

Module 4: General Pedagogy

Users:

Teachers and CLs for SBI, DTST for CL Sourcebook Training, National Trainers for DTST Training

Objectives of this Module:

Module 4 provides the users with reference materials in terms of general pedagogy. The module offers general teaching skills and methods as well as subject-oriented teaching skills and methods. The module uses several examples of the skills and methods for the sake of explanation; however, those who need more practical examples are advised to refer to Modules 5 and 6, which elaborate how to use some of those skills and methods in actual lessons.

It is recommended that the users refer to some specific sections of Module 4 when they are involved in SBI/CBI, CL Sourcebook Training and DTST Training. For example, during SBI/CBI, Module 4 can help a CL to form a focus or a theme of the discussion and demonstration activity. Besides, when dealing with challenging topics, CLs and teachers can search for relevant information that can assist them in developing a better lesson plan for the topic.

Module 4 consists of 6 chapters as shown below:

1. Study of the Primary School Curriculum Materials
2. Good Primary Practices
3. Teaching and Learning Activities
4. Lesson Plan
5. Assessment
6. English as a Tool to Support Understanding of other Subjects

Module 4 has been developed with reference to:

- Teaching syllabus for Mathematics (primary school), by MOE
- Teaching syllabus for Integrated Science (primary 4-6), by MOE
- Handbook on the teaching of Mathematics in primary schools, GES
- Handbook on the teaching of Science and Environmental Studies in primary schools, GES
- Handbook on the teaching of English Language in primary schools, GES
- Handbook on lesson notes preparation and teaching and learning materials in primary schools, GES
- Manual for the teaching of Science and Mathematics in basic schools, GES/JICA

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1. Study of the Primary School Curriculum Materials

Introduction

Successful teaching and learning to a large extent emanates from careful planning and preparation. Before this can be done, the teacher must be fully aware of the need to familiarize himself/herself with the requisite curriculum materials. The curriculum of a school is the structured and controlled total learning experience under the guidance of a school.

What are curriculum materials?

Curriculum materials are the documents or reference materials available for teachers for effective lesson planning, preparation and delivery. These materials contain vital information, which directs the teacher to prepare lesson plans and to teach effectively. They are:

- the syllabus
- teachers' manual/guide
- pupils' textbook
- pupils' workbook and
- other relevant external reference materials

The Syllabus

It is a document that contains all the topics for a course or teaching of a particular subject. Each subject taught in the basic school has its own syllabus. A syllabus is planned to include the work to be taught for a whole year.

The syllabus contains other important information such as:

- General Objectives/Goals
- Year and Units for Mathematics
- Section and Units for Science
- Specific Objectives
- Content
- Teaching/learning Activities
- Evaluation

Table 1: Information Contained in the Syllabus

Headings/Items	Explanation
General Objectives/Goals	They are a summary of the specific objectives of the various units contained in that section.
Sections and units	These are divisions in the syllabus or the way the syllabus has been planned year by year. Each year's work has been divided into sections.
Specific Objectives	These state the knowledge; skills and attitudes that the pupil is expected to acquire or develop in one or more lessons. They are stated in measurable/behavioural terms. They indicate what the pupil will be able to do after instruction and learning in the unit.
Content	The content presents a selected body of core ideas that will be needed in teaching or achieving particular specific objectives. They are selected to bring out the basic ideas, concepts, knowledge, principles and skills, including generic skills and attitudes relevant to particular subjects at the primary level.
Teaching and Learning Activities	These are activities, which indicate the extent to which the various aspects of each topic are expected to be covered at any particular stage in the lesson delivery. They include suggestions for the methods that could be employed to promote good or best primary practices. The teaching and learning activities are outlined to ensure maximum pupils' participation in the lesson. The teacher is encouraged to re-order the suggested teaching and learning activities and also add to them where necessary in order to achieve optimum pupil learning.
Evaluation	The evaluation is expected to provide information to help the teacher to decide whether the objectives of the lesson have been achieved. It also seeks to find out whether the methods employed are sufficient enough to achieve the objectives set out for the lesson and to identify any defects in the learning situation. It deals with exercises to find out the extent to which the lesson or each unit has been understood.

Teachers ' Manual/Handbook

The handbook attempts to present the units in the same sequence as found in the syllabus. It contains suggestions for the activities and teaching/learning materials that could be used to teach the various aspects of each unit. It may also give some background knowledge for each unit. It contains answers to questions in the pupils' textbook.

Pupils' textbook

The pupils' textbook gives reliable support material for use by the teacher in terms of what is relevant at the level of the pupils. It attempts to match the exercises for the pupils with the sequence of the materials in the syllabus.

Pupils' workbook

It supplements and extends the material presented in the pupils' textbook.

It provides exercises and activities in a lively and interesting way. It also assesses pupils'

knowledge and understanding of concepts, skills and processes.

Other relevant external sources of information

These include all other sources of information that are relevant to the topic to be treated by the teacher and which may make the lesson more understandable to both the teacher and the pupils.

2. Good Primary Practices

2.1. Good Practices (General)

There are certain basic good practices that teachers need to acquire to make their teaching and learning activities more effective. These practices in teaching and learning are termed “Good Primary Practices”.

2.1.1. Pre-delivery Activities (Good Primary Practices Before a Lesson)

Pre-delivery activities are all the activities that a teacher undertakes before the actual lesson delivery.

- Effective use of the three basic curriculum materials namely the syllabus, pupils’ textbooks and teacher’s guide as well as other reference books.
- Selecting appropriate Relevant Previous Knowledge (R.P.K.) for the topic.
- Statement of specific objectives which are achievable, measurable and observable and suit the level of the class.
- Selection of teaching and learning activities that will help the pupils to develop the necessary process skills and acquire scientific knowledge (core points).
- Preparation of a good lesson plan.

2.1.2. Delivery Activities (Good Primary Practices during a Lesson)

Delivery activities are all the activities which a teacher and the pupils engage in during the presentation of the lesson.

- Very good introduction to link the topic with the R.P.K.
- The use of activity method of teaching together with other methods like discussion, demonstration, etc, to achieve the stated objectives and to derive the core ideas/facts.
- Effective use of questioning skills, i.e. using probing questions, distributing questions evenly, etc.
- Being sensitive to gender issues during lesson delivery.
- Sequencing of core points during general class discussion on the activities which were performed by the pupils.
- Very Clear and audible voice together with legible handwriting on the chalkboard.
- Effective use of chalkboard, which helps pupils to follow the lesson sequence and the summarised lesson content.

2.1.3. Post-delivery Activities (Good Primary Practices after a Lesson)

Post-delivery activities are all the activities which a teacher and the pupils undertake after the presentation of the lesson. Normally, pupils are assessed during the post-delivery activities.

- Evaluation of the lesson, which can take the form of:
 1. Drawing and labelling of objects,
 2. Doing a short writing or oral exercise based on the activities,

3. Writing chalkboard summary.

- Assigning a project work.
- Discussion with pupils after they have written an assignment.

2.2. Good Practices (Mathematics)

The general observation is that at the primary level in Ghana, Mathematics lessons lack the necessary attractions to make the subject meaningful and appealing to our pupils. A good practice in teaching Mathematics at that level will be a child-centred activity which involves a variety of activities to enable the pupils to like and learn the subject as they DO and TALK Mathematics. Such practice relates Mathematics teaching and learning to our daily life activities and makes pupils' learning more fun.

The following aspects are helpful to the realisation of such good practices in teaching Mathematics:

a) Good Communication Skills

The use of simple language is needed to help pupils to understand so they can respond to whatever is being taught. For example, the product of 6 and 4 to a lower class in a primary school should rather be: Multiply 6 and 4. In the case of teaching a Mathematical Concept of greater than (>) to a P1 class, it will be better to use bigger than before the concept of greater than is used. Also, the teacher's voice must be clear and loud enough.

b) Teaching from Concrete, through Semi-concrete to Abstract

In teaching pupils to develop a concept, start with real or concrete objects, follow up with diagrams/charts or sketches and end with symbols. In counting at the early stages, use counters such as bottle tops, then follow up with pictures of groups and end with numerals (symbols).

c) Word/story Problems should be Related to Pupils' Environment

We need to tap pupils' P.K. for effective teaching and learning. It is therefore, necessary to relate word/story problems to the pupils' environment. For example, a problem in a farming community could be related to foodstuffs. In sum, the pupils should be exposed to things they are familiar with.

d) The Use of Correct Mathematical Language/Terms

Mathematics is used as a means of communication and as such language/terms are associated with it. These can only be acquired through usage. Therefore from P1 the correct Mathematical language/terms have to be used, e.g. $\frac{1}{2}$ as one half, 0 as zero,

$\frac{5}{10}$, i.e. five tenths, $\frac{2}{3}$ as two thirds, 106 is read, one hundred and six.

e) The Use of Mathematical Games/Puzzles

Mathematical games portray mathematical concepts. They allow teachers to employ the Play/Activity method of teaching Mathematics. They help to consolidate lessons

taught. Examples of mathematical games include: Ludo, Oware, Dominos, Fraction Game, etc. Puzzles encourage pupils to reason, analyse and enjoy Mathematics at the same time.

f) Assignments for Evaluation

The assignments are the exercises/project/homework given out to pupils to do in order to find out whether or not they have understood a lesson delivered. This is also to ascertain whether the teacher’s methodology was appropriate or not. Giving assignments for evaluation is an important tool for the teacher to assess the effectiveness of the lesson taught. Teachers are therefore to be cautious of how to select test items.

g) Guiding Pupils to Make Corrections and Marking them

It is a remedial process put in place to help the pupil overcome learning difficulties and to be on the right learning track. Through corrections, the teacher could determine whether the pupil has fully understood the concept or not. When a pupil is able to solve a problem in a second attempt, he feels motivated and confident to attempt a harder task. It is important therefore for the teacher to go about correcting exercises cautiously so that the pupil is able to get an exercise right, at least, on the second attempt.

GENERIC SKILLS: PRIMARY 1 – GROUPS OF OBJECTS

Table 2: Skill Development in Primary 1

Generic Skills	Activity	Example
Listening	Playing the game ‘I Spy’	I am thinking of a group of objects with wheels. What is it?
Speaking	Identifying groups of objects	Mention the name of a given group of objects
Writing	Drawing groups of objects	Draw a group of squares
Reading	Identifying members in a group	Read the name on the label for a given group of objects
Talking	Comparing of objects in a group	Pupils compare the lengths of two objects to tell which is short and which is long
Showing	Ordering of objects	Pupils arrange groups of sticks from the shortest to the longest and show to the class
Reporting	Comparing objects	Pupils compare any two groups of objects and report on how to show that one is more or less than the other
Observing	Matching objects	Pupils observe how objects are matched using one-to-one matching
Investigating, Thinking and Problem solving	Playing the game ‘I Spy’	I am thinking of a group of objects that fly but they are not living things. What are they?
Playing	Playing the game ‘I Spy’	In two groups, pupils pose problems to each other about groups of objects, and tell the winning group finally
Making	Sorting objects	Pupils group objects according to shape or colour.
Doing	Ordering groups of objects	Pupils group objects according to size

2.3. Good Practices (Science)

A Science and Environmental Studies teacher can make his/her lessons interesting and child-centred when certain basic skills like observation, manipulation, measurement and classification of objects are projected in the teaching and learning activities. Pupils as we know, do participate actively in a lesson when they manipulate objects to find out things or facts for themselves. The relevant basic skills which pupils use to acquire facts and knowledge and also to solve their problems are called Generic/Process Skills. In this section, we shall learn more about the skill.

2.3.1. Definition of Science

Examples of definition of Science and Environmental Studies are shown below.

- A body of knowledge which can be communicated to others and which can be verified by anyone willing to make the effort to do so.
- A way of learning which involves first-hand experience, inquiry, problem solving, interpretation and communication of findings and the development of attitudes which promote this way of working.
- Exploring the environment, observing things and solving problems.

The aforementioned definitions are among many other definitions given by scientists but there are only two major views on all these definitions of Science and Environmental Studies. These views consider science as a body of knowledge (product) and as a means or process of generating knowledge (process). As we know, scientists carry out studies of the environment or investigate the natural phenomena through identifying a problem, observing, experimenting and communicating findings. They make use of certain attitudes like objectivity and open-mindedness when collecting and interpreting information. **Process of Science** is the procedure scientists use to carry out a study of the environment.

2.3.2. Generic/Process Skills and Science

It is very important to use a variety of Generic/Process skills in a lesson. The following table shows briefly Process Skills in Science and their meanings.

Table 3: Generic/Process Skills in Science and their Meanings

Generic/Process skills	Explanation/Meaning
Planning	Defining the problem and thinking of ways to solve it through experimentation, or some structured investigation.
Observing	It involves the use of the senses to take in information.
Classifying	Placing a collection of objects or events in categories based on similar characteristics.
Experimenting/fair testing	Interacting with materials to find out things for yourself or managing the factors that may influence a situation or event so that the effect of a given factor may be learned.
Raising questions	Asking a variety of questions through words or actions; asking questions which can be answered through scientific investigations/experimentation.

Generic/Process skills	Explanation/Meaning
Measuring	Using measuring instruments correctly and with appropriate precision as required by the investigation, and being able to compute results from measurements taken.
Manipulating	Skilful handling of objects and tools in accomplishing a task.
Predicting	Forecasting what future observations will be on the basis of previous information, which distinguishes it from guessing.
Hypothesising	Suggesting reasons for events or phenomena, which can be tested scientifically. It involves applying concepts and ideas from previous experience.
Interpreting data	Giving meaning to information gathered.
Inferring	Drawing conclusion based on trends and patterns observed or on one's previous experience.
Generalising	Extending the conclusion of an experiment to other similar situations; being able to predict possible solutions to similar problems based on the results of a previous experiment.
Evaluating	Assessing the results of the experiment and finding conclusions or inferring conclusions from the experiment; determine whether results confirm one's prior prediction or not. Making value judgment based on assessment result.
Communicating	Being able to present information so that it can be understood by others, being able to understand information from others presented in various forms using graphs, charts, prose, written instructions diagrams, pictorial and oral representation.

It is very important for teachers to put their knowledge of Process Skills into practice. That means teachers apply Process Skills in lessons. One of the effective ways to do so is to use questions that are related to Process Skills. When these questions are well planned, they are very powerful to foster pupils' process skills. Table 4 shows some examples of questions related to Process Skills. They are categorized into four stages, planning, experimenting, assessing and communicating.

Table 4: Application of Generic/Process Skills through Questioning

Generic/Process Skills	Generic/Process Skills through Questioning
Planning Resources Predicting Hypothesising	What will you need? What is the key idea and what is likely to happen? Why will it happen?
Experimenting Observing Measuring Handling Apparatus Recording (Writing)	What do you see, hear, smell and feel? What will you measure? What will you change to make a fair test? How will you record the results?
Assessing Evaluating Discussing Generalising	What have you found out? How do you relate the outcomes? What might be said about the key ideas?

Communicating Speaking (Talking) Writing or drawing diagrams/posters Listening	Will you describe the experiment orally? Will you write a clear report about the data? How will you communicate to others and also receive information from others?
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Although it is not practically possible for teachers to carry out an experiment in a lesson on a daily basis, teachers should make efforts to maximize pupils' opportunities to see/do an experiment. In an experiment, Generic/Process Skills can be effectively presented. Table 5 presents application of Generic/Process Skills during experiments in a particular lesson. It shows the relationship between Generic/Process Skills and activities in the experiments.

**Table 5: Application of Generic/Process Skills during an Experiment
(Topic: Electrical Circuits, Class: Primary 6)**

Generic/Process Skills	Description of Activity
Planning (Resources)	Wire, dry cells, bulbs, keys
Predicting	Dry cells in a series circuit will produce brighter light than dry cells in a parallel circuit.
Hypothesising	Dry cells in a series circuit produce brighter light.
Fair Testing/ Experimenting	A Series circuit and a parallel circuit are constructed using two dry cells and a bulb in each circuit.
Observing	The series circuit has the dry cell arranged in a row while in the parallel circuit the cells are arranged side by side.
Manipulating	Two dry cells and a bulb are connected by pieces of copper wire to make a series and a parallel circuit.
Measuring	The intensity of the light is measured by using a number of sheets of paper to block the light rays from each of the bulbs.
Recording	Draw each circuit. The brightness of the bulbs is recorded by tabulating the number of sheets of paper that the light rays from each bulb passed through.
Interpreting data	A series circuit produces brighter light than a parallel circuit. The light from a series circuit was able to penetrate more sheets of paper than light from a parallel circuit.
Generalising	Dry cells in a series circuit produce brighter light than cells in a parallel circuit.
Communicating	Cells give more power when they are arranged in series than when they are arranged in a parallel circuit. In a series circuit, dry cells are arranged in a row. In a parallel circuit, cells are arranged side by side.

2.4. Managing Special Classes

There are certain problems/challenges facing classroom teachers that hinder effective teaching and learning in primary schools. The challenges include large class size, small class size, extremely high ability group, low ability group, classes without curriculum materials and classes without furniture. Using effective class management techniques can solve these challenges. This section discusses how to manage special classes with those challenges.

2.4.1. Special Classes and their Features

Special classes are the classes that are quite different from normal or usual classes.

Their anomalous nature is characterised by the challenges enumerated above and other additional features summarised below:

- Large class size (A class with 35 pupils is the norm and a class with more than 40 can be regarded as large class)
- Small class size
- Extremely high ability group
- Extremely low ability group
- Multi-grade classes
- Classes without curriculum materials, i.e. no syllabuses, no textbooks, no teacher's manual
- Classes without tables and chairs for the pupils to sit comfortably to do exercises
- Classes held under trees, sheds and in uncompleted buildings

2.4.2. Large Class Teaching

Features of Large Classes

Due to expanding enrolment of the primary schools, managing large classes is now one of the most important skills primary school teachers need to employ.

For successful large class teaching, it is necessary to understand the features of large classes. The following are some of the typical features of large class teaching.

- There are often various learning backgrounds.
- Extra time and effort are needed for class activities.
- Teacher's speech might not be clearly heard by pupils at the back of the class.
- Pupils tend to be more passive.
- Pupils can easily hide themselves among others.
- It is more difficult to give individual attention, care and advice to pupils.
- Amount of TLMs and working space might be insufficient.
- Time pupils spend on activities decreases.

Strategies for Large Class Teaching

Although large class teaching can be more difficult than normal class teaching, teachers must provide the best possible learning environment. The following suggests some teaching strategies that can minimise difficulties and challenges that teachers often face in large classes.

Station work: Pupils move around a series of stations (i.e. a number of desks set up in different locations in the classroom) that offer different tasks. Because the stations have brief instructions, pupils can carry out learning activities individually. The learning activities can be simple experiments, exercises, and reading tasks.

Small group work: Pupils work on a task in small groups. Pupils can develop ownership of the task and responsibility for their own learning.

Peer evaluation: For effective pupil assessment, the teacher can use peer evaluation. For example, one pupil is active and the other observes so as to assess him/her.

Peer teaching: Pupils help each other to learn, often showing leadership skills. For instance, a group of pupils assist other groups in learning giving advice and comments. In this way, pupils learn from one another. Pupils who receive comments can ask questions that they are normally hesitant to ask their teachers. On the other hand, pupils who give comments can develop their understanding of the topics through the process of explaining to others.

An example of a case of managing large classes is presented in the following:

A teacher can handle or control a large class by first and foremost being able to know his or her own pupils at the following levels.

- Extremely high level,
- Extremely low level,
- Middle ability.

As the teacher gets to know pupils of extremely low ability levels, he or she will also concentrate on them by giving them direct instructions as others are also occupied with different tasks. For instance, as the middle ability groups are engaged in cumulative review, the extremely high ability group will be doing a greater task of practising the skills that are yet to be introduced to the class. With this approach, the teacher will succeed by engaging all the ability levels as he or she goes round to supervise or serve as a co-learner. This can be simplified as shown in Table 6.

Table 6: Example of a Time Table for Large Classes

Group	Monday			Tuesday	
	8:00 - 8:20	8:20 – 8:40	8:40 – 9:00	8:00 – 8:20	8:20 – 8:40
A (Extremely low ability)	Direct Instruction (New Skills)	Practice (Newly-learned Skills)	Cumulative Review (Skill from the Previous Lesson)	Direct Instruction (New Skills)	Practice (Newly-learned Skills)
B (Middle ability)	Cumulative Review (Skills from the Previous Lesson)	Direct Instruction (New Skill)	Practice (Newly-learned Skills)	Cumulative Review (Skills from the Previous Lesson)	Direct Instruction (New Skills)
C (Extremely high ability)	Practice (Newly-learned Skills)	Cumulative Review (Skills from the Previous Lesson)	Direct Instruction (New Skills)	Practice (Newly-learned Skills)	Cumulative Review (Skills from Previous Lesson)

Note: A - is the group the teacher has recognized to be extremely low. B - Middle ability group. C - Extremely high ability group

Again, from Table 6, as the teacher spends 20 minutes for Group A on direct instruction, B and C will then be engaged. After the 20 minutes, A will be practising a new skill and the teacher gives direct instruction to B and so on and so forth. The same table can be used for multi-grade classes. In this case, A will stand for one of the classes that has been combined with the other class(es). B will stand for the other class that A has been combined with. However, the teacher should consider the following points for effective group work:

- Very low ability classes need individual attention as an appropriate approach for teaching the pupils in these classes.
- When pupils are grouped according to similarities in their learning needs or ability levels, it is said to be homogeneous. For example, when all the members of the extremely high ability level are in one group, that will be a homogeneous group. However, middle ability groups fall under heterogeneous grouping.
- It is very important that a teacher makes a conscious effort to maintain a reasonable balance between homogeneous and heterogeneous grouping.
- Too much homogeneous grouping will promote labelling, i.e. "slow learners" and "smart pupils".
- Train the extremely high ability group to help their classmates or provide simple tutorial/remedial help to other groups of classmates.
- Give very clear instructions and agree on rules on how the "tutor" and "tutee(s)" "learners" should work together. (i.e. Tutors need to respect learners, etc.)
- Provide the "tutor" and "tutees" with the materials they need for a successful peer tutoring activity. (i.e. Worksheets, flip charts and red pens for tutors, etc.)

Here are some things you can do to ensure that group learning is productive and not just "busy work". Establish simple rules of acceptable behaviour of pupils for everybody to observe, such as:

- How to work together on a group assignment, i.e. how to be a good leader and how to be a good member of the group.
- How to talk softly without disturbing others during group work.
- How to take turns and how to wait for one's turn.

2.4.3. Multi-grade Teaching

Multi-grade teaching (MGT) is also known as multiple-class teaching. It involves the combination of two or more classes in selected schools. MGT may be adopted when:

Class enrolments are low.

- This situation arises when schools are built in catchment areas where the enrolment is low. Two or more classes are then combined to be taught by one teacher while the other teachers are re-deployed to other needy schools.

Teachers in the schools are few.

- This may be the case in rural areas where some basic schools may not have their full complement of teachers.

Some Characteristics of Pupils in Multi-grade Classes (MGCs)

- They have different intellectual backgrounds.
- They have different socio-economic backgrounds.
- They have different interests.

- Their previous experiences are different.
- They have different educational needs.
- They may prefer different learning approaches.

Types of MGT

Single-class cases of MGT

- There can be **single-class cases of MGT** in which case two classes (e.g. P5 and P6) are combined to be taught with the same lesson plans. The lessons are however to be based on the P6 scheme of work/syllabus and time-table. It must be noted that adopting this approach will slow down the progress of the higher class. On the other hand, the lower class will encounter problems in understanding the lessons since it lacks the appropriate background/ previous knowledge.

Separate-class cases of MGT

- There can also be **separate-class cases of MGT** teaching. Teaching focuses on the scheme of work/syllabus for each class. The pupils may be in the same room (in the case of school with low enrolment) or in different rooms (in the case of schools with normal class sizes but few teachers). If this teaching approach is adopted, then as much as possible there should be separate black/chalkboards if the lessons take place in the same room. This teaching approach enables each class to proceed at its own pace since the time-tables are different . Some difficulties may arise in that class. For example, supervision will not be effective. The teacher will also be overworked.

The combined Approach

- In this approach some lessons are taught differently while others are combined.

Time-tabling and teaching guidelines

Based on the practical experiences of some teachers and educationalists, the following suggestions are made for the effective time-tabling of combined class lessons.

- Where possible, lessons that require little or no previous knowledge/specific background knowledge (e.g. P.E., environmental studies, etc) should be combined.
- When separate lessons are organized, the time-table should be such that while one class is taking a lesson that requires maximum supervision (e.g. lessons that involve the use of fire, sharp objects, etc.) the other class can be taken through a lesson that requires minimum supervision (e.g. expression work, story-telling, etc).
- As much as possible Mathematics and Science should be taught when the pupils are fresh and active. This should be reflected on the time-table.
- As much as possible, the syllabus/scheme of work for Science, Mathematics and Language should be followed separately for each class. This should also be reflected on the time-table.
- Non-examinable subjects (e.g. story-telling, gardening, etc.) may be excluded from the time-table in pressing situations. They should however be re-inserted when the situation improves.
- New Science, Mathematics and English topics should be taught on different days.
- On the whole the ages and mental abilities of the pupils should be considered in the preparation of the time-table.
- When necessary, subjects should be re-arranged on the time-table to ensure effective supervision.

Steps to Ensure Effective Multi-Grade Teaching

Teaching pupils in MGCs requires special techniques and skills. These are quite apart from the general teaching approaches teachers are taught while under training. This is because MGT is a challenging task. It can however be done with adequate preparation. The following points may be helpful in the organization of effective lessons in multi-grade classes.

- Where possible only pupils in adjacent classes should be combined.
- To avoid confusion, assign the various groups to specific portions of the classroom where appropriate. (This will not apply where the pupils are in different classrooms).
- Give clear instructions on how certain activities (e.g. seating, collection of materials, group work etc.) are to be performed. Routinise such activities so that they can be performed without detailed instructions.
- Through quizzes and question and answer sessions, determine the levels of understanding of various groups.
- Ensure that the lessons are appropriate to each group's level of mental development.
- Reinforce the pupils' responses (i.e. by question and answer sessions).
- Assess the pupils' progress as the lessons proceed.
- When appropriate, change the teaching approaches (e.g. group work, demonstrations, etc.)
- The normal school time-table should be modified to indicate the lessons to be organized for each group.
- Keep the various groups profitably engaged at all times on different tasks (e.g. seatwork, group work, etc.). Seatwork refers to any work the teacher assigns to the pupils to be completed in class. This is different from take-home assignments (homework) the teacher gives to the pupils for submission in the course of the week.

MGC teachers can best do this by being proactive (but not reactive) in their teaching task. To be proactive implies to anticipate a problem/challenge and design or think of an intervention in advance. For example, the lesson on the properties of air requires the pupils to make two coalpot fires. The teacher can anticipate what the pupils are likely to do with the materials (i.e. matches, kerosene, etc) that are used to make the fire. He/she can then issue appropriate interactions (eg. ask the more mature pupils to light the fire; ask for the return of the matches and kerosene etc.)

2.5. Questioning Skills

2.5.1. Introduction

Questions constitute a large part of a teacher's trade in stock. The success of teaching depends on how skilful teachers are with the use of questions. The kinds of questions teachers ask influence the levels of thinking operations pupils engage in.

It is always true that good teachers ask a variety of questions during their interactions with pupils in the class. However, it is generally said a large proportion of teachers tends to use the same types of questions that appeal to them or are favourable for them.

This section first discusses the purposes of questioning and then shows a variety of questions that teachers might want to use. The last part of this section presents strategies for the effective use of questions.

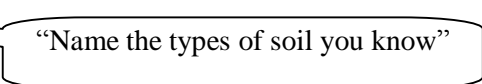
2.5.2. Purposes of Questioning

Questions have a wide range of educational purposes depending on the context of the classroom. Questions may be used for communication, classroom management, reviewing, drawing attention, stimulating pupils' thinking, evaluating pupils' understanding, and building expression.

Questions for reviewing (checking pupils' Relevant Previous Knowledge (R.P.K.))

Questions can be used to review or find out what pupils know about a subject or topic. A teacher can utilise questions to check the previous knowledge of pupils. It is always a good idea that a teacher introduces his/her lessons by reviewing pupils' previous knowledge. By doing so, the teacher can find out what pupils already know and he/she can quickly adjust what to teach in accordance with pupils' needs. Implementing this process on a regular basis is very beneficial. This technique builds up confidence in pupils and assures them of the relevance of the topic they already have knowledge of. Questions can also be used to review the core points they have learnt in the previous lesson.

Sample question for the lesson on properties of soil:

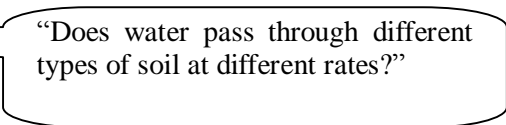


"Name the types of soil you know"

Questions to draw attention to core points or important feature of a topic

Questions can draw pupils' attention to core points of a topic as a way of emphasizing a point.

Sample question for the lesson on properties of soil:



"Does water pass through different types of soil at different rates?"

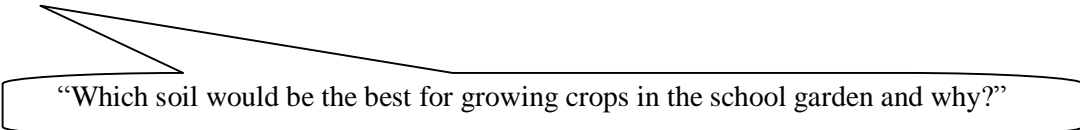
Core point:

Different soils allow water to drain through them at different rates.

Questions for stimulating pupils' thinking

Teachers can use questions to trigger pupils' thinking. Diverse range of questions can prompt low level of cognitive activity, such as recall of facts and also high level of cognitive activity, such as, analysis, synthesis, application or evaluation of knowledge. Appropriate questions can stimulate and motivate pupils to think independently, objectively and critically.

Sample question for the lesson on properties of soil:



"Which soil would be the best for growing crops in the school garden and why?"

Questions for evaluating pupils' understanding of content (core points, etc.)

Questions can be used to determine if pupils understand the lesson content. When pupils' answers show poor understanding, the teacher may need to teach the content again adding extra assistance. When pupils' answers show good understanding, the teacher can present a more advanced content. Appropriate questions find out pupils' difficulties and problems in particular areas of the topic.

Sample question for the lesson on properties of soil:

“Give one reason why water passes through sand faster than clay.”

Note:

Some teachers repeat questions like “Do you understand ...? “ and “Are you OK with it?” when they want to check whether their pupils have understood the content of their lesson well. However, it is commonly observed that those pupils who respond saying “ Yes, we understand, Sir/Madam!” do not in fact understand the teaching content. Teachers should not repeat those questions too frequently because pupils develop the habit of saying “Yes, we understand.” often to please the teacher even though their understanding may be low. This implies that teachers cannot rely too much on such questions like “Do you understand ...” and “Are you OK with it?” when they want to check pupils’ level of understanding. Teachers should use more specific questions instead, leading pupils to say more than just “Yes, Sir/Madam”.

Questions for communication

Questions offer verbal interactions between pupils and teachers. Appropriate questions help to increase the quality of pupils’ communication. Questions can help teachers to establish a friendly atmosphere in the class.

Sample question:

“What did you have for lunch yesterday?”

Questions for classroom management

Such questions seek to control classroom activities and cut down on disruptive behaviour.

Example question:

“What made you behave like that?” “Do you think you are making the learning environment in the class better?”

2.5.3. Types of Questions

Classification of questions is dependent on one’s view of the purpose of questions, or the purpose of education. Thus, it varies from teacher to teacher. However, it is beneficial to know some of the major classifications of questions and types of questions discussed in each classification. There are many ways of classifying questions. One of such ways is to determine whether they are open or close questions.

Close and Open Questions

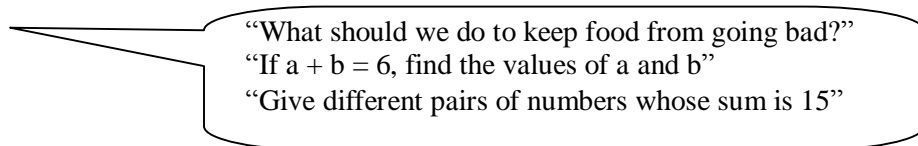
Close questions accept only a narrow range of responses and the number of responses is limited. Close questions expect convergent thinking. Some close questions allow only one “correct” or “right” answer. Answers to some close questions are “yes” or “no”.

Examples of close questions:

“What is the chemical formula for common salt?”
“When did Ghana achieve full independence?”
“If $a + 4 = 6$, find the value of “a”.”
“ $10 + 5 = ?$ ”

Open questions emphasize divergent thinking and can accept a wide range of responses. The number of answers to an open question may be two or more. Open questions encourage pupils to use their past experience and justify their opinions/thinking. Some open questions ask pupils to make judgments based on their own values.

Examples of open questions:

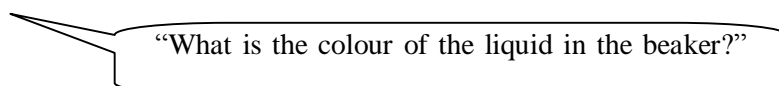


It is important for teachers to choose whether to use close or open questions depending on the teaching contexts.

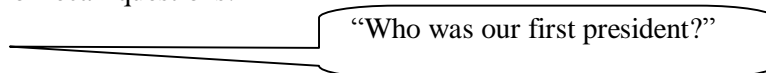
Low and High Order Questions

Questions can be classified depending on whether they are low order or high order. Examples of low order questions are perceiving questions (based on observation) and recall questions (based on knowledge or memorisation of facts). In recall questions, “Who?”, ” What?”, “Where?” and “When?” are often used.

An example of perceiving questions:



An example of recall questions:



High order questions encourage pupils to think rather than just to remember some facts that they have previously acquired. Those questions often require higher cognitive level. One of the best-known classification of questions related to people’s cognitive levels is the classification that uses the cognitive domain of Bloom’s Taxonomy¹.

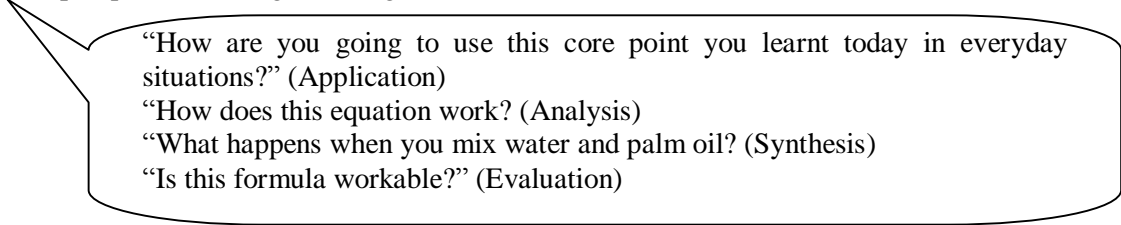
The categories in the cognitive domain and brief explanation of them are as follows.

High order/More Complex	Knowledge	Recalling data, information, experience, facts etc.
	Comprehension	Understanding the meaning, translation and interpretation of instructions, information and problems based on prior learning.
	Application	Applying a concept or what was learned in the classroom in a new situation.
	Analysis	Separating material or concepts into component parts so that its organizational structure may be understood. Distinguishing between facts and inferences.

¹ Bloom, B.S. (1956). *Taxonomy of Educational Objectives*, London: Longman

Synthesis	Put parts together to form a whole, with emphasis on creating a new meaning or structure.
Evaluation	Making judgments about the value of ideas or materials.

Example questions using the categories:



“How are you going to use this core point you learnt today in everyday situations?” (Application)
“How does this equation work?” (Analysis)
“What happens when you mix water and palm oil?” (Synthesis)
“Is this formula workable?” (Evaluation)

It is important to note that it does not mean high order questions are always better than low order questions. After putting pupils’ understanding and contents of the lesson into consideration, a well-balanced mixture of these questions is needed.

2.5.4. Strategies for Effective Questioning

Experienced teachers tend to use a variety of strategies for effective questioning in the classroom to help pupils. It is commonly observed that the pupils have difficulty in answering a question. Sometimes, they do not know how to answer. Sometimes, they are not sure what the question is about. Thus, it is crucially important for the teachers to equip themselves with a variety of questioning strategies. The following are some examples of the strategies.

Pausing

Do not expect answers too soon; give pupils some time to digest the question first. To receive responses, teachers should wait for around 5 seconds. Without ample time to think, teachers cannot expect pupils to process their thinking. This is one of the most effective strategies.

Check the level of vocabulary

Check the wording of your questions to make sure it is up to the vocabulary level of your pupils. New vocabulary should be used with care and only after it has been seen that the words can be well understood by the pupils.

Prediction of Answers

Let pupils predict answers even when they are not very sure. This encourages higher levels of thinking and increases pupils’ active participation. It is important that teachers make this the culture of the class so that pupils always feel free to predict answers.

Random selection

Select pupils at random to answer questions. If the teacher follows the same patterns of

selecting who to answer, some pupils will neither be listening nor thinking until it is their turn.

Using Pupils ' names

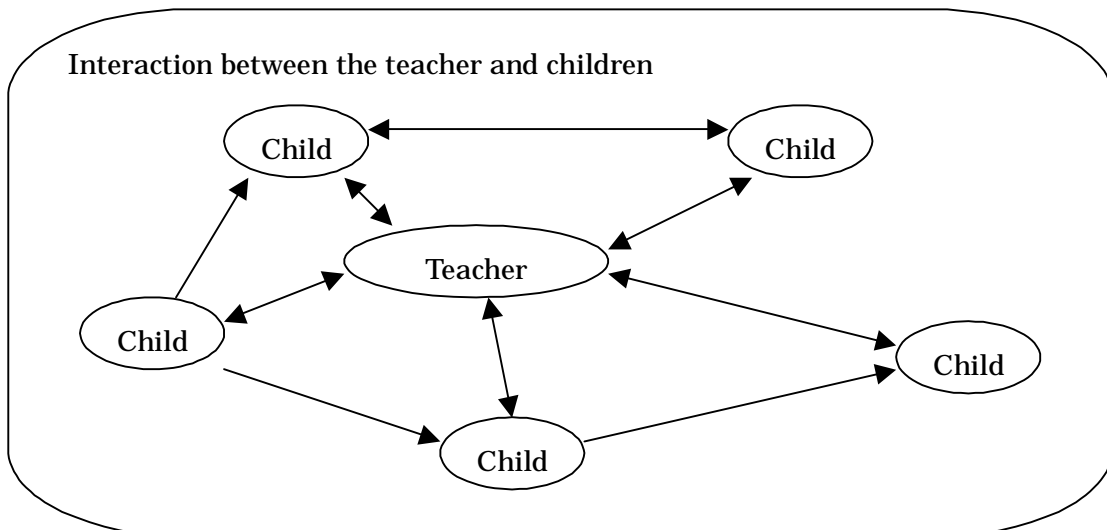
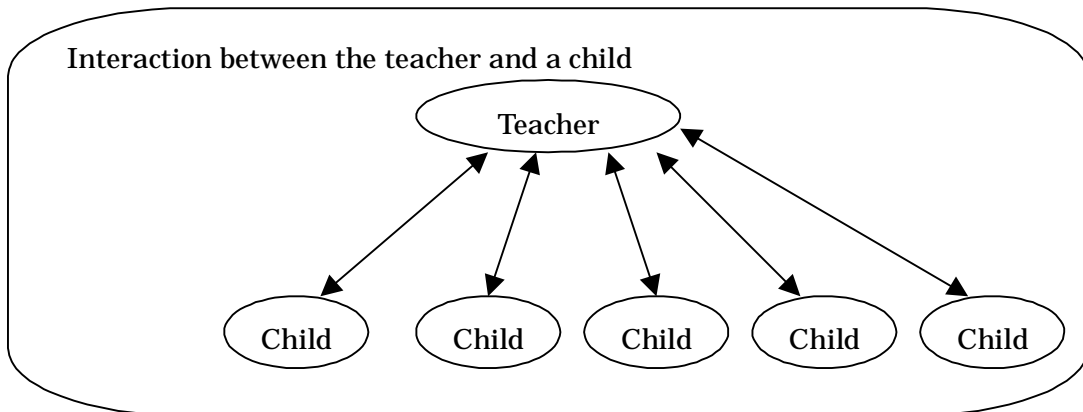
Instead of referring to pupils as, 'the one in the corner wearing the red dress', or 'the one in glasses', call pupils by their names.

Providing Additional Information

Correct responses may be difficult because a key item of information is missing.

Interacting with each other

Get pupils to interact with each other. Try to change the questioning pattern that involves only the teacher and single pupil. Encourage pupils to ask questions. Pupils can ask questions based on what their friends have said. If pupils are to become problem solvers and critical thinkers, we should encourage them to ask questions.



Ineffective and inappropriate questioning practices

- Do not select the same pupil(s) to answer questions because they always respond correctly.

- Do not become a critical assessor. Questioning is not all about assessing pupils. Pupils can make mistakes and they learn a lot from their mistakes.
- Do not ask questions too quickly. Pupils need some time to digest a question and to process their thinking. Speed of delivery is not always a priority.
- Do not repeat a question too often. Pupils lose attention and focus if you ask the same question unnecessarily too many times.

2.6. Effective Use of Chalkboard

The first ready-made aid for the classroom teacher is the chalkboard. Due to its central position as an ever present resource, the way and manner a teacher uses this resource may affect his/her lesson positively or otherwise. To achieve effective teaching and learning, the classroom environment as well as the correct use of the chalkboard should be consciously planned and executed.

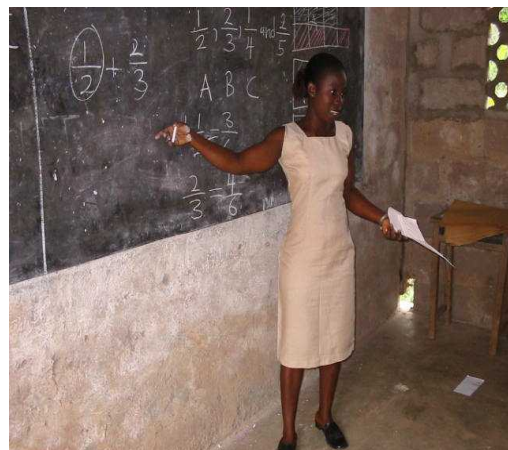
Things to Consider before writing on the chalkboard (Eye contact)

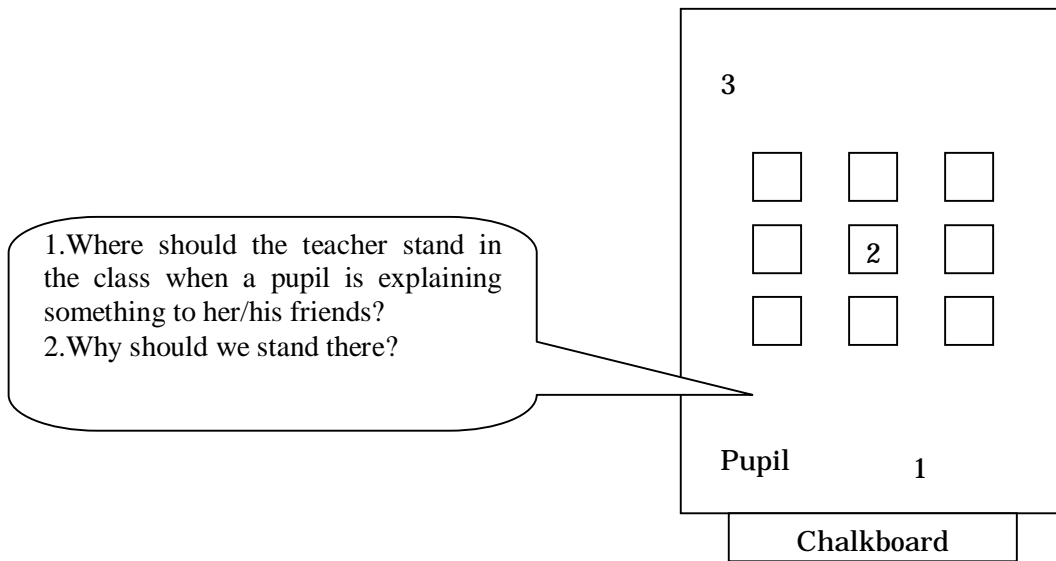
Teacher needs to ask if everyone in the classroom can see the chalkboard clearly.

Teacher is supposed to tell pupils to let him/her know if they cannot see the chalkboard clearly. Teacher needs to create a friendly atmosphere that helps pupils to tell the teacher about it without hesitation. An example of a situation that might interrupt pupils' view is reflection from sunlight.

When using the chalkboard teachers should always ensure that:

- The chalkboard is divided into convenient columns
- The date is written fully at the right-top corner of the board
- The title of the subject/topic/sub-topic is written at the top of the central column
- Exercises given to pupils on the chalkboard are placed under “Worked examples”.
- Pupils do not talk when the teacher is writing on the chalkboard.
- They face the class when talking
- They position themselves so as not to obstruct pupils from seeing the board.
- They summarise the main points of the lesson on the board
- They always seek learners' opinion before cleaning the board.
- They do not clean the board with the bare hands.
- They clean the board after each lesson.



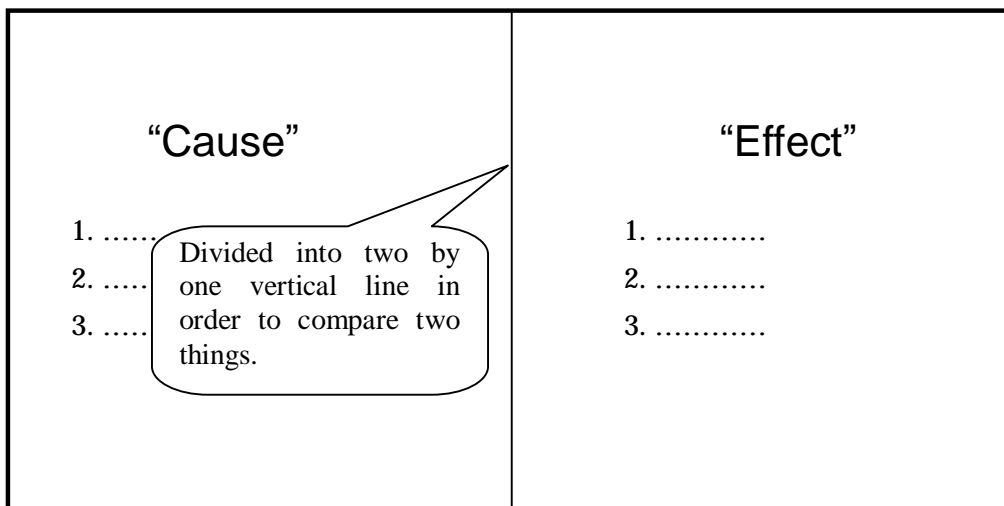


Types of layout of the chalkboard

Plan the layout of the chalkboard. It is helpful to write or draw the layout of the content in a notebook before going to the classroom. Some experienced teachers keep practising this.

A good teacher can make effective use of the chalkboard. Even though conditions and sizes of chalkboard vary from school to school and class to class, a teacher can try to make the most of it. One of the ways of doing so is dividing the chalkboard. When dividing, the teacher needs to consider the contents and the sizes both of the chalkboard and the class. Examples of division of the chalkboard are shown below.

Example A



Example B

Which of these materials conduct electricity? Materials Nail Pencil Paper Can Bottles (plastic, glass)	Predictions	Results
---	--------------------	----------------

Divided into three columns, for materials, predictions and results.

Example C

Experiment Title: Aim: Apparatus:	Method: Observation:	Conclusion
--	---------------------------------	------------

Divided into four, showing clear differences in sections of an experiment.

2.7. Gender Issues

2.7.1. Gender

Gender is used to refer to the characteristics attributed to women, men, boys and girls. These characteristics may be related to aptitude, emotion, physical ability, etc.

- It is different social roles assigned to males and females by a society.
- It involves men or boys as much as it does women or girls and can change over time.
- Gender relations are those social relations cultivated and nurtured by human beings in the society.
- Being a socio-cultural construct it is organized differently in different societies, and affects the expectations for boys and girls, men and women.
- The term gender is mistakenly used to connote women or sex.
- While a person's sex is biologically determined, their gender is socially constructed (learned).

2.7.2. Gender Related Terms and their Meanings

Gender bias

This is when you give unequal treatment to individuals based on their gender. For example we are showing gender bias if we assume that our daughters will prefer to play with dolls and cook while our sons will prefer to play with cars and building structures of objects.

- We base this assumption on gender bias rather than true knowledge of the individual.
- Gender bias applies to all areas of life. For example, in the home, work place, religious institutions and school curriculum.

Gender equity

It is the extent of being fair and reasonable to all individuals.

It calls for a fair share of benefits as well as responsibilities of the family, community and school (syllabus, pupils' textbooks, teacher's handbook and other resource materials for studies).

Gender equity strategies may or may not achieve desired results and need to be monitored closely. Equity is the means while equality is the desired result.

Gender equality

It connotes that the suppression of one sex by another is wrong and must be corrected.

It is a condition in which women, men, boys and girls participate as equals, have equal access to resources and equal opportunities to exercise control. It is achieved through gender equitable strategies. For example, producing curriculum that is gender equitable is a strategy to achieve gender equality in the classroom.

Girl Friendly

The term is often used in reference to curriculum, classroom and school environment. In this context, the term refers to content strategies, assessment, attitudes, policy, etc, which are conducive to girls' full participation and success in all areas of school life.

2.7.3. Some Suggested Solutions to Gender Insensitivity

- Teachers should endeavour to give equal attention to both boys and girls.
- Teachers should encourage both boys and girls to develop their hidden potentials.
- During class work or project work, girls should be assigned leadership roles and be made to actively participate.
- Class assignment should not be done very often on competitive basis but sometimes on a more co-operative and collaborative level with good team spirit.
- In setting examination questions, gender bias questions should not be set; instead general questions should be set.
- Teachers should take workshops on gender issues very seriously.

Table 7: Gender Issues in Textbooks

Gender Bias in language	Gender Balance in language
When men are on the moon, they can't talk to each other as we do.	When astronauts are on the moon, they can't talk to each other as we do.
A poor man may eat more nutritious food than a rich man.	A person of low income may eat better than someone who is wealthy.
How does a farmer look after the animals on his farm?	How do farmers look after the animals on their farms?

3. Teaching and Learning Activities

In this section, types of teaching methods are discussed first. Then, some examples of teaching and learning activities in Mathematics and Science are presented subsequent in the subsequent part.

3.1. Types of Teaching Methods

Four effective methods of teaching are shown in this section. They are

- activity method;
- discussion method;
- question-and-answer method; and
- demonstration method.

It is important for teachers to be aware of the advantages and disadvantages of each method. Then, teachers need to choose the most effective method of teaching depending on the content/topic or classroom situations. These four methods are presented below.

3.1.1. Activity Method

In this method, pupils are provided with materials and an activity is described or demonstrated for them to do.

Some Advantages of the Method

- Pupils learn through first hand experience.
- Pupils do not easily forget what they have learnt
- The method demystifies Science.
- It increases interest in Science.
- It fosters co-operation among pupils.

Some Disadvantages of the Method

- It can be time-consuming.
- Breakages and damage of equipment and materials can occur.
- It involves the liberal use of materials and may therefore be costly.

3.1.2. Discussion Method

This method involves getting pupils together to talk about issues so each one can bring out his/her own idea.

Some Advantages of the Method

- Pupils have the opportunity to practise their oral communication skills.
- It gives pupils practice in critical and evaluative thinking and listening.
- It helps pupils to clarify their thinking.
- Pupils learn readily from each other.
- It provides good practice for problem solving.

Some Disadvantages of the Method

- It does not easily lend itself to all types of subjects or topics.
- It is difficult to achieve maximum interaction when the group is large.
- It may give opportunities for the brighter pupils to show off.
- A few may dominate a discussion while some may never participate in it.

3.1.3. Question-and-Answer Method

In this method, the lesson is developed through effective questioning by the teacher.

Some Advantages of the Method

- It stimulates pupils to think.
- It helps to diagnose pupils' difficulties.
- It helps to determine pupils' progress.
- It helps pupils to clarify their answers.
- It helps to direct pupils' thinking.
- It encourages self-evaluation for pupils.
- It is a means of feedback for the teacher.
- It is an effective class control device.

Some Disadvantages of the Method

- It is a slower method for dealing with information.
- Constant use of questions requiring a factual answer encourages memorization and discourages pupils to think.
- Consistently answering questions incorrectly may cause pupils to lose their self-esteem.

3.1.4. Demonstration Method

This method involves the use of TLMs to show some concepts/ideas in the lesson.

Some Advantages of the Method

- It trains pupils to be good observers.
- It stimulates thinking and the formation of concepts and generalizations.
- It is financially economical since only the demonstrator needs materials.
- It is very effective as an introduction to skill learning.
- It is most appropriate when teaching pupils how to operate a piece of equipment.
- It has high value since it often involves the use of instruments and equipment that might be new to the pupils.

Some Disadvantages of the Method

- Much planning and preparation is required on the part of the demonstrator.
- It can be ineffective if the demonstrator just carries out the activities without asking for feedback.
- It is not suitable for a large class or with extremely small objects.
- It can lead to imitation without understanding.

3.2. Teaching and Learning Activities in Mathematics

3.2.1. Preparation of Multi-Base Materials Using Manila Card

Chalkboard Size

Step 1: A manila card should be divided into a number of equal square sizes. The square size should be 5cm as shown in Figure 1. A single square of 5cm by 5cm should represent the Cube.

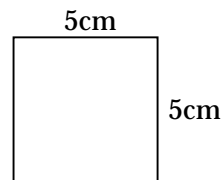


Figure 1

Step 2: Rod should be represented by 5cm by 50cm (5cm × 10 of Cubes) as shown in Figure 2.

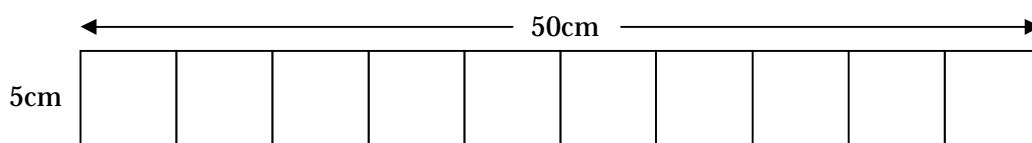


Figure 2

Step 3: Flat should be represented by 50cm by 50cm (5cm × 10 Cubes representing one side of the square) as shown in Figure 3.

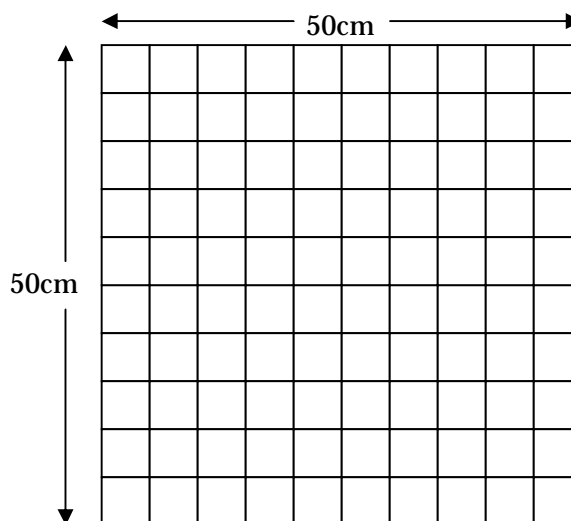


Figure 3

Desktop Size for pupils

Step 1: Manila card should be divided into a number of equal square sizes. The square size should be 1cm as shown in Figure 4. A single square 1cm by 1cm should represent the Cube.

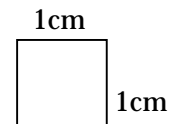


Figure 4

Step 2: Rod should be represented by 1cm by 10cm (1cm × 10 of Cubes) as shown in Figure 5.

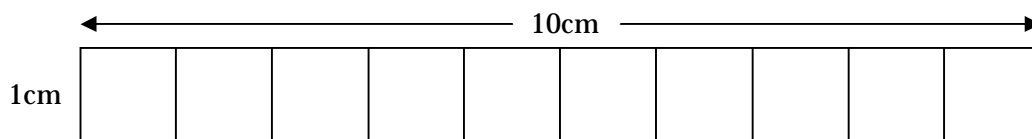


Figure 5

Step 3: Flat should be represented by 10cm by 10cm (10cm × 10 Cubes representing one side of the square) as shown in Figure 6.

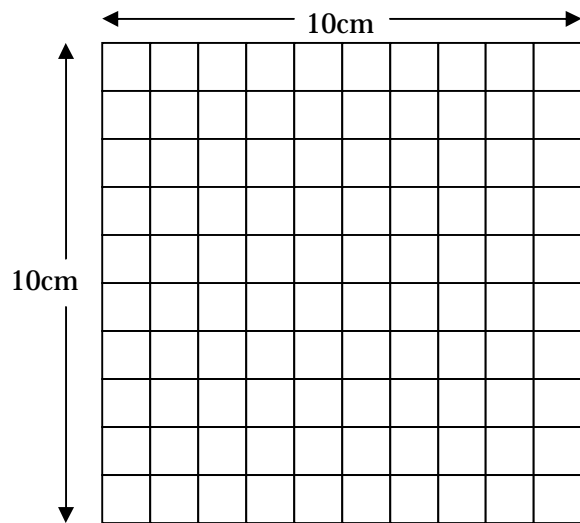


Figure 6

Topics that can be taught using the prepared Multi-base Materials from Manila cards:

1. Place value
2. Collecting and handling data - graphs
3. Decimal fractions
4. Area and perimeter of shapes
5. Fractions
6. Vectors
7. Percentages

(Refer to topics listed above in the Mathematics manual.)

Note:

1. Depending on the thickness of the Manila card, the teaching and learning material prepared may assume a 3D shape.
2. Other materials that can be used to prepare the Multi-base Materials include wood, cardboard, plastics, empty cartons, formica, etc.

3.2.2. Preparation of Cubes from Wood

Materials needed:

- Wood
- Rulers
- Cutters, Pencils

Chalkboard Size

Cut the wood to the dimension 5cm by 5cm by 5cm as shown Figure 7.

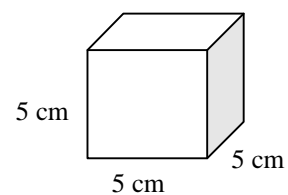


Figure 7

Desktop Size for pupils

The same materials are to be used. Dimension: 1cm by 1 cm by 1 cm.

Topics that can be taught using Cubes:

1. Operations on numbers less than 10
2. Volume of cuboids
3. Fractions
4. Pre-number work (staircases)

3.2.3. Preparation of Dice Using Wood

Chalkboard Size

You will need to cut wood into a cube of 10cm by 10cm by 10cm dimension.

Label the surfaces with permanent marker so that the sum of directly opposite surfaces equals 7, i.e. directly opposite faces are 1 and 6, 2 and 5, and 3 and 4.

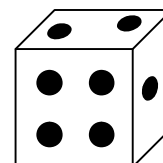


Figure 8

Desktop Size for pupils

The dimension should be 2cm by 2cm by 2cm. Use the same style of numbering as described above.

Topics that can be taught using the dice

- Probability
- Ordered pairs
- Operation of numbers
- Shade in game on fractions (in this case the surface of the die should be numbered in fraction form. Example $\frac{1}{2}$, $\frac{2}{5}$, $\frac{3}{4}$, etc.

3.3. Teaching and Learning Activities in Science

3.3.1. Guidelines for Drawings in Science

- Diagrams should have a margin.
- Create space for the title of the drawing.
- Diagrams should be bold, simple, neat, clear and attractive.
- Draw with free hand and the lines should be straight and not woolly or double.
- Labels should be done with straight lines within the margin and the lines should not cross each other
- Lines used for labels should not have arrows.

3.3.2. Experimentation

Importance of Experiment

An experiment is, without doubt, a significantly important aspect of Science lessons. It makes the learning of scientific facts and acquisition of knowledge real Science. If Science is the study

of the environment, we need to investigate natural phenomena through observing, identifying a problem, experimenting and communicating findings. We can build certain attitudes like objectivity and open-mindedness in experiments as well. If pupils are to be scientific in thinking, they should be encouraged to see/do experiments in class.

Experiments are expected to help pupils to:

- Build scientific attitudes like objectivity and open-mindedness
- Develop scientific ways of thinking
- Acquire process skills of Science
- Increase interest in the environment and Science
- Enhance scientific knowledge acquisition
- Relate textbook knowledge of Science to the real world

Types of Experiment

There are several types of scientific experiment. The following shows three major types.

- Testing a specific hypothesis.
- Exploratory/discovery.
- Data gathering.

An example of experiment on testing a specific hypothesis

In an actual classroom situation, testing of a specific hypothesis is commonly used and is highlighted here. Through an experiment, pupils can test whether a hypothesis is correct or not. Testing a hypothesis should help pupils to acquire correct scientific knowledge, concept and ways of thinking. A brief example of this type of experiment is shown below:

Topic of Experiment:

Electrical Circuits with Bulbs in Parallel

Hypothesis:

The brightness of two bulbs in a parallel circuit is the same.

(Conducting the experiment)

Result:

The brightness of two bulbs in a parallel circuit can be different. (If the bulbs are different kinds)

Note: Experiment is done before the teacher tells pupils the answer. Pupils are to find it out themselves.

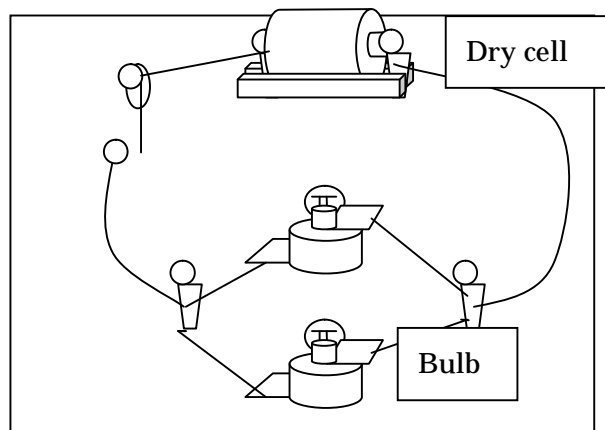


Figure 9

Another Type of Experiment

Unlike the type of experiment shown above, an experiment can also be used to support a fact that has been taught already in a lesson. For instance, a teacher can tell pupils the fact that the

brightness of two bulbs in a parallel circuit is not always the same. Then, he/she will conduct the experiment to prove whether the statement or the fact is true or not. In this case, the experiment is done after the teacher tells pupils the fact.

It is important to have variety of types of experiment. When writing the scheme of work, it is a good idea to include several types of experiment. It should be noted that selecting types of experiment depends heavily on the class size, the contents of the topic, availability of the resources, pupils' interest and ability.

3.3.3. Improvisation of Teaching/Learning Materials

In the teaching of Science and Environmental Studies in the primary school, TLMs are carefully selected from the environment or improvised when the actual materials are not available. This section stresses on improvisation of some challenging materials.

Improvisation

Improvisation is the use of materials, which are readily available in the environment in place of the original materials, which are not available or are expensive, delicate or sophisticated to bring about the same leaning effect. Examples of types of improvisation are shown below.

- Improvisation by Substitution
- Improvisation by Construction

Improvisation by Substitution

This is replacing the original or actual standard prototype material with one which is locally available and which can perform identical functions.

Examples:

Original Materials	Substitution (Substituted Materials)
Distilled water	Rain water
Trough	Plastic bowl
Spatula	Spoon
Delivery tubes	Discarded drinking straw/plastic tubes

Improvisation by Construction

This involves making use of locally available materials to design, construct / build / produce an apparatus. These pieces of apparatus so constructed are referred to as improvised apparatus. Examples of improvisation by construction are:

- Construction of a pinhole camera using plywood, tracing paper and nails.
- Construction of a periscope using PVC pipe tube and plane mirrors, manila cards or stems.
- Construction of electrical circuit board using plywood, screws, aluminium sheet or foil and flashing bulbs.

- Making a test tube holder from a metal wire or bamboo sticks.

Importance of Improvisation of TLMs

- It demystifies Science and creates interest in learning it.
- Improvised materials are less expensive, low cost or cheaper.
- It enables many of the learners to engage in practical activity at the same time.
- It enables the learners to develop an appreciation of the use of everyday things in their environment in learning Science and Environmental Studies.
- Pupils learn not to discard all items at home as they get to know that there are more uses for them at a later time.
- It helps to develop self-reliance and sense of initiative in the teacher.
- It encourages group work hence, co-operation and tolerance are enhanced.
- It helps to reduce the purchasing of materials.

Principles to consider when improvising TLMs

- The function and working principles involved.
- Where and how to get the bits and pieces needed for improvisation.
- The need to co-operate with some local craftsmen, e.g. carpenters, mechanics, welders etc.

Principles underlying the use of improvised materials for teaching and learning

- The function and working principles involved.
- Will the improvised materials help pupils to understand what is being demonstrated?
Will the improvised materials suit the level of the pupils?
- Is the improvised material safe (is precaution against dangers taken into account)?
- Are the materials to be used readily available or affordable?

Collection of Materials for Improvisation

- The pupils should be greatly involved in the collection of materials.
- Collecting trips should be organized.
- We should look for materials within our environment.
- Scrap materials could be collected from kitchen, clinics or hospitals, local craftsmen, rubbish dump, market or houses.
- Materials can be bought from the market or shops.

Table 8: Some Suggested Improvised Materials for Teaching Science in Basic Schools

MATERIAL	IMPROVISED MATERIALS
Filter paper	Cotton wool/cloth/foam/cement paper/
Beam balance	Make two scale pans from coffee tin lids or plastic pipelines. Hang these by thread at the ends of a cloth hanger. Hang the hanger by its hook on a nail.
Pipette	Drinking straw, ball point barrel
Delivery tube	Infusion tube boiled for 15 minutes before use.
Magnifying glass or hand lens.	Pick used transparent electric bulb, break off the black seal on the metal and remove the inner glass which holds the filament. Wash and fill with water and use it to observe things. Other things that can be used are, spectacles, a clear bottle, a beaker.
Concave mirror	Use steel wool or metal polish with cotton to polish thoroughly the bottom part of an empty canned drink. E.g. Fanta, Coke.
Round bottom flask	Pick a discarded electric bulb; remove the black seal and the inner glass tube. Wash and use as round bottom flask
Beaker and Funnel	Get a transparent plastic bottle and cut through its circumference (2/3 way of its height). Use bottom portion as beaker and top portion as funnel.
Measuring devices for measurement of volume of liquids.	Collect transparent flat bottom plastic bottles, with straight sides and cut off the top part. Paste a stick of paper along the outside and using an injection syringe and water, calibrate the container using a fixed volume of water drawn at a time. Paste a cello tape strip over the calibrated strip of paper.
Rubber stopper or cork	These can be cut from discarded bathroom sandals, corn stalk or cob, bamboo or raffia palm stalk, etc by cutting them to the required shape.
Standard masses or weights	Use coins, bottle tops, nails of the same size, bolts and nuts.
Magnets	Get magnets from old discarded radio speakers, magnetized bar metals, etc.
Electro-magnet	Wind round a nail (15 cm long) an insulator copper wire, connect a dry cell to its terminals and use it to pick tiny magnetic substances such as office pins, small nails, etc
Biological specimens I Animals II Plants III. Flowers	Make a collection of small animals by putting them in formalin and preserving them in bottles containing formaldehyde. Make a plant-press by collecting or picking fresh plants, place them in a double newspaper sheet. Sandwich them between two cardboards of the same size. Tie with a string and leave them to dry in a room/shade. Make a flower and pin it onto a cardboard and label its parts.
Calcium hydroxide	Get spent carbide from a welder's shop. Add water and decant. When mixture settles, clear solution of the hydroxide remains.
Sulphur	Can be bought from market.
Iron (Iron fillings)	Metal shavings / pieces of steel wool
Alkaline solution	Ashes from burnt plantain peels, cocoa pods or ordinary wood ash added to water in a beaker and stirred. Filter the mixture. The filtrate is an alkaline solution (KOH)
Potassium Permanganate	Use food dye or "shoodee" which is used to polish shoes.

MATERIAL	IMPROVISED MATERIALS
Indicators	Detach and grind some petals of flowers. Add water to the ground pulps and boil for a few minutes. Allow them to settle on cooling and filter solution. Dye a filter paper with solution; allow them to dry and use as litmus paper for acid and alkaline tests.
Acids	Extract juices of lime, lemon or tomato and use as acids. Also one can use vinegar, or acids from car batteries.

4. Lesson Plan

4.1. Lesson Plan Preparation

The secret of all good teaching is proper planning. If you want your teaching to be effective, then you have to think carefully during the planning stage. You can make your thoughts useful if you translate them into lesson plans. A well-planned lesson helps the teacher teach with confidence. Before you can prepare your lesson plans you will need some basic materials. They are the main reference books (the syllabus, teacher's handbook, pupils' textbook or any other source of reference or books or materials) relevant to the subject or topic to be treated by the teacher. The syllabus contains the list of the topics to be studied and the level to which a teacher must teach each topic.

The lesson plan approved for use by basic schools in Ghana has the following components. Note: Mathematics and Science are used as examples of subjects.

4.1.1. About the Subject and other Relevant Information

Subject

This is the particular subject that the lesson plan is about. e.g. Mathematics, Science, etc.

Week ending

This is the last day of the working week for which the lesson plan is meant. The working week usually starts on Monday and ends on Friday.

Date /Day/Time/Duration

These refer to the particular date, day and time for which a particular lesson is meant. e.g. 5th May, 2007, Thursday: 10:00am-10:30am. The duration is the specification of the length of time allocated to the lesson. e.g. 30 mins or 60 mins.

Topic/sub-topic

The topic is usually taken from the syllabus and the subtopic is from the scheme of work. The topic is the small area of learning or subject matter which is to be covered in a particular lesson within a particular time/period. But sometimes when the topic is too broad, it can be subdivided into subtopics. For example:

Science Topic: Water Sub-topic: Sources of water

Mathematics Topic: Fraction Sub-Topic: Addition of fractions with different denominators.

Reference books

These are the list of books, textbooks or any other sources of information that could be referred to for information that may be required for the lesson to be taught. Where information is obtained from the pupils' books and teacher's guide, the pages must be indicated. E.g. Pupils' Mathematics Textbook 4, Page 12.

4.1.2. Relevant Previous Knowledge (R.P.K.)

This is the knowledge, skills or ideas, which the pupils already know, and which relate to the

new topic that is to be learnt. This knowledge is very helpful to the teacher to make him construct his teaching. It can also be used as a starting point or foundation, upon which the new lesson could be built. If there is no interaction between the R.P.K. and the new topic, understanding of the new topic becomes more difficult. It must be noted that R.P.K. does not necessarily come from a previous lesson. There must be an obvious link between the R.P.K. and the new topic. The R.P.K. could be general knowledge acquired from experience or real life.

4.1.3. Details About the Class

The sub-heading named “Details About the Class” explains the current situation of the class in terms of the general information concerning the pupils, their academic progress, interest in the subject and attitude towards the subject. While R.P.K. focuses on pupils’ knowledge related to the lesson topic, “About the Class” probes into the background of the pupils of the class. “About the Class” should help the teacher to choose what kind of approaches would be best suited to the pupils of the class. Providing information for “About the Class” in a lesson plan is optional; however, it is advised that teachers try writing and thinking about the class. This should be a very helpful piece of information.

4.1.4. Objective(s)

The objective states the value of the lesson to the learner. It is a statement indicating why the teaching is being done and describes the target set for attainment or achievement at the end of the lesson.

- The objective should be stated in behavioural terms to describe observable behaviour.
- The objective tells what changes we intend to bring about in pupils. It spells out the knowledge, abilities, and attitudes that we expect our pupils to gain as a result of our teaching.
- The objectives specify what the pupils should be able to do at the end of the lesson, including mental, affective and psychomotor skills.
- The objective in the lesson plan should not to be confused with the more general and broad objectives of a particular subject. The objective must be stated using performance/active verbs based on at least two of the profile dimensions stated in the syllabus. i.e. knowledge and understanding, application of knowledge and process skills and attitude (Science).

In stating lesson objectives (instructional objectives) the following points must be remembered.

- A lesson can have more than one objective. Do not however aim at too many.
- The objective(s) must be stated in a way that shows what the desired change in the pupils’ behaviour will be.
- The objective(s) must be achievable within one lesson, unless specified for a double lesson.
- The objective(s) must relate to what the pupils will learn rather than what the teacher will teach. This means objectives should be child-centred.
- The change in the pupils’ behaviour should be observable and measurable.

A few of the good instructional objectives are as follows:

By the end of the 30-minutes lesson, pupils will be able to:

- measure the size of a leaf using squares
- calculate the density of a regular object

- interpret a graph showing annual rainfall
- mention at least three differences between a plant cell and an animal cell
- draw a complete flower and label it correctly
- list at least five sources of water

Examples of objectives for the various profile dimensions are as follows:

- Knowledge and understanding: - List five sources of water.
- Application of knowledge: - Interpret a graph showing annual rainfall.
- Process skills and attitudes:-Draw a complete flower and label it correctly.
- The objective(s) stated for each lesson should be Specific, Measurable, Achievable, Realistic and Time bound (SMART).

4.1.5. Teaching /Learning Materials

Any materials that are used to make learning more effective should be listed here. The materials listed here must be relevant and very suitable for the lesson. Learning aids can be real objects, models, charts, pictures, etc. It is important to remember the following points when using learning aids.

- They must be adequate for the number of pupils in the class.
- Real objects are the best learning materials unless otherwise stated.
- Models, pictures, photographs and charts are used when real objects cannot be obtained. These must be simple, clear and brief.

4.1.6. Teacher/Learner Activities

These activities indicate how the teaching must be done, according to the stated objectives. Teacher writes down in a step-by-step manner the way the learning situation will be explored. The steps must indicate:

- Teacher Activities: Strategies the teacher would use to promote and facilitate pupils' learning.
- Pupils' activities: What the pupils should perform or go through in order to learn.

The activities must be child-centred instead of teacher-centred. This implies that the teacher should have the pupils as the focus of the lesson. The methods of organising work which include discovery, remedial work and the use of textbooks, work cards, etc. are to be clearly shown. For example:

- Pupils use match boxes, draw or colour squares to represent various numbers to pupils born on each of the days of the week.
- Pupils draw bar graphs/block graphs to present numbers of objects and pupils.

The lesson must begin with an introduction, which must be designed to:

- Connect the new topic with the previous knowledge or experience of pupils.
- Motivate and capture pupils' interest from the beginning through to the end of the lesson.
- Condition pupils' minds for the lesson.

4.1.7. Core Points

These are the main ideas or concepts/skills that the lesson is aimed to achieve. In developing the lesson, the teacher skilfully collects these facts, ideas, values and concepts from the pupils through questioning and lists them systematically on the chalkboard as a summary. For example:

Science

- Types of soil: Sandy, clayey and loamy soils are some of the types of soil.

Mathematics

- Block graphs: Block graphs involve the piling of objects on each other.

4.1.8. Evaluation / Exercise

Evaluation involves exercises to be carried out by pupils the results of which teachers can use to make value judgment for the improvement of teaching and learning.

- They are processes for measuring the effectiveness of the teaching/learning activities and the purpose of evaluation exercise is to find out if the objectives set for the lesson have been achieved or not.
- Evaluation may include homework, class exercises, quizzes, (oral and written) and assignments, etc.
- Pupils could do the evaluation exercises individually, in pairs or in groups. These can form the basis for the teacher's continuous assessment marks, which in turn provide the basis for the teacher's remarks.
- Evaluation/exercises are not meant for pupils only; they can be used to assess the performance of pupils as well as the teaching/learning process (methodology), and also the effective use of teaching/learning materials. The performance of the pupils in the evaluation exercises may be used to review the methodology and the teaching/learning materials in assisting pupils individually to improve upon their performance.

4.1.9. Remarks

This is the statement made at the end of the lesson to indicate if the lesson was successful or not and why. The remarks should also state the specific strengths, problems or weaknesses observed during the lesson in the performance of both the teacher and the pupil for further action. For example, after a lesson on the topic:

- Symbols of elements: pupils were confused about the symbols of those elements which do not have English names, such as, Potassium –K, and, Sodium –Na. The lesson was therefore not successful and should be taught again using a different approach.
- Indices: pupils were confused about the square of positive and negative integers. The lesson was therefore not successful and should be taught again using a different approach.

4.2. Lesson Presentation

In this section, three steps of lesson structure are discussed. They are the introduction, development and conclusion/closure of a lesson.

4.2.1. Introduction

The introduction of a lesson serves to arrest the attention of the pupils at the beginning of the lesson. The introduction should be brief, attractive as well as arousing to sustain the interest of the pupils. The content of the introduction must be related to the subject matter of the lesson. Also, the pupils' R.P.K. must be tested during the introduction stage of the lesson. The following broad ideas might be used as introduction to lessons.

- Ask questions about previous lessons that are related to the present one. A few examples of such questions must be included in the lesson plan.
- Discuss a situation which is familiar to the content of the lesson with the pupils.
- Display an interesting learning aid related to the lesson and discuss it with the pupils.

The importance of introduction

- It helps in preparing the pupils for the lesson.
- It arouses interest and provides a conducive environment for the lesson.
- It helps in linking previous knowledge with the one to be taught.
- It helps to eliminate misconception in previous knowledge.

4.2.2. Lesson Development

The development of the lesson is written under teacher/learner activities and organised under steps in the lesson plan. The number of steps depends on the nature of the topic. The subject matter will have to be presented in an orderly and logical sequence in the form of activities. The activities can be in the form of verbal interactions e.g. discussions, asking and answering of questions, or performance of physical activities like demonstrations, experiments, constructions, etc.

It is important to start with what is known to the pupils before the new information is introduced to them. The teacher must present the information from a simple level and move on gradually to the more difficult.

In each step the teacher must be clear about what he or she intends to do and what the pupils must do. At no point should the pupils be wasting time in a lesson, not knowing what to do next.

The activities must be planned taking into consideration the objectives of the lesson.

Also, activities can be organised in groups, in pairs or as a whole class.

Some examples of teacher activities are: discussing, explaining, demonstrating, providing the necessary materials, and giving instructions and asking questions.

Some examples of pupils' activities are: listening, answering questions, discussing, experimenting, looking for information from diagrams or maps, drawing, modelling and answering written or oral questions.

During the lesson, the teacher should prepare some kind of activity so that the pupils can apply their new knowledge or the skills that they have learned during the lesson. The emphasis here is on 'learning by doing'.

4.2.3. Examples of Written Activities

Teacher guides pupils on how to fold a filter paper.

Teacher guides pupils to fold a rectangular paper along the diagonal to form two separate

triangles.

4.2.4. Conclusion/Closure of Lesson

The conclusion is the rounding off of the lesson satisfactorily; the way to conclude a lesson will depend on the nature of the lesson. A conclusion may involve:

- Going over the main points of the lesson through oral or written questions;
- Correcting some common mistakes made by the pupils while working;
- Emphasizing again the main message of the lesson, e.g. that of a new concept.

Collecting books and tidying up at the end of the lesson are obvious duties and are not to be regarded as activities to round off the lesson, especially, in practical lessons.

4.2.5. Application

In application, pupils must be made to see the relevance of Science and Mathematics in their everyday lives. This is when the knowledge gained by the pupils in the lesson can be put into use or applied in everyday life.

For example after a lesson on purification of water, pupils should be able to apply the knowledge acquired to either filter/boil or add alum, etc. to water which is not pure before using it. They should be able to apply what they have learnt to determine the appropriate unit of measure to use when measuring distances. Science and Mathematics must be viewed as fields that are open to them as careers, and also as a means to understand the world around them.

5. Assessment

5.1. Profile Dimension

5.1.1. Profile Dimensions for the Basic Level and Percentage Weight

Profile dimensions describe the underlying behaviour and changes in learners during teaching, learning and assessment. The profile dimensions for the basic level are shown in the table below.

Table 9: Profile Dimension for Basic Level²

SUBJECT	PROFILE	P1 – 3	P4 – 6	J.S.S
MATHS	Knowledge and understanding	40%	30 %	30 %
	Application of knowledge	60%	70 %	70 %
SCIENCE	Knowledge and understanding		20 %	30 %
	Application of knowledge		20 %	40 %
	Attitudes and Process skills		60 %	30%

Each dimension has been given a percentage weight that should be reflected in teaching, learning and assessment/testing. The weights indicated show the relative emphasis the teacher should give in the teaching, learning and assessment processes.

5.1.2. Explanation and Key Words of the Profile Dimension

The explanation and key words involved in each of the profile dimensions are shown in Table 10.

Table 10: Explanation and Key Words of the Profile Dimension

Dimensions	Identification of the dimensions	Levels of Learning
Knowledge	The ability to: remember, recall, identify, define, describe, list, name, match, memorise, mention, state, etc.	Lower Level
Understanding	The ability to: explain, summarise, translate, re-write, paraphrase, give examples, generalise, estimate, predict etc.	Lower Level

² Source: Teaching Syllabus for Mathematics (Primary School) and Teaching Syllabus for Integrated Science (Primary 4-6)

Dimensions	Identification of the dimensions	Levels of Learning
Application	The ability to: produce, solve, design, calculate, demonstrate, discover, outline, create, compare, differentiate, analyse, distinguish, determine, compose, apply rules, methods and principles to situations that are new and unfamiliar.	Higher Level
Process skills	It involves ways of carrying out investigations through: identifying a problem, planning, designing an experiment, observing, classifying, measuring, manipulating of objects, predicting, hypothesizing, fair testing (experimenting), recording, interpreting findings, generalizing, evaluating, communicating.	Higher Level
Attitudes	The desirable attitudes to be developed include: curiosity, perseverance, flexibility in ideas, reflection, questioning of events, thinking in an organized manner, self-confidence, respect for evidence, etc.	Higher Level

5.2. Test Items

How can we apply the concept of Profile Dimensions in the construction of test items (questions)? Teachers need to make sure that they place the appropriate weighting on each of the Profile Dimensions stated in the primary school syllabus.

5.2.1. Testing

When a teacher administers a test, the main goal is to provide valid, reliable and useful information concerning the pupils' performance. To achieve the above goal, the following steps must be followed.

- Set objectives that relate to the objectives that you set when teaching the topics. Note that the dimensions of teaching, learning and assessment at the basic school level are knowledge, understanding, application, process skills (and attitude).
- The number of questions (test items) that you set on a particular topic should relate to the importance and/or relevance of that topic.
- Select the appropriate type(s) of test to be used. The types of test include essay, multiple choice test, short-answer test, matching test and true/false test.
- Prepare the test items (questions). The number of questions set should relate to the test specification table you have made.

5.2.2. Specification Table

Specification table for a test in Integrated Science class BS 4 is shown in Table 11.

**Table 11: Specification Table for a Test in Integrated Science Class
(Topic Unit: Learning Objectives/Dimensions of Learning: Primary 4)**

	Knowledge	Understanding	Process skills	Application	Total
1. Use of water.	1	1	3	1	6
2. Water Pollution	1		2		3
3. Air-properties			3	1	4
4. Keeping our surroundings clean	1		2	1	4
5. Sound Energy			2	1	3
Total number of questions	2	2	12	4	20
% of the questions (test items)	10%	10%	60%	20%	100%

5.2.3. Concept of Profile Dimensions and Set Test Questions (Test Items)

Examples of the use of the Profile Dimensions and Set Test Questions are shown in Table 12.

**Table 12: The Profile Dimensions and Set Test Questions (Test Items)
(Topic: Purification of Water: Primary 4)**

Test Questions	Dimensions of Learning
Q1. State six uses of water.	Knowledge
Q2. Explain why boiled and filtered water is good for drinking	Understanding
Q3. Draw a labelled diagram showing a method of filtering water.	Process skills
Q4. You have been given a filter paper or a piece of clean cloth, two beakers, a funnel and dirty water. Using these materials describe an experiment that you will perform to get clean water.	Process skills and application of knowledge
Q5. You are staying in a guinea worm infested area. How will you make your water safe for drinking?	Application of knowledge

5.3. True/False objective test

Advantages

- Marking is very objective.
- The test is easy and quick to mark.
- It enables the teacher to have a scan of pupils' knowledge.
- Construction is relatively easy compared with multiple-choice test.
- It is usually short.
- There can be extensive sampling to cover a greater part of the syllabus.

Disadvantages

- It is susceptible to guessing as there are only two options to choose from.
- It encourages pupils to memorize facts without understanding.
- Test cannot be very valid.

Guidelines for preparing true/false test

- Statements used must be definitely right or wrong. (It should not be partly right and partly wrong).
- If a test is false that statement must be false by itself not because of certain minor phrases, which make it wrong. Items of controversy should be avoided.
- Sentences used should be simple and grammatically correct.
- Avoid lifting statements from textbooks.
- Do not use terms that will provide clues to the right answers. e.g. Usually, never, generally, may, etc.
- Do not follow a fixed pattern in the sequence of true/false items.
- Have approximately equal numbers of true/false items. This calls for a conscious effort to write balanced items.
- Items should not be arranged in a regular pattern. E.g. True statements should not always be followed by false statements and vice versa.

5.4. Completion Type Test

Introduction

This is the type of test, which requires the pupil to complete a statement by supplying missing words or phrases, numbers or symbols. No possible answers are listed as part of the item. Also, a diagram or map or an illustration is presented and the pupil is required to label the parts indicated. This test is used to measure knowledge of factual information. In writing a completion test item, it is best to use one blank space per item. Many blank spaces in a single item easily lead to confusion and guessing. The blank space should, as much as possible, be put at the end or near the end of the items. Items should be worded such that only one answer would be correct. Words, which serve as clues to the answers, should be avoided, e.g. “a”, “an”, “the”. The blanks for answers must be equal in length. Instructions must be clear, stating how the pupil should respond to the item and how to record the answer. For example:

1. An example of an insect which undergoes complete metamorphosis is
2. An example of a vegetable is
3. $2 + 4 = \square$
4. $3 + 4 \dots 7$ (Use “<”, “>”, or “=” to make the statement true)

Advantages of completion type objective test

1. It is a reliable method of testing and can be constructed to cover a greater part of the syllabus.
2. It is relatively easy to construct.

3. There is limited guessing element.
4. It can be used for a comprehensive assessment.
5. It has a valuable application in test situations presented in the form of maps, charts and diagrams in which the pupil is required to supply, in the spaces provided, the names of parts keyed by numbers or letters.

Disadvantages of completion type objective test

- The items often measure only factual knowledge of the pupil.
- It is sometimes difficult to weigh the answers to eliminate only one correct answer.
- It is less objective because it is sometimes difficult to depend on only one answer. The teacher has to decide whether an answer is close enough or “means the same”.
- Teacher often uses too many blanks resulting in a vague and ambiguous puzzle to be solved by the pupils.

5.5. Matching Type Objective Test

Introduction

A matching type of objective test consists of a stem and a list of responses to match the stem. The stem and the responses can be in two columns (A and B or 1 and 2). Each column contains a word, number, symbol, sentence or phrase. The pupil is asked to match or associate an item, word, etc. in one column with a choice in the other.

Matching test is not well adapted to measure understanding. It is however, useful for checking precise information based on simple associations. It emphasises the ability to identify the relationship between two things such as events and dates, countries and their capital towns and their definitions, rules, tools, equipment facilities and their use, explanation of terms, etc. An example is shown below:

Match the words in column A with the statements in column B to make the sentences complete.

Example 1

Column A	Column B
1. Glycogen	- A compound made of carbon, hydrogen and oxygen.
2. Carbohydrate form	- A process whereby metabolic wastes are removed from the body.
3. Skin	- An example of an excretory organ.
4. Protein	- Glucose is stored in the liver as
5. Excretion	- An example of an excretory organ.
6. Amino acids	

Advantages of matching type objective test

- Scoring is objective.
- Guessing is very much reduced.

- Scoring is easy.

Disadvantages of matching type objective test

- Its use is limited to tests of relationships or associations.
- Its construction is not all that easy. It requires some degree of skills to construct useful stems.
- It is sometimes difficult to obtain homogeneity.
- It turns to ask for trivial information.
- When the test is almost completed, the pupils can complete the final link by a process of elimination.

Guidelines for constructing matching tests

- Use homogeneous options and items, i.e. the statement and “answer” must be dealing with the same thing.
- The number of options must be greater than the test items (statements). This decreases the incidence of guessing by the pupils.
- The arrangement should be such that the short items should be the responses while the longer words or sentences should be the stem.
- The items in each set should be limited to about 5 or 6 and the responses should not be more than 10.
- Both the stem or premises and the responses should be on the same page.
- Instructions to pupils should be clear and definite and should specify the basis for matching.
- What each column represents should be stated clearly.

5.6. Multiple Choice Test

Introduction

This is the commonest type of objective test. In this test, a question is given with three or more responses and a pupil is required to select an answer from the given list of alternative answers. It is also possible to have several correct options and only one incorrect option, which is to be chosen from the list of alternatives. The first part, which poses the question, is referred to as the stem and the list of alternative answers is referred to as the options.

Example 1: (Multiple choice test)

The end product of protein digestion is?

1. Glycogen
2. Amino acids
3. Glucose
4. Fatty acids and glycerol

Example 2: (Multiple choice test)

$2x + 4 = 12$, what is x ?

- a) 4
- b) 5
- c) 6

d) 8

In the options, we have the true answer and the incorrect ones called distractions. The distractions should be plausible (seeming to be true or reasonable) as the true answer but they should not be true.

This type of objective test is the most difficult to design, it involves making three things.

1. A good question.
2. A good correct answer.
3. Three or four plausible but incorrect answers.

Advantages of multiple choice test

- It can be used to test a wider area of knowledge and also to test different types of complex skills other than true/false, supply or matching test types.
- Marking is very objective.
- The test is easy and quick to mark.
- It is easy to score by anyone using the scoring key.

Disadvantages of multiple choice test

- It is very difficult to construct, for instance, finding alternative plausible responses.
- It takes a longer time to construct the test items.
- Test occupies much space.
- Answers are open to some degree of guessing.
- It cannot be used to measure certain problem-solving skills.

Guidelines for constructing multiple choice test items

- The statement of the item must be carefully worded in order to avoid vagueness and different interpretations.
- Design distractors that are plausible but not obvious.
- Problems should be expressed clearly and accurately so that pupils know what to do.
- A fixed pattern in the positioning or placement of the correct option should be avoided.
- There should be no clue for the correct option, e.g. the use of ‘a’, ‘an’, ‘the’ etc.
- Options should be vertically arranged instead of horizontal (A, B, C), since it facilitates easy reading and clarity of words. For example:

A

B

C

- As much as possible items should be stated in positive terms rather than in negative terms. Negative terms such as “no” “not” etc. are usually overlooked by pupils. However, if statements with negative words are used, those words should be marked boldly, capitalized or underlined to make them conspicuous.
- The stem should be written at the appropriate language level for the pupils answering the items.

Guidelines for constructing stems for objective tests

- Decide on the proper type of test for the purpose to be served. If the purpose is to measure ability to recall facts rather than just to recognize them, then completion items rather than true/false or multiple choice should be used.
- A small portion of the items should be very easy and a few questions should be very difficult. Most items should be around 50% difficulty level.
- Stems should be clear and unambiguous (not to be understood in more than one way or of unclear meaning).
- Stems should be as brief as possible but most of the material should be contained in the stem. Usually the stem should be longer than the response.
- Generally, it is better to have positive stem and not negative ones. Negative stems can lead to misinterpretation unless carefully constructed.

5.7. Essay Type Test

Introduction

An essay type test is the one, which requires the pupil to compose in one or more sentences the answer to a question. It is one of the major tools for assessing pupils in our schools. It gives the pupil the chance to measure his thoughts. The test is generally used to assess learning outcomes such as the ability to recall, organize and integrate ideas into a logical and meaningful manner, and also the ability to express oneself in writing. It is also used to measure complex learning outcomes, which cannot be satisfactorily measured by objective tests. It allows for maximum response and encourages self-expression. It develops a variety of skills by calling upon pupils to use these skills. Skills like selection and use of relevant materials and organizing materials into coherent discussions and arriving at a conclusion.

Advantages of essay type test

- It is relatively easy to construct.
- It allows free expression and practice in organizing and arranging facts and arguments in an effective manner.
- The ability of the candidate to express him/her self in good language can be tested through the essay.
- It is more effective in testing achievements in certain types of skills, e.g. the ability to organize and relate information and the ability to select information that is related to particular information. (This merit does not apply automatically to all essay items)
- Guessing is reduced, if not completely eliminated.
- It motivates pupils to learn.

Disadvantages of essay type test

- Unless the marking of the test has been standardized it turns to be unreliable and halo effect sets in.
- It suffers from limited sampling. Sampling covers a limited area of the syllabus. One research finding shows that the essay calls for less than half the knowledge the average pupil actually possesses on the subject.
- The mood of the examiner at the time of marking may affect the pupil's grades. Factors like physical and mental condition of the examiner may tend to influence the marks awarded to the candidate.

- A pupil who has vocabulary handicap might be penalized.
- It gives pupils the chance to bluff or show off, writing irrelevant material to show that they know.
- It is time-consuming both for the teacher and the pupil. For the teacher, the reading, marking and grading require a lot of time if it is to be done well.
- There is variation in the difficulty level of questions answered by different pupils so that the marks do not have one basis for comparison.

Guidelines for improving on the construction of essay type test

- The sampling of materials taught should be as wide as possible. This can be done by increasing the number of questions asked and reducing the amount of discussion required on each. The type of response required must always be clearly indicated.
- Do not ask a question such as ‘Describe the Digestive system’. The specific aspects of the digestive system to be described should be stated. For example: Describe what happens to a piece of meat eaten until it becomes part of the body.
- Each item should contain only one question. If there is more than one question in an item, they should be clearly indicated. So instead of ‘What contributions do heredity and environment make to the pupil’s growth and his performance in the classroom’? This could be better framed as ‘What contribution do heredity and environment make on the following:
 1. A pupil’s growth and development.
 2. A pupil’s performance in the classroom.
- Indicate the time limit for taking the test.

Guidelines for constructing essay tests

- Prepare in advance a marking scheme. This is a list of answers, which are considered adequate for the objectives of the test.
- Assign a specific value to each essential part of the answer.
- Mark one question through all the papers before going to another question. This makes the scorer attend to only one set of criteria at a time in marking the script.
- Avoid generalizing performance on one question to another, predicting the pupil’s performance on a subsequent question or item from performance on an item marked earlier.
- Use identification numbers to conceal the identity of the pupils before marking. This is to avoid a possible “halo” effect.

6. English as a Tool to Support Understanding of other Subjects

Introduction

One of the key objectives of the SBI/CBI is to assist teachers to be more efficient in the delivery of lessons. Since the medium of instruction is English, pupils must become proficient in both the use of English and in the knowledge of the subject. A major challenge to teachers in Ghana is how to develop pupils' subject knowledge using English language as a tool to support their understanding. This requires the teacher to teach English in the content area, which includes both the language specific to a subject and additional English language skills. For example, when teaching the Mathematics content that an obtuse angle is greater than 90 degrees, the teacher will not only have to teach the vocabulary item 'obtuse' but may also have to teach the use of the -er suffix to show comparison in the word greater.

Communication is an essential skill to be developed by teachers and learners. The ways in which teachers communicate knowledge and information to pupils will affect their understanding of the subject. In order to be most effective the teacher must be conscious of the pupils' level of language competency, including each pupil's skills in reading, writing, listening, speaking and overall understanding.

For example, there may be classroom situations where the pupils' understanding of concepts, such as a concept of Mathematics, is hindered by their lack of understanding of English. At the same time, pupils' understanding and competence in English can be improved through their practical experience of using English in lessons of other subjects.

Pupils need to use language in the classroom through two different opportunities:

1. They need to practice new language structures and terminology - repetition will provide good opportunity for practicing language skills.
2. They need the opportunity to develop their own thinking and understanding – this will not come from repetition alone but from opportunities to explain concepts in their own words, from asking their questions and from discussions.

6.1. English as a Tool to Support Understanding (General)

6.1.1. Language and lesson activities

Pupils need to have the opportunity to discuss in groups – to share ideas, to develop ideas and to improve their language communication skills, to clarify and organise their thoughts and to correct misunderstandings among themselves.

Instructional activities should maximize opportunities for language use. Opportunities for substantive, sustained dialogue are critical to challenging pupils' ability to communicate ideas, formulate questions, and use language for higher order thinking. Each pupil, at his or her own level of proficiency, should have opportunities to communicate meaningfully in this way.

Instructional tasks should involve pupils as active participants. Pupils contribute and learn more effectively when they are able to play a role in structuring their own learning, when tasks are oriented toward discovery of concepts and answers to questions, and when the content is both meaningful and challenging.

Instructional interactions should provide support at each pupil’s level of understanding. Teachers should ensure that pupils understand the concepts and materials being presented. This includes providing support for the pupils’ understanding of instructions and the subject concepts presented in English.

Problems in translation The teacher should consider carefully the words she/he uses when translating between the local language of the pupils and the English language of the classroom. Some words will not have a direct translation into the local language. For example, there may not be a single word for “symmetrical” or for “electricity”.

6.1.2. TIPS for Using English as a Tool to Support Understanding of other Subjects

Teachers must learn to talk less	AND	listen to pupils more
Teachers must improve their questioning skills:		
<ul style="list-style-type: none"> – MORE open questions requiring <u>explanation from the pupils</u> – Note: an open question has more than one answer – FEWER close questions with YES/NO answers or only one correct answer. E.g. $2 + 3 = 5$ – Pupils must be encouraged to ask questions – ALL PUPILS must be encouraged to speak in the classroom 		

Teachers should:

- Use simple, short and clear English phrases as often as possible.
- Use a range of common and useful classroom phrases regularly – for example:
 - “What did you do next?”
 - “What happened next?”
 - “What does ... mean?”
 - “How did you work out the answer?”
 - “Please tell us in your own words”

If the teacher uses a few common questions, phrases and instructions regularly in the classroom the pupils will become familiar with what is expected of them and they will be able to anticipate what the teacher wants them to do.

Use of the Local Language used at home

1. Give clear, simple instructions - check for understanding using one of these strategies:
 - First, give the instructions in English. If necessary repeat the instructions in the pupils’ local language and then again in English to reinforce the understanding of English;
 - Write the instructions on the blackboard and ask the pupils to read or copy the instructions;
 - Ask one or two pupils to repeat the oral instructions you have given.
 - Pupils in the class who are knowledgeable in the subject or in the use of English may be able to explain to other pupils in their local language to help their understanding.

2. If necessary, when explaining or clarifying a difficult concept and when introducing a new concept, give a simple translation in the local language to help pupils' understanding of the English explanation but
 - DO NOT make this a habit or the pupils will learn to expect this.
 - DO explain in English first and repeat the English explanation later.
3. Check pupils' understanding by occasionally asking them to explain in their local language.
4. Ensure that you are consistent in your use of language. For example:
 - use the same vocabulary on the blackboard as pupils will read in their books;
 - use the same words to give explanations and to ask questions both orally and in written form;
 - use the same terminology in tests and exercises as pupils will have heard and read in the lesson and in their books.

6.1.3. Checking Understanding

Answering Questions

In most classrooms the teacher asks the questions and the pupils give the answer, sometimes in unison and sometimes individually. Some pupils are never asked to answer a question, may be because the teacher is sure the pupil will not know the correct answer.

How can we ensure that all pupils have the opportunity to answer questions in the classroom?

Eliciting Answers

The teacher needs to develop the skills of asking open questions, leading the pupils towards giving an explanation in their own words. This helps the pupils to develop their understanding of the concept and reveals to the teacher any problems in their level of understanding.

For example, in the Science classroom, questions such as the following can be asked:

- What do you think will happen?
- Why did that happen?
- What do you think would happen if ?

For example, in the **Science or Mathematics** classroom, when using pictures and diagrams:

- What can you see in the diagram?
- What does the diagram show us?
- Explain this part of the chart to the class.
- Describe in your own words what you see in this picture.

For example, in the **Mathematics** classroom:

Tell us how you worked out this answer?

- What did you do next?
- What can you tell us about this shape?
- What does the word “angle” mean?

If the teacher asks the class “Do you understand?” - this is NOT a good question. Why?

In addition to being aware of the questioning skills she/he is using, the teacher should also develop the skill of listening to the pupils’ answers and responding effectively. The teacher’s response will be important in developing pupils’ confidence in the subject and in their use of language.

Marking Pupils’ Written Work

Here are three key questions relating to the development of language when marking pupils’ work:

Table 13: Tips for Marking

QUESTION	POINTS FOR THE TEACHER TO THINK ABOUT
Who marks the pupil’s work?	If the teacher marks the pupil’s work she/he should ensure that she communicates with the pupils to overcome any misunderstandings they may have, checking and reinforcing language understanding.
If there is a mistake how is the mistake corrected?	Is the misunderstanding conceptual or is it a problem with understanding the written language? Will there be a language problem in trying to correct any mistakes the pupil has made? If the problem is due to language difficulties what strategies can the teacher use to correct this?
Does the pupil check her answers – before and after the work is marked?	Pupils must be encouraged to check their work before it is marked and again after it is marked. In this way, they can read carefully and correct any mistakes they notice before the work is marked. When the work is marked and returned to the pupils, they can check again to see where they had some misunderstanding. This simple checking task will help the pupils to develop their language by re-reading for understanding.

6.1.4. Examples of Language Activities

Language Activities and Roles of the Teacher and the Pupils

There are various language activities which the teacher can use to encourage pupils to gain better understanding of the topics. These activities will need to be chosen carefully to suit the topic. Both teachers and pupils will need time to become used to some of these activities. For example, pupils will not be sure of what is expected of them when suddenly asked to discuss a question in groups if they have never worked in this way before. The teacher will need to plan, organize and introduce the activity carefully. Demonstration lessons can be used to introduce some of these activities during SBI/CBI programmes.

Table 14: Roles of Classroom English

THE TEACHER’S ROLE	THE PUPIL’S ROLE
- Leads and encourages classroom <u>discussion</u>	- Participates actively in <u>classroom discussion</u>
- Provides <u>explanation</u>	- Listens to the <u>explanations</u> of the teacher

THE TEACHER'S ROLE	THE PUPIL'S ROLE
– Uses <u>demonstration</u> to illustrate concept and language	– Observes the <u>demonstration</u> – listening and asking questions for improved understanding
– Gives clear, simple <u>instructions</u> to guide the pupils	– Listens to and follows <u>instructions</u> given by the teacher
– <u>Asks questions</u> to encourage thinking and to test understanding (written and oral)	– <u>Answers questions</u> the teacher asks (written and oral)
– <u>Answers questions</u> the pupils are encouraged by the teacher to ask (oral)	– <u>Asks</u> the teacher and other pupils questions to clarify thinking (oral)
– <u>Listens</u> to the pupil's discussion and answers to questions	– <u>Listens</u> to the teacher and to other pupils in discussion and gives answers to questions
– Uses class books and wall charts to encourage pupils to <u>read for information</u>	– <u>Reads the information</u> in class books and wall charts

Notes:

Which of these activities do you do most often in your classroom?

Which activities do the pupils in your classroom do most often?

Are there any of these activities that NEVER happen in your classroom?

How can you change this?

Lesson Planning

When you are planning a lesson, think carefully about the language challenges that may arise in the lesson. A common problem is confusion between vocabulary used in the classroom and the language of everyday life. For example “What do you mean?” may be confused with calculating the mean score in data handling in Mathematics. The following steps should be included in the lesson:

- Step 1 Explain the meaning of new vocabulary
- Step 2 Give examples of how to use the new vocabulary and when to use it
- Step 3 Give the pupils the opportunity to practice saying and spelling the new vocabulary

FIVE WORDS A DAY : A simple way to practice new vocabulary is to start or end each day with class practice. Write five words on the blackboard relating to the present topic. The pupils have to think of a sentence for each word. Choose five pupils – each one tells the class one of their sentences. Choose different pupils and different words each day so that all pupils have a chance to share their sentences with the class.

6.1.5. Some Ideas to Help Pupils to Explain in their Own Words

The pupils will be able to explain their understanding very well in their local language but we want to encourage them to develop their understanding in English which will be much more difficult for them. How can the teacher help pupils to explain in their own words AND in English?

- Prompt with one or two words to help the pupils if they are struggling to find the correct word.
- Use simple structures and use repetition of phrases that the pupils can easily learn to use.
- Encourage pupils to help each other when they are struggling to explain in English.
- Give the pupils the opportunity to ask for help, for example, in their local language they can ask “How do you say in English?”
- Allow the pupils to make a few mistakes in their use of English when they are trying to express an idea.

6.1.6. Some Practical Ideas for Teachers

1. Technical terminology and simple definitions:

- Introduce new terminology by giving the pupils a simple explanation
- If the definition is not clear in the textbook, write the definition on the blackboard and ask the pupils to copy it into their exercise books. They can put a text box round the definition and include a simple illustration where relevant.

2. **Use a combination of group work and individual work.** It is important to point out that second language learners develop and improve their language skills through group work activities, working in small groups where they can share ideas and learn from each other. Group work enables pupils to use language to talk about the tasks of a subject at hand while they solve non-routine problems. Setting individual work ensures that all pupils process lessons at their own rate of learning.

3. **The classroom can be enriched with extra attention to language.** Charts with important vocabulary and language structures should be displayed on the walls, along with writing by the teacher and pupils.

- regularly revise the new vocabulary and understanding of related concepts
- make a class dictionary in which to record new vocabulary

4. **The teachers should be aware of the language level of their pupils and also know their standard of the subjects through periodic assessment.** The teacher should be aware of appropriate levels of reading and writing skills and should know some basic language teaching methodologies such as the use of repetition and how to balance the use of the local language with English.

5. **Make the lessons as relevant to the pupils’ every day experiences as possible.** Use every day examples, real objects, resources from the local environment and activities in the local community.

6. Listen carefully to pupils’ use of language. Use the following teaching techniques:

- restate complex sentences as a sequence of simple sentences;

- avoid or explain use of idiomatic expressions;
- restate at a slower rate when needed, but make sure that the pace is not so slow that normal intonation and stress patterns become distorted;
- pause often to allow pupils to process what they hear;
- provide specific explanations of key words and special or technical vocabulary, using examples and non-linguistic props when possible; use everyday language.
- provide opportunity for pupils to practice and use new vocabulary in oral and written form.

6.2. English to Support Understanding of Science and Mathematics

In this section, we will consider some strategies for using **English as a tool to support the understanding of Science and Mathematics**. We will also address some of the main language challenges in the Mathematics and Science classrooms.

6.2.1. Language Activities that pupils generally find most difficult in Science and Mathematics lessons

Here are some specific examples of Mathematics and Science language which pupils might find problematic.

a) Confusion between mass and weight:

How can the teacher help pupils to understand the difference?

b) Difficulty with definition of technical language:

- How would you explain technical terms such as “congruent” in simple language for the pupils to understand?

Congruent means:

- Exactly the same size and shape
- Two are congruent if they fit exactly on top of each other



c) Some examples of vocabulary structures pupils will need to learn:

– nought	zero	nothing	nil
– add	sum	plus	
– take away	subtract	minus	
– approximately	approximation	approximate	
– multiply	multiplication	multiplied by	
	multiples		
– divide	division		
– centimetre	metre	millimetre	
– kilometre			
– great	greater	greatest	
– less	fewer	least	
– hundred	hundredth		
– rotate	rotation		
– symmetry	symmetrical		
– triangle	triangular		
– vertex	vertices		
– conductor	insulator	insulation	
– vapour	vaporise	evaporate	
– -		evaporation	
– live	alive	living	
	life		
– mature	immature	maturity	
– fertile	fertilise	fertilisation	
	fertility		
– health	healthier	healthy	
	healthiest		
– nutrients	nutrition		
– hygiene	hygienic		
– pollute	pollution	polluted	
	pollutes		
– pollinate	pollination	pollinator	
	pollinated		
– reproduce	reproduction	reproductive	
– electric	electricity	electrical	
– magnet	magnetism	magnetic	

d) All new vocabulary must be taught in context:

Pupils can be introduced to the new structures using sentences relating to the topic they are studying. They need to be given plenty of opportunity to practice each new structure in its correct context.

6.2.2. Language Teaching Activities to Support Understanding of Science and Mathematics

Some basic language teaching activities are illustrated below which are simple to make and which can be modified to correspond with any topic:

Complete the sentence / Fill in the blanks

The outer layer of the earth is called the earth's It is made of

Cool air is than warm air.

A square has ... sides and a has 3 sides.

A cuboid has faces, 12 and 8

Jumbled letters

When you heat water, it changes into U A V O P R

I R G Y V A T is a force that pulls things towards the earth.

The E T E P I R M R is the sum of the lengths of all the sides of a shape

I N T M T R E C E S equals 1 E E M R T

Matching sentences - write one part of each sentence on strips of paper and distribute one to each pupil. Each pupil has to find the pupil who has the other part of their sentence and read the sentence aloud.

438	the space between two straight lines which meet.
three fourths	The distance all the way round a circle.
an angle	four hundred and thirty eight.
circumference	$\frac{3}{4}$.

Soil is made up of	smoke dust and gases.
Boiled water is almost free of	dissolve in water.
Air can be polluted from	particles of stones and other materials.
Solids such as sugar and salt	disease causing organisms and impurities.

Putting sentences in the correct sequence

Press the cassava to remove water and starch.

Roast the cassava.

MAKING GARI

Peel the cassava with a sharp knife.

Grate the cassava into small pieces.

Sieve the cassava through a wire mesh.

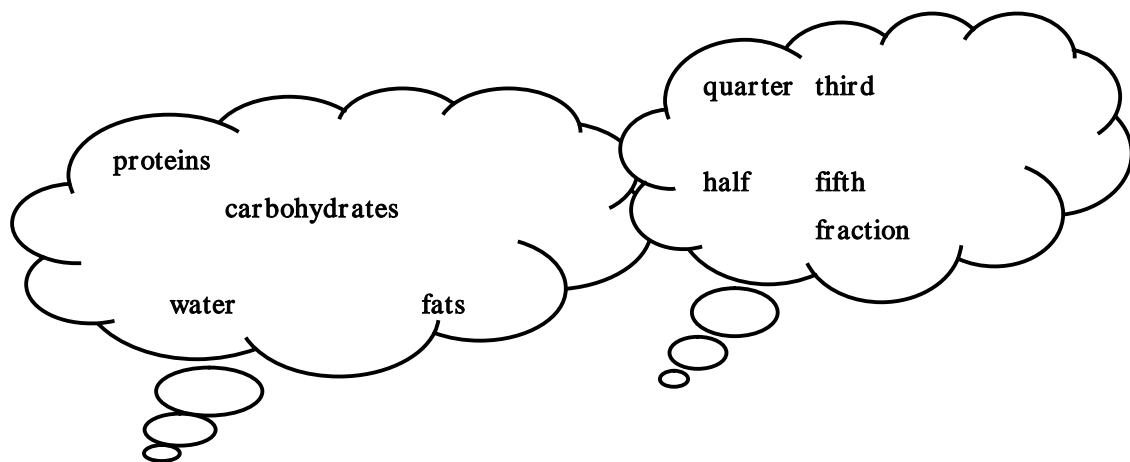


Figure 10: Families of Words