers will perform well in this unit if they are competent in lesson planning learnt in Foundation of Education- TTC year one, Unit 8 and in all concepts related to word problems learnt from Primary one (P1) to primary six (P6).

10.3 Guidance on the introductory activity

- Use play-based technique in forming groups of student-teachers and invite them to use learning resources to work on the introductory activity of unit 10 in the student's book where they will find out the types of word problems, appropriate resources for facilitating words problems using low cost materials, suggest how to produce them and discuss the role of visual representations as one of appropriate teaching techniques for facilitating a lesson related to word problems.
- Invite groups to present their findings in a whole class discussion.
- Use different questions to facilitate learners give their points of view and ensure that you arouse their curiosity on what is going to be learnt in this unit basing on their experience, prior knowledge and abilities shown in answering the questions for this activity.

Possible answers to the questions of the introductory activity

1. In primary school there are type of word problems to be solved by lower or upper primary learners such as:

One-step word problems: It is a word problem for which the solving requires only one operation

Two-steps word problems: In two-steps word problems, learners work out problems where the finding out the answer requires two separate operations.

Multi-step word problems: This type includes word problems that involve more than 2 operations. For **example:** addition, subtraction, multiplication, or division.

2. Materials for facilitating word problems are identified according to the type and materials needed for that word problem. In lower primary, the teaching and learning word problems both teacher and learners use manipulative materials, improved materials, printable or non-printable materials. However, in upper primary, the teaching and learning resources of word problems depend on the content of the problems and the operations to be used in solving it.

Examples of some resources that can be used in lessons for word problems:

Manipulative materials such as counters, stones, bottle tops, sticks, flash cards, etc in lower primary.

Pattern Blocks can be used when solving word problems related to fractions, Geometry, addition, Multiplication and Ratios in upper primary.

Calculator also can be used by both teacher and learners to calculate the complex operations when finding the solution in numerical values and give answers.

3. In facilitating a lesson on “*solving word problems*” to lower or upper primary learners” various teaching techniques can be used. Students may give different answers to this question. such as:

Peer teaching and learning activities: through peer teaching and learning and depending on their level of understanding, learners use manipulative materials such as counters to solve word problems;

Research work: learners are asked to read the problem and find out the needed process for helping him or her to find solution. Learners can visit library or internet for further research on word problem solving strategies and steps.

Think, write, pair, and share (TWPS): learners are given the time to think independently about the problem and write their ideas before they share the ideas with their classmates and then with the entire group. As a teacher, identify the reflective problems that learners naturally met to help their own thinking and provide assistance.

(Check the content summary in student’s book for more understanding)

10. 4 List of lessons/Sub-heading

No	Lesson title	Learning objectives	Number of periods	
			SME	ECLPE
1	Concepts on word problems in primary school	Categorize the concepts related to word problems in primary.	2	1
2	Appropriate resources for visualization in solving word problems	Organize and make teaching and learning resources to visualize word problems in mathematics using local materials.	1	1
3	Techniques and strategies for facilitating lessons related to word problems	Discuss techniques and strategies for facilitating lessons related to word problems.	1	1
4	Activities for developing generic competences and integrating crosscutting issues in lessons on word problems	Incorporate, in the lesson, teaching techniques and activities that help to develop competences and to address crosscutting issues.	1	
5	Tasks for assessing the problem solving skills	Discuss the status of assessment tasks for facilitating lessons related to word problems.	1	
6	Lesson plan on word problems	Prepare lessons that include steps for solving word problems in primary school.	2	1
	Assessment			

10. 5 Guidance on different lessons

Lesson 1: Recall on concepts related to word problems in primary school

a) Learning objective

Categorize the concepts related to word problems in primary.

b) Teaching resources:

Syllabus and Mathematics books for lower or upper primary, Manila papers, markers, pencils, real different types of counters, XO laptop and related mathematics software.

c) Learning activities

- Form groups of student-teachers, ask them to take the learning materials (lower or upper primary syllabus, mathematics textbooks for lower or upper primary school) and do activity 10.1 given in the student's book.
- Ask student-teachers to select different concepts related to word problems in those given books (Each group take one level such as P1, P2, P3, P4, P5 or P6).
- Ask student-teachers to identify the challenging topics from selected topics related to word problems.
- Guide student-teachers in their self-study on the challenging topics;.
- Invite student-teachers to ask support to their classmates or tutor on topics they find more challenging.
- Request student-teachers to share to the whole class their findings on concepts related to word problems that are taught at primary school.
- Guide all student-teachers to follow attentively and to participate actively in the presentation and to take a short summary.
- Help student-teachers to conclude on concepts related to word problems taught at primary school.

Possible answers for given activities

Answers to activity 10.1

Different concepts related to word problems: Word problems obtained in the syllabus of lower and upper primary are classified into three types such as One-step word problems, Two-steps word problems and Multi-steps word problems.

“As student-teachers may give various challenging topics, organize the peer learning where they will learn from their colleagues.

Answers to application activity 10.1

Word problems involving addition or subtraction of numbers cover all three types of word problems unless skills developed can differ according to the level of learners and the asked problem.

For each of lessons on word problem involving addition or subtraction, learners acquire and develop skills such as creativity when they are producing materials to be used, critical thinking and decision-making skills are developed. Learners develop also problem-solving skills as they relate the acquired concepts to real life situations. Thinking skills are developed while learners search different strategies to solve word problem. Learners develop the spirit of being self-manager of problems they face.

Lesson 2: Appropriate resources for visualization in solving word problems

a) Learning objective

Organize and make teaching and learning resources to visualize word problems in mathematics using local materials.

b) Teaching and learning resources:

Mathematics books and syllabus for lower or upper primary, manila papers, local materials, rice sacs, markers, flash cards, etc...

c) Learning activities

- Form groups of student-teachers in the class-room; distribute learning resources such as syllabus and Mathematics books for lower or upper primary.
- Ask student-teachers to choose one lesson on problems involving addition and subtraction of fractions from distrusted resources (syllabus and mathematics books). Hence, they organize appropriate teaching resources for their choice and explain how those resources can be used while teaching and learning the mentioned topic.
- Circulate in the classroom by guiding student-teachers in their group discussions.
- Invite groups to present their findings and as a tutor, harmonize with constructive feedback and help them to conclude on appropriate resources for concept visualization when solving word problems.

Possible answers for given activities

Answers to Activity 10.2

Lessons to be chosen by the student-teacher on problems involving addition and subtraction of fractions can be differ according to the level of learners and the types of word problem, as tutor guide or facilitate student-teachers to check whether chosen word problem is appropriate to the level they mentioned.

Some appropriate resources for teaching every lesson of word problems involving addition and subtraction of fractions:

- **Manipulative materials:** counters, stones, bottle tops, sticks, flash cards, oranges, etc... can be used to better understand the concepts reflected in that problem.

The following image shows some manipulative materials that can be purchased for usage when visualizing givens of a word problem. *Note:* they can be easily bought in case they are produced in our country



Source: Adapted from www.rainbowresource.com/proddtl?id=MIFGR1

- **XO Laptop programs** are used in teaching word problems by the use of turtle art activity where learners solve simple word problems.

(Check content summary in student's book for answers)

Answers to application activities 10.2

Help student-teachers in making and producing teaching and learning materials for facilitating lessons related to all types of word problems.

For example: some materials for facilitating lesson on word problems can be produced in TRC: from rice sack, Manila paper, plastic bottles, bottle tops, sheet of papers, etc...

- Steps to follow in solving word problems can be written on rice sack or Manila paper
- Use Manila paper to make flash cards on which you can write word problem to be shared in group discussion; you can draw different fractions on rice sack, etc...
- Keep bottle tops in a cup or in other objects so that you can use them when facilitating lesson on word problem involving multiplication and division of fractions
- Draw different objects with parts like sugar cane, oranges, etc on rice sack showing fractions by shading those parts.

(Check summary content in student's book for more information)

Lesson 3: Techniques and strategies for facilitating lessons related to word problems

a) Learning objective

Discuss techniques and strategies for facilitating lessons related to word problems

b) Teaching and learning resources

Manila papers, markers, flash cards, rulers, meter, rice sack, etc...

c) Learning activities

- Form groups of student-teachers and give them instructions to be followed in group discussions: discuss what can make enjoyable the lesson on problems involving multiplication and division of fractions, summarize active teaching techniques and strategies that can be best for facilitating lessons related to real life problems that involve finding time intervals,
- Move around in the classroom checking whether they are discussing the given activities and guide them on any clarification needed.
- Invite groups to present their findings to the whole class for discussion.
- As a tutor, harmonize the work done by student-teachers and help them to conclude on teaching techniques and strategies for facilitating lessons related to word problems.

Possible answers for given activities

Answers to Activity 10.3

(a). Lesson on Problems involving multiplication and division of fractions become enjoyable when teacher develops key points in his or her classroom:

- Give learners more opportunities to manipulate real objects (sugar cane, oranges, pineapple, sticks, et) to be used in teaching and learning lessons on problems involving multiplication and division of fractions: they can be cut in a number of equal parts and grouped.
- Provide to learners enough time for interaction in group discussion by encouraging them to link the concept with their real life situations (experience).

(b). Active teaching techniques and strategies that are the best for facilitating lessons related to real life problems that involve finding time intervals:

Group work: Distribute real materials like clocks, calendar, chronometers, etc and guide learners to use them in solving a simple word problem involving time intervals.

Brainstorming: In open discussion, the teacher asks the question about how learners can use clocks and chronometer in calculating time intervals when they are solving word problems.

Practical work and outdoor activities: by the use of chronometer, learners go outside of the classroom and make practice in calculating time interval used by their colleagues when running on given distance.

Peer teaching and learning activities: some learners teach their colleagues the how to find time intervals such as a half, *quarter*, et in a range of micro-lessons related to word problems. In peer teaching and learning learners develop expressions such as “*at the rate*” to express the multiplication and “*ratio*” to illustrate the division.

(Check more active techniques in contentment summary)

Answers to application activity 10.3

Problem: One day a shopkeeper Peter went to the market to buy a dozen boxes of markers, each box has 24 markers inside costing 4000Frw for each box. He repacked five of these boxes into packages of six markers each, and sold them for 2400Frw per package. He sold the rest of the markers separately at the rate of three markers for 1600Frw. How much profit did he make?

Step 1: Read the first part of the problem and highlight the question

“One day a shopkeeper Peter went to the market to buy a dozen box of markers, each box has 24 markers inside costing 4000Frw for each box.”

Question: what is the cost of the dozen boxes of markers?

24	24	24	24	24	24	24	24	24	24	24	24
4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000

Step2: guide learners in finding the cost of a dozen boxes of markers.

Through the first paragraph guide learners to find out the answer of this question

Step 3: Read the second part and highlight the question

He repacked five of these boxes into packages of six markers each, and sold them for 2400Frw per package and he sold the rest of the markers separately at the rate of three markers for 1600rwf

Question: How much money did Peter get from five boxes?

How much money did Peter get from other 7 boxes? what is the sum of this money? How much profit did he make?

24	24	24	24	24
----	----	----	----	----

Make 120 markers

Step 4: ask ourselves if the answers from step2 can help us to find out the answers of these questions:

The profit made: is the difference of the sold and the cost found in step 2

Step 5: Solve the second part to answer questions from step 3

Guide learners to find out the answers of the question asked by writing full answers.

6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

120 makers become 20 packages of 6 markers where one package costs 2400Frw.

How much did he get?

The remaining 7 boxes

24	24	24	24	24	24	24
----	----	----	----	----	----	----

They have $24 \times 7 = 168$ markers. Each package of 3 markers costs 1600Frw. How much will he get?

Step 6: Determine the profit made:

It is the difference between the sold calculated in the part 2(Step3, step 4 and step 5) and the cost found in part 1 (step1 and step2).

Step7: Read the problem again and think about how you got answers and then conclude on the question asked.

(Check steps for solving word problems in contentment summary)

Lesson 4: Activities for developing generic competences and integrating crosscutting issues in lessons on word problems

a) Learning objective

Incorporate, in the lesson, teaching techniques and activities that help to develop competences and to address crosscutting issues.

b) Teaching and learning resources

Manila papers, markers, flash cards, rice sack and other related materials, and where possible they can use computers with mathematics software, projector etc.

c) Learning activities

- Give student-teachers instructions to be followed in group discussions: to read through and discuss the activity 10.4 where they determine competences to be developed and identify crosscutting issues that can be addressed by learners while finding answers for questions given.
- Guide student-teachers in their group discussions by providing questions to orient them through more ideas.
- Give student-teachers the opportunity of presenting and sharing their findings in the classroom.

As tutor, harmonize the work done by student-teachers and help them to conclude on the types of activities for developing generic competences and integrating crosscutting issues while teaching word problems.

Possible answers for given activities

Answers to Activity 10.4

Some competences to be developed while performing activity 10.4 in student's book

Critical thinking developed through reading the given word problem and identify different questions for each paragraph which lead learners to answers. This helps learners to develop how they can find out the answers to the given word problems and solve them.

Cooperation developed through group discussion on given word problems, when learners work together in finding out the answers by following some steps, they develop the spirit of teamwork.

Problem solving: As learners solve word problems, they link the acquired concepts with real life situations met in their society.

Cross-cutting issues that can be addressed while performing activity 10.4 in student's book

Inclusive education addressed through activities that should cater for different abilities of learners including those with special educational needs.

Gender addressed when all learners work together both girls and boys sharing the same responsibilities in the group.

(Check the contentment summary for more information on competences and cross-cutting issues to be addressed).

Answers to application activity 10.4

During the process of teaching and learning the lesson on problems involving time (minutes and hours, dates and hours) learners acquire and develop different skills. Some of these skills are: -

Cognitive skills are acquired by learners when performing numerical operations such as addition, subtraction, multiplication and division.

Reading and comprehension: Learners develop the ability of reading and comprehension through reading the given mathematical word problem and find out the answers.

Communication skills: as learners discuss in groups or present their understandings on given word problem to the whole class.

Problem-solving: through Mathematical problem solving learners try to relate what they discussed on different type of problems to real life situations which will help them to solve related word problem.

Creativity and innovation skills: through the acquired mathematical concepts, learners can create their own word problem by referring to the real life situation and propose the way of handling the problem.

(Check more information in content summary in student's book)

Lesson 5: Tasks for assessing the problem solving skills

a) Learning objective

Discuss the status of assessment tasks for facilitating lessons related to word problems.

b) Teaching and learning resources

Syllabus and text books for Mathematics taught at primary, Manila papers, markers, flash cards, rice sack, etc.

c) Learning activities

- Give student-teachers instructions to be followed in their group discussions: to observe and analyze the activity 10.5 in student's book, to explain whether the action verbs used in that activity develop low, medium or high order thinking skills;
- Move around in the classroom and facilitate groups in their discussions;
- Invite student-teachers to present their findings to the whole class;
- As tutor, harmonize the work done by student-teachers and help them to conclude on how to set tasks for assessing the problem solving skills. Highlight that when setting tasks and activities, teachers must use action verbs referring to all levels of the revised bloom's Taxonomy.

Possible answers for given activities

Answers to Activity 10.5

Answers for this activity may be different according to the task chosen by student-teachers. As a tutor, refer to the revised Bloom's Taxonomy when verifying students' work.

Example of task in P4:

1. Mutoni sells 11 cans of milk to a milk depot every week. If each can of milk has a capacity of 20 litres, calculate number of liters she will sell per month.
2. John has a jerry can full of 20 liters of water and Peter has different jerry cans full of 30 liters of water. John and Peter want to put water in the same tank measured in centiliters.
 - a) Help John and Peter to convert their quantity of water in centiliters.
 - b) Add the centiliters of water and calculate the number of centiliters which can fill the tank.

From the above tasks there are verbs used such as *calculate*, *convert* and *add*.

The action verbs used are classified into three categories.

- a) High level of thinking: verb to calculate is located at this level by referring to the ways used in finding out the needed number of liters to be sold per month, Learners develop a high level of thinking skill.
- b) Medium level of thinking: verb to convert is at this level as learners use acquired knowledge and skills in capacity measurement and convert liters in centiliters.
- c) Lower level of thinking: through basic operations acquired, they apply addition in finding the number of centiliters that can fill the tank.

As a tutor, check the content summary in student's book and use revised bloom's taxonomy for more information. Help student-teachers to classify the action verbs identified in different activities accordingly.

Answers to application activity 10.5

When learners perform the application activity 10.5 planned in student's book, learners develop different skills such as:

Critical thinking developed through a deep emphasis on the calculation made on given word problem during the determination of perimeter, area of the farm and poles needed to fence it. Due to the calculation made, learners become good decision-maker from analysis.

Through group discussion and peer learning, learners develop **problem-solving skills** as they relate what they discussed in groups with real life situations.

Decision making: Problem solving and decision making are closely related skills, and making a decision is an important part of the problem solving process as after calculating the area and perimeter of the farm, learners he will take a decision on the needed poles for fencing the farm.

Creativity: word problems are usually solved either intuitively or systematically. Intuition is used as new knowledge is needed to solve a problem that learners have not experienced before. It will likely require a more systematic and logical approach to solve with creative thinking skills: the determination of needed poles requires learners to use acquired prerequisites on intervals.

Lesson 6: Lesson plan on word problems

a) Learning objective

Prepare lessons that include steps for solving word problems in primary school.

b) Teaching and learning resources

Syllabus and textbooks for Mathematics in primary school, Manila paper, markers, flash cards, pencils, pens, rice sack, etc.

c) Learning activities

- Form groups of student-teachers in classroom and give them instructions to be followed during discussion when working on the activity 10.6: to observe and discuss the lesson plan on word problems given in the student's book, to decide if the lesson can help the teacher in his or her effective teaching and learning and rectify eventual errors in that lesson plan if it is not effective.
- Move around in every group and facilitate them in their discussions by asking some questions and prompts to student-teachers, encourage talk and extend thinking as they are working to let them think about many ways.
- Invite groups to present their findings.
- As Tutor, harmonize the work done by student-teachers highlighting the component of a lesson plan and the characteristics of a good mathematics lesson plan, students teachers should be motivated to write down the summary during the concluding remarks.
- After the harmonization, ask student-teachers to design a well-planned lesson on word problems.

Possible answers for given activities

Activity 10.6

Make reference to content summary and the examples of well prepared lessons given in previous units for the student's book and guide students to improve their work accordingly.

Application activity 10.6

Refer to the guidance on how to develop a good lesson plan in FOE, facilitate student teachers to make a lesson plan as indicated in application activity 10.6.

10.6 End unit assessment 10

Make reference to content summary and the examples of well prepared lessons given in previous units for the student's book and guide students to improve their lessons on *“word problems involving multiplication of integers”*.

11.1 Key unit Competence

Use lesson observation sheet to evaluate the adequacy of teaching and learning strategies used during model lessons of Mathematics.

11.2 Prerequisites

Student-teachers will perform well in this unit if they make a short revision on general concepts learnt in foundation of education:

- Teacher's documents and their importance,
- Techniques, strategies and methods used in teaching Mathematics in primary school,
- Lesson observation and
- The classroom management.

11.3 Guidance on the introductory activity:

- Form groups of student-teachers and invite them to use learning resources to work on the introductory activity of unit 11 in the student's book where they will describe what they can consider to verify: learners' engagement in the learning of mathematics, the role of Mathematics teacher as the one who guides all classroom activities.
- Invite groups to present their findings in a whole class discussion.
- Use different questions to facilitate students to give their points of view and ensure that you arouse their curiosity on the process of mathematics lesson observation (using lesson observation sheet, lesson observation report, constructive feedback) basing on their experience, prior knowledge acquired in FOE and abilities shown in answering the questions for this activity.

Possible answers to the questions of the introductory activity

Student teachers may give different items to be considered when observing the lesson as they learnt it in the Foundation of education. They can use the items found on the general lesson observation sheet and relate each item to the context of Mathematics lesson.

11.4 List of lessons

#	Lesson title	Learning objectives	Number of periods	
			SME	ECLPE
1	Mathematics classroom observation for practice	Describe item to be observed in a Mathematics lesson Use of a lesson observation in a Mathematics lesson Provide constructive feedback of the observed lesson	4	2
	Assessment and remediation			

11.5 Guidance on different lessons

Lesson 1: Item to be observed in a Mathematics lesson

a) Learning objectives

- Describe item to be observed in a Mathematics lesson;
- Use of a lesson observation in a Mathematics lesson.
- Provide constructive feedback of the observed lesson.

b) Teaching and learning resources

Lesson observation sheets, textbooks, notebooks and pens. If possible avail Camera and Ipad to take video for the model lesson.

c) Learning activities

- Form groups of students and give them instructions on how to do the **activity 11.1**: Describe activity to be done by a mathematics lesson observer and items he/she must verify and the purpose of a lesson observation.
- Move around in every group and facilitate them in their discussions by asking some questions and prompts to student-teachers, encourage talk and extend thinking'
- Invite groups to present their findings.

- As Tutor, harmonize the work done by student-teachers highlighting the purpose of lesson observation, activities to be done when observing a mathematics lesson: Before observation, during observation and after observation.
- Distribute the lesson observation to all students and ask them to discuss all items to be observed (the components) taking them in the context of a Mathematics lesson.
- Move around in every group and facilitate them in their discussions by asking some questions and prompts, for example what can show you that a mathematics teacher is : engaging all learners? Following the use of teaching materials? Helping learners persevere in problem solving, in critical thinking, in examining symbolic notation, patterns, generalizations or conjectures, is the teacher giving learners the wait-time to think before responding? etc.
- Invite groups to present their findings.
- Using the lesson observation sheet, help students to harmonize their answers and findings and ask them to summarize the notes they will use in practicing the mathematics lesson observation.
- Organize a whole class discussion on how to provide or to receive feedback from a lesson observation.

Possible answers for activities

Activity 11.1

Refer to the student's book, the lesson observation sheet and lesson observation guide provided by REB to assess students' works.

The lesson observation sheet and lesson observation guide provided by REB must be distributed to students.

During the observation of model lesson, student teachers should be well supervised, accompanied by the Tutor of Mathematics teaching Methods and practices capable of collaborating with the mathematics teachers from the demonstration school to give students the constructive feedback with clear explanations.

11.5.1 Steps for observation of model lesson

(i) Before lesson observation

At least a week before observation of model lesson in a demonstration school, the tutor informs the teacher about it for him/her to plan accordingly.

Depending on the number of student teachers per class and number of classes in demonstration school, the tutor can plan to conduct observation in more than one classroom at the same time. Make sure that there is acceptable number of student teachers in a class and camera to film the whole process without disturbing pupils.

The student-teacher doing lesson observation must read beforehand the observation guide and be conversant with it. Apart from the lesson observation form, the observer must be equipped with a **notebook** to take down some important events (actions, gestures, teacher's or learners' attitudes, etc) that occurred during the lesson, which are likely to influence the teaching/learning process or the observer's appreciation.

In addition, the observer should be equipped with subject knowledge so that feedback will be based on correct information related to the subject observed. The tutors in collaboration with student teachers try to relate to mathematics lesson observation and what had been taught in Foundations of Education subject in term of methods of teaching, observation sheet, item to be observed.

There are different categories of aspects to be focused on during the Mathematics lesson observation.

The first category refers to **the mathematical observable learning outcomes (foci)**: *Conceptual* (the conceptual development of his or her learners), *derivational* (the process of developing new mathematical entities from existing knowledge), *structural* (the links or connections between different mathematical entities, concepts, properties, etc), *procedural* (the acquisition of skills, procedures, techniques or algorithms), *efficiency* (learners' understanding or acquisition of processes or techniques that develop flexibility, elegance or critical comparison of working), *problem solving* (learners' engagement with the solution of non-trivial or non-routine tasks) and *reasoning* (learners' development and articulation of justification and argumentation).

The second category for observation focuses on the **contexts in which the teachers posed the tasks**. It has two dimensions: (1) whether the context was related to the real world or not and (2) whether the data or information used was genuine or invented by the teachers.

The third and final category concerns **teacher strategies** or “mathematical didactics” that might be used to facilitate learners' learning of Mathematics.

The teaching strategies to verify are such as: Activating prior knowledge,

Exercising prior knowledge, Explaining, Sharing, Exploring, coaching, Assessing or evaluating, Motivating, Questioning, and the Differentiation in which the teacher should attempt to treat learners differently in terms of the kind of activities performed, materials provided and/or the expected outcome to make instruction optimally adapted to the learners' characteristics and needs.

(ii) During the lesson observation

In class, the tutors introduce the student teachers and ensure that there is no disturbance caused by their visit.

During the observation of the lesson, making sure all student teachers are in class at beginning of the lesson and observe the whole lesson. The student-teacher observing the lesson progressively completes the form and takes notes on events as they occur in his/her notebook. Those notes will be a referential basis for the appreciation on different aspects of the lesson. It is recommended to film the whole lesson for using that video during the feedback session.

(iii) After the observation session

After observation session, the tutor invites the teacher for a short debriefing before he/she leaves. When the time allows, student teachers can participate in the debriefing session. During the debriefing, the teacher expresses him/herself about some facts that characterized the lesson such as his/her intentions/motivation, his/her choice of lesson objectives, learning activities, methods and techniques used, organizational and evaluation styles, processes and results.

When the debriefing session is not possible in the demonstration school, the tutor can invite him/her during reflecting session in TTC.

11.5.2 Components of a Mathematics lesson observation sheet

The following are the main components of a lesson observation sheet at the international level (Education Development Trust, 2018):

	Item	Indicator (detail)
1	Assessment and evaluation	Assessment is aligned with goals and instructional objectives
		The teacher gives explicit, detailed and constructive feedback

2	Differentiation and inclusion	The teacher creates an environment in which all learners are involved
		The teacher takes full account of learner differences
3	Clarity of instruction	The teacher shows good communication skills
		There is clear explanation of purpose
		Lessons are well structured
4	Instructional skills	The teacher is able to engage learners
		The teacher possesses good questioning skills
		The teacher uses various teaching methods and strategies
5	Promoting active learning and developing meta-cognitive skills	The teacher helps learners develop problem-solving and meta-cognitive strategies
		The teacher gives learners opportunities to be active learners
		The teacher fosters critical thinking in learners
		The teacher connects material to learners' real-world experiences
6	Classroom climate	All learners are valued
		The teacher initiates active interaction and participation
		The teacher interacts with all learners
		The teacher communicates high expectations
7	Classroom management	Learning time is maximized
		Clear rules are evident
		Misbehavior and disruptions are effectively dealt with

Source: Education Development Trust, 2018).

Assessment

The student teacher makes a short report showing what they have learned, positive aspect and area of improvement.

Lesson 2: Reflect and criticize the lesson observed

a) Learning objective

Provide constructive feedback of the observed lesson

b) Teaching and learning resources

Lesson observation sheet filled of all student teachers, textbook of Foundation of Education and TMP, notebook and pen, Video of the recorded lesson or I-pad

c) Guidance to conduct reflective session effectively

Here are six tips for improving lesson observation feedback

(i). Capture your lesson

Whether you are being observed or observing someone else, video can be an objective tool for you both, allowing you to have a two-way discussion rather than just a feedback session. Reviewing the video together means you can actively discuss, pause, rewind, fast-forward and allow your colleague to come to their own conclusions, making it more meaningful for you both.

(ii). Use exploratory questioning

This type of questioning naturally opens up dialogue, giving you time to think and draw conclusions. For example, try saying: “What do you think you could do to tackle the problem of...” rather than “What you need to do is...”

(iii). Make feedback constructive

Even if a lesson does not go as planned, the situation can be turned into a positive one if you give the teacher constructive feedback and help them to learn from the situation. Constructive feedback helps identify solutions for areas of weakness by looking at what can be improved rather than focusing on what went wrong.

(iv). Relate back to previous objectives set

Always keep a clear focus in mind. Relate your discussion to the targets already set, if new topics arise; set these as development targets for your next session. Staying focused will allow you to give some 'easy wins'; developing a feeling of immediate progression. Be clear in your own mind about why you are feeding back. What exactly do you want your colleague to achieve with what you are telling them?

(v). Be patient

Give you and your colleague time to draw your own conclusions and then explore them together without cutting across one another. You will develop a stronger, more professional relationship.

(vi). Do it again

Whether giving or receiving lesson observation feedback, request you do it again and regularly. Only by continually discussing and breaking down what you saw can help you understand progression.

Some learning activities to make reflective session more active

- Form groups of students and give them observation sheet collected after lesson observation
- Ask them to remember the whole process of the lesson and try to describe the process of the lesson and highlight positive aspects and area of improvement.
- Move around in every group and facilitate them in their discussions by asking some questions and prompts to student-teachers, encourage talk and extend thinking'
- Invite groups to present their findings.

12.1 Guidance on the lesson

Lesson 1: Microteaching and its steps

a) Learning objective

- Describe the role of microteaching and its steps;
- Extend microteaching for teacher trainees to the lesson study for in-service teachers.

b) Teaching and learning resources

Lesson observation sheet, textbooks, notebooks and pens.

c) Learning activities

- Invite a group of students to take lesson observation sheets and observe the lesson taught by one student teacher who was previously asked to prepare a lesson and teach it to another group of peers.
- After the lesson, organize a whole class discussion for feedback: listen to the student who taught the lesson, the team of lesson observers, and the comments leading to the improvement of the lesson taught.

As a Tutor, harmonize the work done by students guiding them to describe the microteaching, its importance and its steps. Help them to highlight the process of giving constructive feedback during microteaching (to who, when and why to give feedback) and receiving feedback: readiness to accept and to improve.

After this lesson, form groups of student teachers and give them a home work to be done: to consider the importance and the steps of micro-teaching and think of the same activity done by in-service teachers when they take the culture of learning from the teaching practices for their peers. They are to be requested to search on lesson study and its steps.

- After the homework, invite student teachers to a whole class discussion where you will invite them to present their findings.
- Harmonize their works and answers by guiding them to compare the lesson study and the microteaching and how the lesson study can be well implemented in the context of Rwandan schools.

d) Possible answers for activities

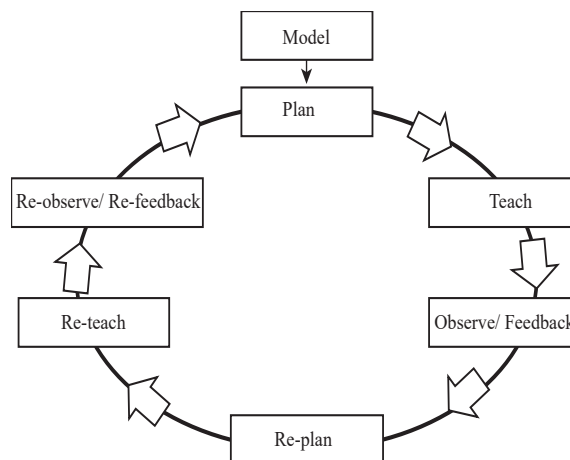
Activity 12.1 and application activity 12.1

Refer to the student's book and the textbook for the foundation of education to assess the students' works.

What is micro-teaching?

Micro-teaching is a shorter version of the process that you go through to prepare and teach a lesson. The micro-teaching session will bring together a small group of peer student teachers to observe each other teaching short lessons and to provide and gain feedback on teaching. Learners are peer student teachers. The micro-teaching session allows student-teacher to focus on teaching and assessment strategies in a non-threatening environment, and receive supportive feedback on their teaching from their peers and tutors.

Micro-teaching cycle



Source: Reddy KR, 2019; adapted by the content provider

Step 1: Preparation of Micro-Teaching Lesson

What to do to prepare for micro-teaching?

Due to the time constraints of time reserved for micro teaching, the tutor will ask the student teachers to prepare in advance for the upcoming micro-teaching session. The student teacher will prepare a content which will be delivered in 15-minute lesson that will include questions from the “students,” their peer observers. The tutor will ensure that everyone has equal time to participate and receive feedback. The tutors remind the student teacher to

prepare all materials that they will need and that point of preparedness will be included in appreciation of the lesson.

The tutors should prepare ICT tools which will help in recording the session during delivering and displaying the session during feedback session. Make sure that all ICT tools are working efficiently.

Step 2: Teach in micro-teaching model

Under this step the student teacher teaches a micro-lesson to a micro-class (peers). This lesson is observed by the tutor and the peer group with the help of the appropriate observation schedule. The lesson can be recorded using an audiotape or video tape.

Step 3: Feedback

Immediate feedback is given by the tutors and the peer group observer.

Step 4: Re-planning:

On the basis of the feedback the student teacher may re-plan the lesson.

Step 5: Re-teaching

The session where the student teacher re-teaches his/her micro-lesson on the basis of his/her re-planned lesson.

Step 6: Re-feedback:

The student teacher is provided re-feedback on the re-taught micro-lesson.

To sum up, during microteaching process, the “teach-re-teach” cycle may be repeated several times until the desired level of skill or adequate mastery is achieved. Such repeated cycles of teaching, feedback and re-teaching help the student teacher to improve his/her teaching skills one at a time.

Micro-teaching cycle (continues up to the extent when a trainee will be able to master a specific skill)

Practicing micro teaching

a) Learning objective

Deliver lesson in microteaching setting

b) Teaching and learning resources

Lesson observation sheet, Tape video recorder, Camera, Video- Projector and computer

c) Learning activities

- During the preparation phase Tutor asks student teachers to choose one topic to teach that they feel most comfortable with. Tutor tells them to assume that they will be teaching the class with the following characteristics:
 - Number of students/pupils to teach (to be precise)
 - Type of pupils: pre-primary or primary and special needs cases
 - Class and prior knowledge (to be precise)
 - Time duration for micro-teaching lesson

Tutor asks student teachers to keep the lesson focused on a clear learning objective and use relevant but not expensive teaching materials. During preparation steps, the tutors will be around to support student teachers as needed. This preparatory step ends by lesson plans ready to be submitted to the tutor for correction and more guidance.

• During the delivering of the lesson

The tutor reminds the student-teachers that the focus of the micro-teaching session is on learners engagement. The strategies used to encourage learners discourse. How student teacher engages learners in a class discussion: The focus can change according to the objectives of the micro-teaching but it would be better to focus on no more than three items in one session. Remind the student teachers who are acting as learners, to behave as learners depending on the level chosen.

Tutor reminds student teachers who act as observers to fill observation sheet and to be focused on what have been agreed before. The way the student teacher fills that observation sheet will be part of the record of their performance in that lesson.

Tutor takes video of whole lesson and doesn't accept any interruption during the lesson. When time allocated to the lesson is finished the tutor gives a signal to stop the lesson.

d) Feedback

Immediate feedback is given by the student teacher and the peer group. This feedback will use the strategies of constructive feedback. It would be better to conduct quick feedback before proceeding to feedback using the video taken.

If the time allows, the feedback session should take place immediately after micro teaching. If the tutor doesn't have time, in accordance with student

teachers they can plan next time to make that session. The tutor takes the observation sheets of all student teachers to evaluate their skills on how to appreciate a lesson.

e) **Re-planning, Re-Teaching and Re-feedback**

These three sessions depend on the feedback the student teacher has received. The conclusion of feedback is to say if student teacher passed or will re-plan the lesson for next sessions.

End unit Assessment

Tutor asks student teachers to take syllabus and each one select lesson to prepare and to present in small group. Each student teacher will then submit report with observation sheet filled of lesson watched.

12.2 End unit assessment

1. Refer to the student's book to find at least 11 skills a student teacher gain from micro-teaching
2. Compare the microteaching and the lesson study: do your own research before assessing students' work.

The following figure is the lesson study cycle in which in-service teachers work together to discover solutions to shared teaching and learning challenges. After observing a challenge, a group of teachers **work** collaboratively to plan a lesson, one of them teaches the lesson while others are observing. After the lesson, they reflect on the strategies used and summarize the feedback for improvement. The teacher can re-plan and re-teach this lesson in another class (parallel classroom) putting into application the feedback.

This process can continue until the challenge is addressed.

Figure: Lesson study cycle



Considering the process of microteaching and the process of lesson study, the following can be a comparison of them in the context of Rwanda:

Item	Microteaching	Lesson study
Objective	To practice the teaching skills as a learning process.	To improve the teaching skills in the career of teaching.
Concerned	Pre-service teachers or teacher trainees	In-service teachers
Time duration	The time depends on the organizer	At least one period of 40 minutes
Planning	Individual planning	Group planning
Learners	Small class size of peers or learners	The whole class of learners
Steps	Consider a skill, plan, observe, reflect, re-plan, re-teach, re-feedback.	Study a challenge, plan, observe, reflect, re-plan, re-teach, re-feedback.
Reflection	Collaborative feedback: Tutor, student teachers and eventually the class teacher.	Collaborative feedback: the group of concerned teachers
Revision	Re-feedback, re-planning and re-teaching are necessary.	Re-feedback, re-planning and re-teaching are to be done until the observed challenge is addressed.

Source: *Content provider, (2019).*

The lesson study can be a solution of teacher training. As there is no sufficient budget for assembling teachers from remote areas for training, lesson study becomes an opportunity for teachers to learn mutually at their schools. However, we must persuade teachers that it is possible to carry out trainings at school, even without money, with the aim of actively exchanging constructive ideas on teaching practices.

- As Tutor, harmonize the work done by student-teachers highlighting the purpose of lesson observation, activities to be done when observing a lesson
- Using the lesson observation sheet, help students to harmonize their answers and findings.

- Organize a whole class discussion on how to improve the lesson observed
- Correct the reports of student teachers done after observing the lesson.

12.6. End unit Assessment 12

Play a video of one recorded lesson and ask student teachers to criticize that lesson using the student's book, the lesson observation sheet and lesson observation guide provided by REB .

13.1 Key unit competence

Facilitate various mathematics lessons in demonstration schools

13.2 Prerequisites

Student-teachers are going to work successively in this unit if they make a short revision on general concepts learnt in foundation of education:

- General techniques and strategies of teaching.
- Lesson planning
- Use of teaching and learning resources in the lesson
- Classroom management

13.3 Guidance on the teaching practice activity

Preparation step

- At least a week before the lesson delivery, the tutor works with teachers in demonstration schools to have a list of lessons to be taught by student teachers in different subjects and grades.
- The tutor assigns student teachers for lesson preparation and ensures that a student teacher has chance to teach different subjects in different grades to gain skills in different pedagogical contexts.
- Tutors of different subjects should be available to support student teachers during lesson planning.
- After lesson preparation, lesson plans are reviewed and marked by the tutor responsible of Teaching practice.
- Student teachers are given opportunity to discuss the responsibilities of a Mathematics teacher in the classroom
- Student teachers are provided with instructions and guidance to follow at the demonstration school: lesson observation and feedback, prepare their Mathematics lesson effectively, organize appropriate teaching aids and appropriate class management strategies.
- The tutor ensures that teachers in demonstration school are familiar with the lesson observation sheet, have enough skills in giving constructive feedback.
- The tutor organizes how different tutors will supervise student teachers

During delivery of lessons

- The tutor ensures that the class/subject teacher in demonstration school observes the whole lesson without any interruption and fills in the observation sheet progressively.
- The student teachers who don't have a lesson to deliver observe the lesson of their fellow student teachers and fill in observation sheet.
- All tutors who have been assigned to accompany to the demonstration school ensure that teaching practice is effectively done for all student teachers.

After delivery

- After the teaching practice, each student teacher meets with the class teacher and where possible together with the Tutor to discuss feedback to improve the next teaching practices.
- Back at school/TTC, the tutor meets all student teachers for debriefing session on teaching practice and takes some strategies for improvement for next sessions.
- For recording purposes, student teachers and supervisor tutors submit filled observation sheets to the tutor in charge of teaching practice.
- The Tutor marks the observation sheets for student teachers who played as observers of their fellow students and consider marks of lesson plans and delivery for student teachers who played role of teachers.

13.4. Additional information to the tutor

Purpose of teaching practice

- It provides the opportunity to develop positive approach and attitudes to the school and school community which facilitate to grow in profession awareness and development of the student teacher.
- It provides the opportunities to establish relationship with learners, teachers and other stakeholder involved in education.
- It provides opportunity to discover and develop one's ability as a teacher,
- It gives the opportunity to interact and understand learners and attempt to cater for their individual need;
- It provides the opportunities to have classroom experiences and apply the theoretical skills learnt in college;
- It gives the opportunity to develop qualities crucial to teaching such as humility, interpersonal skills, openness and patience.

NOTE: The guidance on the school attachment (Unit 1,Year 3) is related the guidance highlighted above in the teaching practice but during the school attachment, the student teacher assumes all responsibilities of a teacher at the school.

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