Mathematics

Upper primary

Syllabus 2003

Section 1

Curriculum Information

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Department of Education

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Secretary's Message

The current reforms in education have been in progress since 1992. The Education Reform has emphasised community-based schooling, the use of vernacular languages in schools, the introduction of Elementary Schools and the expansion of Primary schooling to grade 8 and increased access to Grades 9 and 10.

This syllabus is to be used by Upper Primary (Grades 6, 7 and 8) students in Primary schools throughout Papua New Guinea. This syllabus develops, extends, links and builds upon concepts, skills and attitudes flowing from Lower Primary (Grades 3, 4 and 5). This syllabus provides a sound foundation for further learning in the reformed school system.

Students' language abilities, already gained in their home environments and during the previous years of schooling, must be respected, built on and extended. Vernacular languages have a large part to play in our students' formative years and their first language should be used to promote a deeper understanding of difficult concepts when this is appropriate.

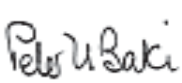
The Upper Primary Mathematics Syllabus contributes significantly towards achieving Integral Human Development. Without a sound working knowledge of mathematics, a person's ability to function effectively is severely restricted. This course is designed to promote both a firm understanding of practical everyday mathematics and the theoretical basis to support higher learning.

By studying Mathematics, students will take an active role in building their societies and appreciating others by using the acquired numeracy skills.

Building on the Lower Primary course, students focus on developing numerical, analytical and investigative skills to solve real life problems likely to be encountered in their societies as well as in the outside world. This knowledge and skills will enable students to perform mathematical tasks in everyday life and to be useful members of society as well as preparing for further mathematical studies.

This course is designed to allow and indeed to encourage active integration primarily between the different units of mathematics and also between mathematics and all other subjects. Such integration will result in providing the practice and skills that will set the ground for lifelong learning.

I commend and approve this syllabus as the official curriculum for Mathematics to be used in all Upper Primary schools throughout Papua New Guinea.



Peter M. Baki
Secretary for Education

Introduction

This syllabus makes explicit the knowledge, skills, attitudes and values that students should achieve for Grades 6, 7 and 8 in Mathematics. These are expressed as learning outcomes and indicators.

The learning outcomes are student centred and written in terms that enable them to be demonstrated, assessed or measured. The outcomes are written to show a progression from one grade to the next.

Each learning outcome is illustrated with a list of examples of the kinds of things students should be able to do, know and understand if they are achieving an outcome. These are called indicators.

The learning outcomes and indicators will:

- give teachers individually or collaboratively, the flexibility to write programs and units of work—these can be developed to suit local conditions and individual student needs,
- help teachers assess and report students' achievements in relation to the learning outcomes,
- allow student achievement of the outcomes to be described in consistent ways,
- help teachers to monitor student learning,
- help teachers plan their future teaching programs.

This Upper Primary Mathematics Syllabus reflects a significant step forward as part of the Education Reform. It presents a coherent view of the course at the Upper Primary level of schooling. It will also be useful to developers of support materials, planners and teachers of Grades Five and Nine.

Flowing from Lower Primary, Mathematics at Upper Primary level focuses on developing numerical, analytical and investigative skills to solve real life problems likely to be encountered in their culture and community. Furthermore, it will provide a sound foundation for future mathematical studies and provides the mathematical literacy necessary to do other studies.

English is the main language of instruction and a vernacular language or a lingua franca will be used as required to enhance understanding of the mathematical concepts.

Students commencing this course will be competent in basic number facts and have a sound working knowledge of mathematical forms such as place value, the four operations and standard symbols.

Teachers teaching this course will be generalist teachers using the Syllabus, Teachers Guide and other support materials to present this course.

Mathematics is to be timetabled for 180 minutes per week in all Upper Primary schools.

Rationale

All citizens of Papua New Guinea have the right to participate fully in all aspects of development and self-determination. To this end a sound mathematical literacy is essential.

An all encompassing view of Mathematics and the whole curriculum is needed to maximise the gain to the students, as the solutions to life problems will not come from neatly separated skills but from the whole of their ability.

By linking new mathematical concepts to existing cultural and scholastic knowledge, the students integrate knowledge so that they are more able to use it in their lives.

The use of familiar and interesting contexts reduces the dissatisfaction often associated with Mathematics and makes clear the processes as students work out solutions to familiar and relevant problems.

Mathematics, as any knowledge area, can be abused and used unethically. Often those with the capacity to do so misuse mathematical information to confuse, decieve or threaten the less knowledgable. The best defence against this abuse is a mathematically literate population.

There are pressing social issues in Papua New Guinea regarding population growth, inequitable distribution of resources, corruption and compensation demands which cannot be fully debated without an understanding of the underlying mathematics.

The potential for misconceptions or deliberate incorrect information is enormous. This course teaches much of the mathematics needed to understand these issues and thus allows the next generation to take steps to begin to correct these problems.

The content of this course has been chosen specifically to provide a solid mathematical literacy both for those leaving the system of formal education at Grade Eight and those remaining. The course provides a solid foundation on which further learning can be built and provides a glimpse into the elegance of mathematical thought.

Papua New Guinean society is changing rapidly, as are the needs of its citizens. Everyday life requires individuals to have an ever increasing mathematical ability to participate fully.

In matters of buying, selling, earning an income, building a house, making a meri blouse or even interpreting political statements, sound mathematical reasoning skills are required. Therefore it is important that our Mathematics curriculum caters for these changing needs, especially in the area of numeracy. This course addresses this by making the mathematics more relevant and more accessible to students.

Curriculum Principles

This course is based on three fundamental learning principles:

- we learn best when we build new learning on what is already known,
- we learn well when we recognise an immediate use or need for what is to be learned,
- we use many different ideas and skills in a coordinated way to solve real problems.

The course continually refers to pre-existing knowledge, setting the mathematics into contexts that are familiar and of interest to the students. The contextual approach leads to real problems in interesting and familiar settings requiring students to participate in both problem-setting and problem-solving processes.

The students need to use concepts and skills from many areas of mathematics and other sources to come up with workable solutions, as in real life. This approach facilitates a student-based mode of learning.

Catering for Diversity

In using a contextual approach, it is vital that the contexts used do not unduly favour one gender over the other. Special attention needs to be given to balancing the contexts to give both males and females equal opportunity. In this instance, a simple majority choice may not be appropriate where there is a gender imbalance in the numbers of students in the class.

While student participation in the choice of contexts may be desirable, it is part of the teacher's role to ensure all students in the class have a fair opportunity to progress and learn. Most contexts are sufficiently broad so that with a little planning and forethought, gender equity can be maintained.

Teaching and Learning

In Primary schools, generalist teachers often prefer to use an integrated approach to teaching and learning. The teacher creates a program that is meaningful, appropriate, engaging and motivating to the students. The use of learning outcomes provides opportunities to integrate the curriculum.

Teachers should map out the learning outcomes for those parts of the syllabus that they are intending to teach in the coming term or year. Where there is more than one teacher across a grade, this should be done as a small team.

Teachers in the school with leadership responsibilities should be invited to attend and support this planning process. While carrying out this process links between learning outcomes for different subjects should be noted, as there is scope for combining and using these outcomes in an integrated approach to teaching.

For example, a Language learning outcome might refer to the use of questionnaires and holding discussions with community members and a Making a Living learning outcome may also do this. In this way evidence of the achievement of these outcomes can be provided in more than one subject.

Teaching Approaches in Mathematics

The teaching approaches required for this course are student-centred learning activities. They promote the philosophy of 'how to think', not 'what to think'. The student-centred teaching activities include investigation, problem solving and out-of-class excursions.

These provide opportunities for students to work cooperatively, to discuss, make decisions, plan, organise, carry out activities, record results and report findings. Activities should also allow the students to listen to each other's opinions, demonstrate their strategies and critically analyse results.

The teaching and learning of concepts promotes the philosophy of 'known to unknown', building on what the students know and teaching concepts using similar contexts for better understanding. The teaching and learning approaches must be student centred and as much as possible, student directed.

Bilingual Education

While it is recognised that English is the main language of instruction it must also be recognised that students are still more familiar with their vernacular or lingua franca and the teacher should encourage their use where it will lead to better understanding.

Since Mathematics is itself a language and one different from any other language, it is believed that the use of their first language will help the students to understand better when dealing with mathematical activities.

Multigrade Teaching

The contextual approach used for this course lends itself to multigrade teaching as the same context can be used for all students in the multigrade classroom with the more advanced students tackling more sophisticated work and those less advanced addressing similar issues at another level.

Teachers of multigrade classes will need to plan their program of work carefully so that students do not repeat the same contexts, and so that students progress through the skill stages presented in the outcomes. It is best if the same teacher remains with the multigrade class over the number of years represented in that class. If this is not possible, then the replacement teacher will need to use the programs of the previous teacher for writing new programs.

Integration

Some topics or teaching strategies in the Upper Primary Mathematics course are also dealt with in other subject areas. These topics include measuring, drawing, classifying, collecting and presenting data, graphing, time, money, decimals and percentages.

The skills and knowledge taught in Mathematics are used widely in other subject areas. Contents from other subjects provide suitable contexts in which to teach Mathematics. For example, if the students are studying ‘budgeting’ or ‘running a small business’ in Making a Living, this would tie in with ‘Decimals and Percentages’ in Mathematics.

This course is designed to be taught with a need for flexibility in programming. While it is necessary for a few of the topics to be taught in sequence the majority of the course can be taught in any order that suits the needs of other subjects. Teachers are advised to take advantage of this to maximise the links between subjects.

Aims

Students:

- develop, extend, link and demonstrate the concepts, skills and attitudes flowing from Lower Primary Mathematics,
- develop numerical, analytical and investigative skills to solve real life problems likely to be encountered in the culture and community of Papua New Guinea,
- develop a sound foundation for further mathematical learning,
- develop confidence in applying mathematical skills,
- develop curiosity leading to the understanding of concepts,
- develop determination to persist with difficult problems,
- develop critical judgement in selecting approaches to problems and appreciation of the cultural diversity in numeracy,
- understand information in graphical, statistical and written forms,
- master numeracy and manipulative skills in presenting information by drawing, illustrating, identifying, comparing, measuring, calculating and graphing,
- become more competent members of society,
- evaluate mathematical data in a sensible fashion and present meaningful information to further their own and their communities' needs.

Content Overview

The content for this syllabus is organised into five Strands. A Strand such as Number and Application is a useful and convenient way of organising the learning outcomes for a subject.

Each Strand identifies a particular aspect of a subject or a particular theme such as a set of processes. Each Strand displays a typical progression of learning from one grade to the next.

Each Strand is further organised into a number of Sub-strands to allow the content to be specified and described as learning outcomes.

Mathematics has five Strands: Number and Application, Space and Shape, Measurement, Chance and Data and Patterns and Algebra.

Number and Application has seven Sub-strands: Fractions, Decimals, Fractions and Decimals, Decimals and Percentage, Ratios and Rates, Directed Numbers and Indices.

Space and Shape has nine Sub-strands: Length, Area, Volume, Shape, Tessellations, Angles, Nets, Direction and Maps and Coordinates.

Measurement has three Sub-strands: Weight, Temperature and Time.

Chance and Data has five Sub-strands: Statistics, Sets, Probability, Accuracy and Error and Estimation.

Patterns and Algebra has two Sub-strands: Packing and Algebra.

Number and Application

Students use all common forms of number including fractions, decimals percentage, indices and negative numbers. They apply these to solve real problems which might be encountered in ordinary life.

Space and Shape

Students estimate and measure length, area, volume and angle. They learn the language required to discuss shape and direction. They learn to locate points on a plane by way of coordinates. They are presented with practical applications of what they are learning. Throughout they are challenged to apply a broad range of mathematics to solve problems.

Measurement

This strand concentrates on the units and practice of measuring weight, temperature and time. Students record, calculate and present measurements they make.

Chance and Data

In this strand the collection, presentation and interpretation of data is stressed. This strand deals with statistical information, graphs, probability and sets. It also considers methods of estimation and issues of accuracy and error.

Patterns and Algebra

This strand deals with patterns in packing, in number and operations. These are used to link common events to mathematical thought and the idea of abstract representation of numbers and processes that is possible with algebra.

Knowledge, Skills and Attitudes

Knowledge—students will:

- recognise, identify, discuss, formulate, understand, analyse and evaluate each of the mathematic strands,
- apply the content in everyday practical situations,
- demonstrate an understanding of the four operations: addition, subtraction, multiplication and division, and be able to solve ordinary practical problems involving mathematics.

Process skills—students will:

- classify, estimate, predict, and perform the four operations of adding, subtracting, multiplying, division,
- locate, compare, sort, order, interpret, and present information including graphical, tabular, drawn, written and numerical,
- round off numbers and formulate rules or formulae,
- explore and investigate practical problems,
- manage, plan and solve problems.

Motor skills—students will:

- manipulate and sort materials,
- translate and transfer mathematical information,
- model, measure and classify practical mathematical problems,
- demonstrate technical drawing and mapping skills.

Life skills—students will:

- read, analyse, abstract, extract, comprehend, research and think critically,
- use calculators to solve practical mathematical problems and to apply knowledge and skills.

Attitudes—students will:

- value, appreciate and enjoy learning Mathematics,
- appreciate that mathematics is in their environment or daily activities,
- develop inquisitive minds to investigate and develop good work and study habits,
- develop a mutual respect for one another's ideas and opinions.

Table of Strands and Sub-strands for Mathematics

Strand	Grade 6	Grade 7	Grade 8
Number and Application	• fractions • decimals • fractions and decimals • decimals and percentage • ratios • directed numbers • indices	• fractions • decimals • fractions and decimals • percentage • ratios, fractions and rates • directed numbers • indices	• fractions • decimals • fractions and decimals • percentage • ratios and rates • directed numbers • indices
Space and Shape	• length • area • volume and capacity • shape • tessellations • angles • nets • direction • maps and coordinates	• length • area • volume and capacity • shape • tessellations • angle • nets • direction • maps and coordinates	• length • area • volume and capacity • shape • tessellation • angle • nets • maps

Strand	Grade 6	Grade 7	Grade 8
Measurement	• weight • temperature • time	• weight • temperature • time	• weight • temperature • time
Chance and Data	• statistics • sets • probability • accuracy and error • estimation	• statistics • sets • probability • accuracy and error • estimation	• statistics • sets • probability • accuracy and error • estimation
Patterns and Algebra	• packing • algebra	• packing • algebra	• packing • algebra

Assessment and Reporting

Assessment and reporting practices described here are detailed further in *The Assessment and Reporting Policy for Papua New Guinea* and in other support materials produced by the Department of Education.

Assessment

Assessment is the ongoing process of identifying, gathering and interpreting information about students' progress towards achievement of the learning outcomes described in the subject syllabuses.

Teachers record evidence of students' learning and use it to make judgements about students' achievements of the learning outcomes. To ensure that assessment is fair and balanced, teachers should use a range of assessment methods including:

- observing and recording details of students' demonstration of process skills and/or their performance on particular tasks,
- setting written assignments, projects and practical work,
- setting and marking written tests and/or examinations,
- keeping portfolios of students' work.

Teachers should provide opportunities for students to assess their own learning (self-assessment) and the learning of others (peer assessment) according to set negotiated criteria. The purpose of assessment is to improve student learning.

Assessment is the process of finding out what the children know. Evaluation is the comparison of the results of assessment against predetermined criteria. To do this effectively it is necessary to record the assessment information. Finally there is little purpose in carrying out any of these things if the results of the evaluation are not reported on and the report acted upon.

Assessment in Mathematics

Assessment should first and foremost be used to evaluate student performance so that teaching can be adjusted to improve the students' performance. Assessment is thus to help the teacher to provide better learning opportunities for the students and to help the teacher adjust the program of instruction to ensure that desired outcomes are achieved. To do this well assessment must be continuous throughout the year. A little often is far better than a lot sometimes.

Written tests and examinations assess a small part of this course. If teachers only use written tests they will overlook important parts of the course.

The emphasis should be on teaching mathematics for understanding. Written tests should not be the only method used to find out what the students have learnt. Other forms of internal assessment must also be used.

Recommended Assessment Strategies

These are some strategies or techniques that teachers can use to assess students performance in Mathematics lessons:

Observing students during the lesson:

Making informal observations and keeping notes of these on a class list. Choose just one or two students in any one lesson and note down both positive and negative things they do during that lesson. Continue with different students until you have some comments on all students, then repeat the process.

Talking with students:

Use both good questioning techniques in class and informal discussions with individual students to get a picture of each student. Relevant points from such talks must be noted down, such as whether or not the correct mathematical terms were used to answer a question, or whether or not the student showed understanding of a concept. Formal interviews may also provide further information.

Profiles:

Teachers may set a series of mini projects or exercises and keep samples of work from each student on file, maintaining a folder of work for each student. Student exercise books fulfil this function to some extent. Examination of students' exercise books can give a good indication of the students' level of understanding especially if the work in their books is their own and not copied from the board.

Another form of maintaining such profiles is to only retain the best and latest version of their work. For instance, a student may not have demonstrated an ability to carry out long division in March, but in June does do so. Under this approach only the work produced in June will be kept, demonstrating that that particular outcome has been achieved.

Checklists:

Create a checklist of all the expected outcomes for the year and list these against the students' names. As each student demonstrates achievement of the outcome, check that outcome off on the list against that student's name.

Tests:

These may be short answer or longer exercises. They may be open book or strictly from memory. There are many possibilities. Multiple-choice tests are the most difficult to write well. Those written for examinations undergo a rigorous trialing and editing before use and even then do not always achieve what was intended. Teachers are advised to use other types of questions.

Regular short tests, both written and oral, will provide more relevant up-to-date information to alter teaching than longer infrequent tests. An end of unit test does not give the teacher the information needed to change their approach to that unit until it is too late. A ten-minute quick quiz every week can provide timely clues to the success or failure of a teaching strategy.

Keeping records of practical work:

These may include models students have made, assignments they have completed and any other work that demonstrates their present ability.

Reporting

Teachers must keep accurate records of students' achievement of the learning outcomes and report these achievements in fair and accurate ways to parents and guardians, teachers, students and others. Recording methods will include the following:

- journal, diary or anecdotal notes,
- portfolios,
- progressive records,
- checklists,
- work samples with comments written by the teacher.

Student reports should be based on assessment information collected from ongoing assessments and where appropriate, from external examinations (Grade 8). Schools will decide on how reports will be presented to best suit the needs of their communities.

Evaluation

Teachers will use assessment information to evaluate the effectiveness of their teaching, learning and assessment programs and to make improvements to their teaching practice in order to improve student learning.

Schools may use whole school assessment data to evaluate the effectiveness of teaching and learning in a particular subject or at particular grade levels and make decisions on how to improve student learning.