NATIONAL CURRICULUM STATEMENT
GRADES 10-12 (GENERAL)

LEARNING PROGRAMME GUIDELINES

MATHEMATICAL LITERACY

29 April 2005
SECTION 1

INTRODUCTION

1.1 INTRODUCING THE NATIONAL CURRICULUM STATEMENT

1.1.1 BACKGROUND

In 1995 the South African government began the process of developing a new curriculum for the school system. There were two imperatives for this. First, the scale of change in the world, the growth and development of knowledge and technology and the demands of the 21st Century required learners to be exposed to different and higher level skills and knowledge than those required by the existing South African curricula. Second, South Africa had changed. The curricula for schools therefore required revision to reflect new values and principles, especially those of the Constitution of South Africa.

The first version of the new curriculum for the General Education Band, known as Curriculum 2005, was introduced into the Foundation Phase in 1997. While there was much to commend the curriculum, the concerns of teachers led to a review of the Curriculum in 1999. The review of Curriculum 2005 provides the basis for the development of the Revised National Curriculum Statement for General Education and Training (Grades R – 9) and the National Curriculum Statement for Grades 10 – 12.

1.1.2 THE NATIONAL CURRICULUM STATEMENT

The National Curriculum Statement consists of 29 subjects. Subject specialists from the provincial education departments and Department of Education developed the Subject Statements which make up the National Curriculum Statement. The draft versions of the Subject Statements were published for comment in 2001 and then re-worked to take account of the comments received. In 2002 24 subject statements and an overview document were declared policy through Government Gazette. In 2004 five subjects were added to the National Curriculum Statement. The National Curriculum Statement now consists of the Overview and Subject Statements for the following subjects:

- Languages – 11 official languages (each counted as three subjects to cater for the three levels Home Language, First Additional Language and Second Additional Language); 13 non-official languages
- Mathematics; Mathematical Literacy; Physical Sciences; Life Sciences
- Computer Applications Technology; Information Technology
- Accounting; Business Studies; Economics
- Geography; History; Life Orientation; Religious Studies
- Consumer Studies; Hospitality Studies; Tourism
- Dramatic Arts; Dance Studies; Design; Music; Visual Arts
- Agricultural Sciences – subjects still to be approved are Agricultural Management Practices and Agricultural Technology
• Civil Technology; Mechanical Technology; Electrical Technology; Engineering Graphics and Design

1.1.3 FURTHER EDUCATION AND TRAINING CERTIFICATE (GENERAL)

The policy on the requirements for the Further Education and Training Certificate (General) has not yet been published. The Minister of Education will release a draft policy for public comment in May 2005. The policy will be re-worked and then gazetted in August 2005. The policy for the Further Education and Training Certificate (General) may require changes to the Assessment Sections of the Overview document and the Subject Statements.

1.1.4 SUBJECT ASSESSMENT GUIDELINES

The Department of Education will develop and distribute Subject Assessment Guidelines for each subject in the National Curriculum Statement. The Subject Assessment Guidelines will set out the minimum internal or school-based assessment requirements for each subject and the external assessment requirements. These will be distributed to schools in September 2005.

1.2 INTRODUCING THE LEARNING PROGRAMME GUIDELINES

1.2.1 PURPOSE AND CONTENT OF THE LEARNING PROGRAMME GUIDELINES

The Learning Programme Guidelines aim to assist teachers and schools in their planning for the introduction of the National Curriculum Statement. The Learning Programme Guidelines should be read in conjunction with the Overview and the Subject Statements.

Section 2 of the Learning Programme Guidelines suggests how teaching the particular subject may be informed by the principles which underpin the National Curriculum Statement.

Section 3 suggests how schools and teachers might plan for the introduction of the National Curriculum Statement. Although these are suggestions the Department of Education strongly encourages careful planning to ensure that the high skills, high knowledge goals of the National Curriculum Statement are attained.

The Learning Programme Guidelines do not include sections on assessment. The assessment requirements for each subject will be provided in the Subject Assessment Guidelines which will reach schools in September 2005.

1.2.2 WHAT IS A LEARNING PROGRAMME

INTRODUCTION

A Learning Programme assists teachers to plan for sequenced learning, teaching and assessment in Grades 10 to 12 so that all Learning Outcomes in a subject are achieved in a progressive manner. The following three phases of planning are recommended:
Phase 1 – develop a *Subject Framework* for grades 10 to 12

Phase 2 – develop a *Work Schedule* for each grade

Phase 3 – develop *Lesson Plans* to cover each classroom contact session

It is recommended that the teachers of a subject at a school or cluster of schools first put together a broad subject outline (Subject Framework) for the three grades to arrive at an understanding of the content of the subject and the progression which needs to take place across the grades (see Section 3.3.1). This will assist with the demarcation of content for each grade. Thereafter, teachers of the subject teaching the same grade need to work together and draw from the content and context identified for their grade in the Subject Framework, to develop a Work Schedule. The Work Schedule should indicate the sequence in which the content and context will be presented for the subject in that particular grade (see Section 3.3.2). Finally, individual teachers should design Lesson Plans using the grade-specific Work Schedule as the starting point. The Lesson Plans should include learning, teaching and assessment activities that reflect the Learning Outcomes and Assessment Standards set out in the Subject Statements (see Section 3.3.3). Learning Programmes should accommodate diversity in schools and classrooms but reflect the core content of a national curriculum.

The process to be followed in the development of a Learning Programme is not a neatly packaged sequence of numbered steps that follow one another in a particular order. Teachers may find themselves moving back and forth in the process as they plan and critically reflect on decisions taken before moving on to the next decision in the process. The process is therefore not strictly linear and is reflective in nature. For this reason the steps provided in this Section are a guide and can be used as a final checklist in the planning process.

An outline of the process involved in the design of a Learning Programme is provided on page 6.

**DESIGNING A LEARNING PROGRAMME**

A detailed description of the process involved in the design of a Learning Programme is provided in Sections 3.3.1 – 3.3.3 of the Learning Programme Guidelines. The first stage, the development of a Subject Framework does not require a written document but teachers are strongly advised to spend time with subject experts in developing a deep understanding of the skills, knowledge and values set out in the subject statements. The quality and rigour of this engagement will determine the teaching and learning in the classroom.

Once the Subject Framework has been completed, teachers should develop Work Schedules and Lesson Plans. Examples of Work Schedules and Lesson Plans are provided in the Learning Programme Guidelines. The Department of Education does not recommend or endorse the format of these examples. Rather teachers are encouraged to critically engage with these formats and develop their own.

- **Developing a Subject Framework (Grades 10-12)**

Planning for the teaching of subjects in Grades 10 to 12 should begin with a detailed examination of the scope of the subject as set out in the Subject Statement. No particular format or template is recommended for this first phase of planning but the steps recommended should be used as a checklist.
Although no prescribed document is required for this stage of planning, school-wide planning (timetables, requisitioning, teacher development, classroom allocation) as well as the development of grade-specific work schedules would benefit from short documents which spell out the:

- Scope of the subject – the knowledge, skills and values; the content; the contexts or themes; electives etc. to be covered in the three grades for each subject
- A three-year assessment plan for the subject
- The list of LTSM required for the subject

### Designing Work Schedules

This is the second phase in the design of a Learning Programme. In this phase teachers develop Work Schedules for each grade. The Work Schedules are informed by the planning undertaken for the Subject Framework. The Work Schedules should be carefully prepared documents that reflect what teaching and assessment will take place in the 32-36 weeks of the school year.

### Designing Lesson Plans

Each grade-specific Work Schedule must be divided into units of deliverable learning experiences, that is, Lesson Plans. A Lesson Plan adds to the level of detail for each issue addressed in the Work Schedule. It also indicates other relevant issues to be considered when teaching and assessing a subject.
FIGURE 1: RELATIONSHIP BETWEEN THE 3 STAGES OF PLANNING WHEN DEVELOPING A LEARNING PROGRAMME

ISSUES TO BE CONSIDERED

- Philosophy and Policy
- NCS Principles
- Conceptual Progression within and across grades
- Time allocation and weighting
- Integration of LOs and ASs
- LTSM
- Inclusivity and Diversity
- Assessment
- Contexts and Content
- Learning and Teaching Methodology

STAGES

- Stage 1
  - Subject Framework (Grades 10-12)
- Stage 2
  - Work Schedule Grade 10
- Stage 3
  - Lesson Plans
  - Work Schedule Grade 11
  - Lesson Plans
  - Work Schedule Grade 12
  - Lesson Plans

Increasing detail
SECTION 2
INTRODUCING MATHEMATICAL LITERACY

2.1 WHAT IS MATHEMATICAL LITERACY?

Mathematical Literacy provides learners with an awareness and understanding of the role that mathematics has in the modern world. Mathematical Literacy is a subject driven by life-related applications of mathematics. It enables learners to develop the ability and confidence to think numerically and spatially in order to interpret and critically analyse everyday situations and solve problems.

2.2 WHAT IS THE PURPOSE OF MATHEMATICAL LITERACY?

The inclusion of Mathematical Literacy as a fundamental subject in the FET curriculum will ensure that learners are highly numerate consumers of mathematics. In the teaching and learning of Mathematical Literacy learners will be provided with opportunities to engage with real life problems in different contexts and so consolidate and extend basic mathematical skills. Mathematical Literacy will thus result in the ability to understand mathematical terminology and make sense of numerical and spatial information communicated in tables, graphs, diagrams and texts. Mathematical Literacy will, furthermore, develop the use of basic mathematical skills in critically analysing situations and creatively solving everyday problems.

The FET subject, Mathematical Literacy, should enable the learner to become a self-managing person, a contributing worker and a participating citizen in a developing democracy. Mathematical Literacy will ensure a broadening of the education of the learner that is suited to the modern world, by ensuring that learners are enabled to become:

A self-managing person
In everyday life a person is continually faced with mathematical demands, which the adolescent and adult should be in a position to handle with confidence. These demands frequently relate to financial issues such as hire purchase, mortgage bonds and investments. There are however others, such as the ability to read a map, follow timetables, estimate and calculate areas and volumes, understand house plans and sewing patterns. Activities such as cooking and the use of medicine require the efficient use of ratio and proportion and are encountered on a daily basis. Here mathematical literacy is required to be a self-managing person.

A contributing worker
The workplace requires the use of fundamental numerical and spatial skills with understanding. To benefit from specialised training for the workplace, a flexible understanding of mathematical principles is often necessary. This literacy must enable the person to, for example, deal with work-related formulas, read statistical charts, deal with schedules and understand instructions involving numerical components. Such literacy will enable the person to be a contributing worker.

A participating citizen
To be a participating citizen in a developing democracy it is essential that the adolescent and adult has acquired a critical stance to mathematical arguments presented in the media and other platforms. The concerned citizen needs to be aware that statistics can often be used to support opposing arguments, say for or against the use of an ecologically sensitive stretch of land for mining purposes. In the information age the power of numbers and mathematical ways of thinking often shape policy. Unless the citizen appreciates this, the citizen will not be in a position to use the vote appropriately.
Across the world, there is evidence that many adults are not able to do any but the simplest arithmetical calculations. They struggle to calculate percentages or interpret interest rates and graphs. The implications for such lack of understanding and facility are far reaching. People are exploited by biased reporting and advertising and ill equipped to make responsible financial decisions. The pervasive presence of handheld calculators and computers makes it critical that people understand how to interpret results of calculations and that they are able to decide logically what mathematics to use. In general, the mathematics learnt in school is not transferred to other contexts.

The teaching and learning of Mathematical Literacy should thus provide opportunities to analyse problems and devise ways to work mathematically in solving them. Opportunities to engage mathematically in this way will also assist learners to become astute consumers of the mathematics reflected in the media.

In summary, Mathematical Literacy aims to develop four important abilities:

1. The ability to use basic mathematics to solve problems encountered in everyday life and in work situations.
2. The ability to understand information represented in mathematical ways.
3. The ability to engage critically with mathematically based arguments encountered in daily life.
4. The ability to communicate mathematically.

These abilities are not mutually exclusive and depend on the understanding of the logic of mathematical methods and processes and their use in modeling situations. The emphasis in learning should be on enabling learners to develop mathematical knowledge while dealing with issues, rather than on applying mathematics after "learning the basics". Mathematical Literacy should be imbedded in applications and extracted from problems in a variety of contexts.

The most noticeable change in approach to the teaching and learning of mathematics in Mathematical Literacy is the delaying of formal methods (algorithms) in favour of extended opportunities to engage with mathematics in diverse contexts. Learners will often meet problem situations in their adult lives for which there are no ready-made formulas or procedures to provide solutions.

2.3 WHAT IS THE RELATIONSHIP BETWEEN MATHEMATICAL LITERACY AND THE PRINCIPLES OF THE NATIONAL CURRICULUM STATEMENT

The Constitution of the Republic of South Africa (Act 108 of 1996) provided a basis for curriculum transformation and development in South Africa. The National Curriculum Statement Grades 10-12 (General) lays a foundation for the achievement of these goals by stipulating Learning Outcomes and Assessment Standards, and by spelling out the key principles and values that underpin the curriculum. The Mathematical Literacy curriculum supports the application of the nine NCS principles as follows:

2.3.1 Social Transformation

The prevalence of low levels of numeracy skills among the adult population due to limited and poor education in the past, requires intervention to ensure that the trend is broken. Mathematical Literacy seeks to transform this situation.
2.3.2 Outcomes-Based Education
The focus of Mathematical Literacy is on the development of skills, knowledge, attitudes and values related to the use of mathematics in authentic everyday life situations.

2.3.3 High levels of knowledge and skills for all
The subject aims to produce mathematically literate citizens who will apply their skills to improve their lives and participate effectively in a democratic society and contribute to developing the economy of the country.

2.3.4 Integration and applied competence
The applied nature of Mathematical Literacy creates ample opportunities for integration with almost every other subject, whether it is Dance, Design, Hospitality Studies, Business Management or the Natural and Life Sciences. Integrated understanding of mathematical concepts is provided for in the holistic view of the learning outcomes, as well as in the requirement that learners use existing knowledge and understanding to solve problems as a basis for further development.

2.3.5 Progression
Assessment standards for each learning outcome imply an increasingly more complex, deeper and broader understanding of knowledge, skills, attitudes and values to be achieved in each grade in the FET band. These go hand in hand with increasingly complex situations in which mathematical thinking must be applied. Such situations become more realistic and meaningful to learners as they mature through the FET years.

2.3.6 Articulation and portability
The Learning Outcomes and Assessment Standards for Mathematical Literacy have been designed to align with the Unit Standards for Mathematical Literacy at NQF levels 2, 3 and 4. This will ensure portability between the formal school sector and the colleges or other workplace related learning programmes registered on the NQF.

2.3.7 Human rights, inclusivity, environmental and socio-economic justice
The subject is designed with the aim of providing access to mathematics through contexts that interest learners and relate to their aspirations. The challenge for teachers of Mathematical Literacy will be to choose contexts that will interest female as well as male learners, and contexts that learners from different socio-economic backgrounds can access. It is expected that many learners who choose Mathematical Literacy will have a negative view of their ability to make sense of mathematics. Care should be taken to use contexts that will inspire learners to reach for opportunities to extend their general knowledge to situations different from their own, while making sense of the mathematics involved.

2.3.8 Valuing indigenous knowledge systems
FET learners from the many cultures that make up the school going population of South Africa must be made aware of the mathematics that is embedded in these cultures. The local environment of learners needs to be focused on from a mathematical perspective in order to inject into Learning Programmes activities that will capitalise on the mathematics evident, for example in local artefacts and architecture. Ethnomathematics in South Africa contributes to the growing body of knowledge in this area.

When learners are allowed to bring their existing knowledge to bear in problem solving and communicating about mathematics, indigenous knowledge systems will be accessed. Teachers must
build on ways in which African languages describe mathematical concepts. An example of the
descriptive power of indigenous languages is the isiZulu phrase “pinda-pinda” for multiplication.
There are many more examples. Contexts like the building and decoration of shelters and houses
provides opportunities for engaging with challenging and aesthetically pleasing mathematical
content.

2.3.9 Credibility, quality, efficiency and relevance

The teaching of Mathematical Literacy and the choice and the design of support materials will
determine whether the subject is relevant to learners. Parents, learners and institutions for Higher
Education will judge the credibility of the subject based on evidence from learners exiting FET.

2.4 PROFILE OF A MATHEMATICAL LITERACY LEARNER

2.4.1 Skills, Knowledge, Attitudes and Values of the Mathematical Literacy learner entering
the Further Education and Training Band

The learning achieved in Mathematics in the GET Band provides an essential base from which to
proceed into the demands of Mathematical Literacy in the FET Band. Learners exiting Grade 9 have
been exposed to Mathematics in the GET Band and will therefore possess the following knowledge
and skills relevant to Mathematical Literacy:

- Application of Mathematics to physical, social, cultural, economic and mathematical
  situations.
- Insight into dealing with mathematical and contextualised problems.
- Describe suitable situations using mathematical notation and language.

2.4.2 Interpretation of Learning Outcomes to facilitate progression from General Education
and Training to Further Education and Training

The table below shows how the learning outcomes for Mathematical Literacy build on and extend
the learning outcomes for Mathematics in GET in the RNCS.

<table>
<thead>
<tr>
<th>The Learning Outcomes for Mathematics in GET</th>
<th>The Learning Outcomes for Mathematical Literacy in FET</th>
</tr>
</thead>
<tbody>
<tr>
<td>LO 1: Numbers, operations and relationships</td>
<td>LO 1: Numbers and operations applied in context</td>
</tr>
<tr>
<td>LO 2: Patterns, Functions and Algebra</td>
<td>LO 2: Functional relationships</td>
</tr>
<tr>
<td>LO 3: Space and Shape</td>
<td>LO 3: Shape, Space and Measurement</td>
</tr>
<tr>
<td>LO 4: Measurement</td>
<td>LO 4: Data Handling</td>
</tr>
<tr>
<td>LO 5: Data Handling</td>
<td></td>
</tr>
</tbody>
</table>

The mathematical knowledge developed in GET is revisited and embedded in authentic contexts. In
this way Mathematical Literacy provides the opportunity for learners to build confidence in their
ability to address and make sense of mathematically based situations, while they strengthen and
extend existing knowledge and skills.
2.5 THE RELATIONSHIP BETWEEN MATHEMATICAL LITERACY LEARNING OUTCOMES AND THE CRITICAL AND DEVELOPMENTAL OUTCOMES

Education and Training in South Africa has 7 critical outcomes and 5 developmental outcomes, which derive from the Constitution. Each of them describes an essential characteristic of the type of South African citizen the education sector hopes to produce. These critical outcomes should therefore be reflected in the teaching approaches and methodologies that Mathematics teachers use. Both teachers and learners should be aware of and focus on these Critical and Developmental outcomes, which will be addressed through Physical Sciences teaching and learning.

The focus of each learning outcome is described in the subject statement for Mathematical Literacy.

Learning Outcome 1: Number and Operations applied in context
The learner is able to use numbers and their relationships to estimate and calculate, investigate and monitor the financial aspects of personal, business and national issues and to investigate and solve problems in other contexts.

Learning Outcome 2: Functional Relationships
The learner is able to recognise, analyse, interpret, describe and represent various functional relationships in order to solve problems in real and simulated contexts.

Learning Outcome 3: Shape, Space and Measurement
The learner is able to measure using appropriate instruments, to estimate and calculate physical quantities and to describe and represent properties of, and relationships between 2D-shapes and 3D-objects in a variety of orientations and positions.

Learning Outcome 4: Data Handling
The learner is able to collect, summarise, display and analyse data and apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions.

The Mathematical Literacy Outcomes are of central importance to the attainment of the Critical outcomes. The way in which this subject is taught must provide authentic opportunities for learners to work towards achieving the critical outcomes.

CO 1: Identify and solve problems and make decisions using critical and creative thinking
Mathematical Literacy engages with contexts and develops through solving problems and in finding applications. Learners are required to solve problems by using critical, creative and logical thinking. This means that learners can make use of their own methods based on their previous knowledge and their understanding of problem situations. When they engage with mathematics used in the media or in financial contexts like hire purchase contracts, they must pose critical questions and investigate the situation based on those questions.

CO 2: Work effectively with others as a member of a team, group, organisation and community
The Mathematical Literacy classroom forms a community where mutual understanding must be reached. Learners must get opportunities to discuss their methods for addressing issues and conclusions reached. They must assist each other by active and critical listening to make sense of the mathematics. In order to work effectively as a group, learners must give each other space to make personal sense (often individually) and refrain from forcing their opinions on others. In an effective Mathematical Literacy classroom, learners will experience that their opinions are valued.
and interrogated with respect. They will feel safe that they will not be belittled when they make mistakes and they will take shared responsibility for reaching the goal of understanding the mathematics embedded in daily life contexts.

CO 3: Organise and manage themselves and their activities responsibly and effectively
Teaching Mathematical Literacy should specifically make provision for and create opportunities where learners have scope to work on extended assignments and projects. Instructions and guidelines should be clear, but should not force lock-step execution of tasks. Allow learners to engage with problem situations where they must pose intermediate questions themselves and insist that they justify answers and methods logically.

CO 4: Collect, analyse, organise and critically evaluate information
This outcome is realised locally when learners are allowed to discuss and argue about their opinions, methods and answers. When learners actively listen to each other, they evaluate the information provided by the speaker. In a broader sense, learners must get opportunities to interrogate and analyse mathematical information contained in magazine and newspaper articles. A well-developed base of general knowledge will contribute to learners’ ability to evaluate information critically. Teachers should take trouble to make newspaper articles, radio discussions and informative television programmes part of daily sources of information.

CO 5: Communicate effectively using visual, symbolic and/or language skills in various modes
When learners are required to share their opinions and methods with their peers, they experience the need to communicate effectively. This outcome is realised when learners are allowed to model situations from their own understanding rather than from prescribed methods. They make use of drawings, symbols and descriptive language to convey their thinking.

CO 6: Use science and technology effectively and critically, showing responsibility towards the environment and the health of others
The most pervasive piece of technology in the classroom is the handheld calculator. In Mathematical Literacy learners are allowed to work with calculators. However, since they are required to communicate their mathematical thinking and to justify methods and answers, they have to reflect on what it is that they do with the calculator and why it works. Nevertheless, Teachers must guard against learners becoming dependent on calculators for the simplest of calculations.

CO 7: Demonstrate an understanding of the world as a set of related systems by recognising that problem-solving does not exist in isolation
Embedding Mathematical Literacy in application and problem-solving and insisting on the communication of mathematical processes rather than the execution of prescribed methods provide opportunities to relate mathematics to other systems. Once again, the role of general knowledge should not be underestimated.

DO 1: Reflecting on and exploring a variety of strategies to learn more effectively
Effective learning of mathematics requires an attitude of questioning and reasoning. Different mathematical content needs different approaches to learning. For example, learners need access to practical, life-related, hands-on activities to learn to measure effectively and to develop understanding of spatial aspects. They need access to information about the conventions used in mathematics, like the correct use of symbols (e.g., the use of exponents in scientific notation). Most importantly they need a wide variety of well-designed context based problems and texts to engage with in order to develop mathematical habits of mind.
**DO 2: Participating as a responsible citizen in the life of local, national and global communities**

Mathematical Literacy makes provision for engaging with authentic application of mathematical concepts. Projects that can make a difference in communities where learners live and learn should be part of the learning programme.

**DO 3: Exploring education and career opportunities**

Mathematical Literacy allows for the use of contexts from other subjects and careers that learners are interested in.

**DO 4: Developing entrepreneurial abilities**

Again, Teachers should use entrepreneurial contexts to embed mathematical literacy where possible.

### 2.6 WAYS TO ACHIEVE MATHEMATICAL LITERACY LEARNING OUTCOMES

Attempting to achieve the Learning Outcomes and Assessment Standards in the same linear sequence they are written in is often not very efficient. Once Teachers have a good understanding of the Learning Outcomes and Assessment Standards, they could combine some of these Assessment Standards into coherent and logically sequenced clusters. This will enrich the learning experiences provided to learners.

Teachers should choose meaningful contexts to embed the content gleaned from the Assessment Standards in clusters across the Learning Outcomes where possible. This means that Assessment Standards from different Learning Outcomes can and should be attained by exploring different problems in the same context whenever possible. For example, in the context of sport measurement of distances, heights and times (LO 3), calculations related to the cost of housing sports events (LO 1), calculations to optimise food provision (LO 2) and data related to attendance over time (LO 4) can be integrated to attain various Assessment Standards.

Teachers should view the learning outcomes as integrated and connected. This will allow learners to develop a more coherent view of mathematics. For example, one may start from a context which focuses on data handling (Learning Outcome 4) and look for opportunities in that context to pose questions or investigations where learners will calculate, estimate and solve problems or procedures which are described in Learning Outcome 1.

The diagram in Figure 2.1 communicates a vision of the integration of learning outcomes in teaching and learning mathematical literacy.

![Figure 2.1](image-url)
The choice of a good context allows one to start a learning sequence in one of the overlapping areas. One can then plan to “move out” to focus on a specific learning outcome and “move back” or “across” to apply extended knowledge and skills. This approach still allows one to plan and sequence teaching and learning according to the learning outcomes. It also gives teachers the freedom to use situations that are prominent in local communities and in the media. Teachers, naturally, also have the freedom to use well-designed simulated problems as context. Integrating learning outcomes also provides opportunities to revisit learning outcomes, which might have been the focus earlier in the learning programme.

The Assessment Standards describe the kind of evidence expected from learners who attained the learning outcome. They describe mathematical processes as well as knowledge and skills and must be interpreted in the light of the critical outcomes. Some examples of assessment questions that address the assessment standards will be provided. The examples are not as extensive as they could be, and teachers may help to refine and expand them during ongoing monitoring and support.
SECTION 3

DESIGNING A LEARNING PROGRAMME FOR MATHEMATICAL LITERACY

3.1 INTRODUCTION

A Learning Programme is a tool that enables teachers to plan for sequenced learning, teaching and assessment across the Further Education and Training Band (i.e. Grades 10-12) so that all three Learning Outcomes in Mathematical Literacy are achieved in a progressive manner. It is recommended that the Mathematical Literacy teachers at a school first put together a broad subject outline (i.e. Subject Framework) for the Band to place the subject in context and to arrive at an understanding of the progression which needs to take place across the grades in the Band (see Section 3.3.1). This will assist them with the demarcation of content for each grade. Thereafter, Mathematical Literacy teachers teaching the same grade need to work together and draw from the content and context identified for their grade in the Subject Framework, to develop a Work Schedule in which they indicate the sequence in which the content and context will be presented for Mathematical Literacy in that particular grade (see Section 3.3.2). Finally, the individual Mathematical Literacy teacher should design Lesson Plans using the grade-specific Work Schedule as the starting point. The Lesson Plans should include authentic learning, teaching and assessment activities that reflect real-life contexts (see Section 3.3.3). When working within the context of the National Curriculum Statement Grades 10-12 (General) and Outcomes-Based Education, Learning Programmes need to be flexible to accommodate diversity in each individual Mathematical Literacy classroom.

An outline of the process involved in the design of a Learning Programme for Mathematical Literacy is provided in the diagram below:

```
STAGE 1:
Mathematical Literacy Subject Framework (Grades 10-12)
for the **FET BAND**

STAGE 2:
Mathematical Literacy Work Schedule
per **GRADE**

STAGE 3:
Mathematical Literacy Lesson Plans
per **TEACHER**
```

The process to be followed in the development of a Learning Programme is not a neatly packaged sequence of numbered steps that follow one another in a particular order. Teachers may find themselves moving back and forth in the process as they plan and critically reflect on decisions taken before moving on to the next decision in the process. The process is therefore not strictly
linear and is very reflective in nature. For this reason the steps provided in this Section are a guide but should be used as a checklist in the planning process.

3.2 ISSUES TO ADDRESS WHEN DESIGNING A LEARNING PROGRAMME

The depth with which each issue is dealt during the development process increases as the planning process moves from one stage to the next. The issues to be addressed in the development of a Mathematical Literacy Learning Programme are presented in a tabular format to indicate the implications of each issue at each of the three stages of the development of a Learning Programme:

- Stage 1 – Subject Framework
- Stage 2 – Work Schedule
- Stage 3 – Lesson Plan

3.2.1 Policies and Principles

| STAGE 1 | While the various Policies that impact on curriculum implementation and the NCS Principles are not recorded on the planning sheets of a Learning Programme, evidence of their use will be seen in the planning product. They therefore need to be taken into account throughout the planning process from Stages 1-3.
| STAGE 2 | NCS:
| STAGE 3 | • Principles: Refer to Section 2.3 to see how Mathematical Literacy supports the application of the nine principles of the NCS
| | • Critical Outcomes & Developmental Outcomes: Refer to Section 2.5 to see how Mathematical Literacy supports the application of the Critical and Developmental Outcomes
| | Other Policies and Legislation:
| | • White Paper 6, Language in Education Policy, Religion & Education Policy, HIV/AIDS – all give indication of how to accommodate diversity and therefore have implications for LTSM and teaching methods in Mathematical Literacy
| | • White Paper 7 – gives an indication on the use of computers in the classroom and therefore has implications for LTSM and teaching methods in Mathematical Literacy

3.2.2 Conceptual Progression

| STAGE 1 | This is evident across the three grades in the Band and indicates the increasing depth of difficulty with which SKAVs are dealt across Grades 10-12. Progression across the Band can be explored by studying the Assessment Standards per Learning Outcome across the three grades.
| STAGE 2 | This is evident within a grade and indicates the increasing depth of difficulty with which SKAVs are dealt in a particular grade. There is no column for progression on the planning template, but progression is evident in how the groupings of Learning Outcomes and Assessment Standards are sequenced in the Work Schedule.
| STAGE 3 | This is evident in the individual Mathematical Literacy classroom and indicates the increasing depth of difficulty with which SKAVs are dealt across the activities and Lesson Plans. There is no column for progression on the planning template, but progression is evident in how the activities in a Lesson Plan and the separate Lesson Plans in the individual Mathematical Literacy classroom are sequenced.

3.2.3 Content and Context

| STAGE 1 | The content is identified by analysing the ASs of each LO to identify the SKAVs contained in each. Furthermore, the situation or condition in which content will be dealt with is also identified.
| STAGE 2 | The content and context need to be reviewed and refined based on the SKAVs found in the different grouping of LOs and ASs for particular grades once integration has taken place.
| STAGE 3 | The content and context are carried over from the Work Schedule. The activities written for each Lesson Plan must address the particular grouping of LOs and ASs carried over from the Work Schedule making sure to include the SKAVs contained in the grouping as the core content in the Lesson Plan.
### 3.2.4 Integration

**STAGE 1**
Integration may be considered in broad terms during discussions at this stage.

**STAGE 2**
Address the integration of LOs and ASs within the subject and with other subjects. This will require the review and refinement of the content and context discussed in Stage 1 as ASs from different LOs are grouped together in the process.

Refer to Section 2.6 for examples of integration within Mathematical Literacy and between

**STAGE 3**
The integrated groupings of LOs and ASs for each grade are carried over directly from the Work Schedule. The activities for each Lesson Plan are developed using a particular grouping of LOs and ASs to guide their development. The Lesson Plans in an individual classroom are presented in the order in which the groupings of LOs and ASs appear on the Work Schedule for that particular grade. Teachers can develop one or more activities to address the LOs and ASs in a particular grouping using different combinations of the LOs and ASs in the grouping to design an activity or use them all together as a unit. There is no policy directive on how many activities or Lesson Plans must be developed to address each grouping of LOs and ASs.

### 3.2.5 Time Allocation and Weighting

**STAGE 1**
5 hours per week is allocated to Mathematical Literacy in the NCS. Working on an estimate of 33-35 weeks being available for contact time in the school year, the time available for Mathematical Literacy is 150 hours per grade in one school year. The suggested weighting of the three LOs for Mathematical Literacy in the FET Band is approximately equal.

**STAGE 2**
The time to be spent on each grouping of LOs and ASs, once these groupings have been sequenced in the Work Schedule, is indicated by how the groupings are paced across the school year taking the weighting of the three LOs into account.

**STAGE 3**
The amount of time to be spent on a Lesson Plan or Lesson Plans per grouping of LOs and ASs is indicated by how each is paced in the Work Schedule. Use this to guide the amount of time to be spent on the different activities in a Lesson Plan.

### 3.2.6 LTSM (Resources)

LTSM refers to any materials that facilitate learning and teaching. LTSM need to be chosen judiciously because they have cost implications for the school and the learner. The Mathematical Literacy approach to teaching and learning provides scope for the use of a variety of resources. Teachers are required to go beyond the textbook. Yet, they do not necessarily need exotic specialized materials. Rather common and readily available items can be used i.e. resources available in the community to make the subject as ‘real’ as possible.

The following provide a broad indication of the criteria one needs to use when selecting and/or developing LTSM for Mathematical Literacy:

- Nine principles of the *National Curriculum Statement Grades 10-12 (General)*
- Three Learning Outcomes for Mathematical Literacy, along with their respective Assessment Standards
- Teaching, learning and assessment practices relevant to Mathematical Literacy
- Layout and/or design of LTSM

**STAGE 1**
Compile a list of general LTSM (resources) that will be useful in the teaching, learning and assessment of each Learning Outcome for each year – this assists with the requisition and availability of LTSM on management level at a school.

**STAGE 2**
Make mention of more grade-specific LTSM (resources) by using the integrated groupings of LOs and ASs to guide to what will be required to address them in the learning, teaching and assessment process.

**STAGE 3**
Identify classroom-specific resources related to the individual activities contained within a Lesson Plan. These are determined by the LOs and ASs placed within the grouping that is to be addressed in an activity. The LTSM (resources) chosen must therefore facilitate the achievement of these particular LOs and ASs in the classroom.
3.2.7 Assessment

The choice of assessment strategies is a subjective one, unique to each teacher, grade and school and dependent on the teacher’s professional judgment. It is important that the strategy chosen is appropriate for the specific Learning Outcomes being assessed and should emphasise the learners’ individual growth and development as well as group participation in dealing with tasks of analyzing, communicating with others and promoting teamwork. In order to administer effective assessment one must have a clearly defined purpose. By answering the following questions the teacher can decide what assessment activity is most appropriate:

- What concept, skill or knowledge needs to be assessed?
- What should the learners know?
- At what level should the learners be performing?
- What type of knowledge is being assessed: reasoning, memory or process?

Tasks and activities should be placed within a broad context, ranging from the personal, home, school, business, community, local and global. The criteria for assessment should be communicated to the learners.

**Observation-based assessment** requires that learner performance be assessed while the learner is actually performing a skill in the classroom as there will be no concrete product for the teacher to assess after the performance, while **performance-based assessment** relies on the availability of a product as evidence of learner performance that can be assessed by the teacher after the completion of the performance. Not all observations need culminate in a formally recorded assessment of learner performance. **Test-based assessment** focuses on assessing the presentation and application of knowledge.

The Mathematical Literacy teacher will need to develop tools such as rubrics, rating scales and checklists to assist in the collecting of evidence of learner performance. These tools need to be in place prior to the learners participating in any of the Mathematical Literacy activities which involve the assessment of learner performance.

| STAGE 1 | Indicate the proposed three-year assessment plan and make sure to differentiate across the 3 grades – this also assists in pointing out progression across the Band. |
| STAGE 2 | Provide a more grade-specific indication of the forms of assessment for the particular grade by using the grouping of LOs and ASs arrived at, as a guide to what form of assessment will be best suited to address them. The form of assessment chosen must facilitate the achievement of the particular LOs and ASs in the grouping. |
| STAGE 3 | Indicate more classroom-specific assessment strategies, by mentioning the methods, forms and tools that will be used to assess learner performance in each separate activity. HINT: Not all activities need to be assessed – some may just be introductory in nature or for enrichment. The choice of an assessment strategy is determined by the LOs and ASs that have been grouped together for a particular Lesson Plan. The assessment strategy chosen must facilitate the achievement of these particular LOs and ASs in the classroom. |

3.2.8 Inclusivity and Diversity

The following steps can be taken to effectively address diversity in the classroom when planning activities:

- consider individual past experiences, learning styles and preferences;
- develop questions and activities that are aimed at different levels of ability;
- modify expectations for some learners including adapted outcomes;
- provide opportunity for a variety of participation levels such as individual, pairs and small group activities;
• give learners choices in determining what methods they use for gathering, synthesising information and in demonstrating their understanding of a concept or performance of a skill or a task;
• accept that the individual methods are of value; and
• assess learners based on individual progress and outcomes.

<table>
<thead>
<tr>
<th>STAGE 1</th>
<th>STAGE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>This will be evident in the identification of content, context, forms of assessment and LTSM (Resources). Diversity needs to be accommodated in the following areas:</td>
<td></td>
</tr>
<tr>
<td>• Learning styles: provide optional activities / different ways of doing same activity</td>
<td></td>
</tr>
<tr>
<td>• Pace of learning: provide for both slower and faster learners by providing optional extra activities, reading or research, as well as multiple assessment opportunities</td>
<td></td>
</tr>
<tr>
<td>• Differences in levels of achievement: provide optional extra activities, challenges and materials that cater for these differences between learners.</td>
<td></td>
</tr>
<tr>
<td>• Language diversity: the LoLT used should not place learners at a disadvantage - consider the use of a variety of assessment strategies and strategies such as code switching</td>
<td></td>
</tr>
<tr>
<td>• Gender diversity: ensure that teachers do not inadvertently allow or contribute towards discrimination against boys or girls in the classroom on the basis of gender.</td>
<td></td>
</tr>
<tr>
<td>• Cultural diversity: recognise, celebrate and be sensitive to this when choosing content with which to address LOs and ASs related to culture.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STAGE 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>This is catered for as EXPANDED OPPORTUNITIES in the Lesson Plan. Enrichment is provided for gifted learners and remediation or other relevant opportunities for learners requiring additional support. It is not necessary to develop an activity to cater for each type of diversity which arises in the classroom – teachers may find it possible to cater for different diversities within one activity with effective planning. There are however exceptions that may need to be catered for individually.</td>
</tr>
</tbody>
</table>

### 3.2.9 Learning and Teaching Methodology

<table>
<thead>
<tr>
<th>STAGE 1</th>
<th>STAGE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is not necessary to record Teaching Methods for either of these stages.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STAGE 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>This is catered for as TEACHING METHOD in the Lesson Plan. It provides an indication of how teaching and learning will take place in each activity – i.e. how each activity will be presented in the classroom.</td>
</tr>
</tbody>
</table>

### 3.3 DESIGNING A LEARNING PROGRAMME

A detailed description of the process involved in the design of a Learning Programme for Mathematical Literacy is provided in this section (see Sections 3.3.1 – 3.3.3). The process presented here is a suggestion of how to go about designing a Learning Programme. The steps are numbered to allow for easy cross-referencing between the different stages.

#### 3.3.1 Subject Framework (Grades 10-12) for Mathematical Literacy

Planning for the teaching of Mathematical Literacy in Grades 10 to 12 should begin with a detailed examination of the scope of the subject as set out in the Subject Statement. No particular format or template is recommended for this first phase of planning but the five steps below should be used as a checklist.

Although no prescribed document is required for this stage of planning, school-wide planning (timetables, ordering, teacher development, classroom allocation) as well as the development of grade-specific work schedules would benefit from short documents which spell out the:

- Scope of the subject – the knowledge, skills and values; the content; the contexts or themes; electives etc. to be covered in the three grades
- A three-year assessment plan
- The list of LTSM required
1 Clarify the Learning Outcomes and Assessment Standards.

The essential question for Mathematical Literacy is: What Learning Outcomes do learners have to master by the end of the Further Education and Training Band and what Assessment Standards should they achieve to show that they are on their way to mastering these outcomes?

All learning, teaching and assessment opportunities must be designed down from what learners should know, do and produce by the end of the Further Education and Training Band. The Learning Outcomes and Assessment Standards that learners should master by the end of Grade 12 are specified in the Mathematical Literacy Subject Statement.

2 Study the conceptual progression across the three grades.

Look at the verbs, adjectives and concepts listed in each of the Assessment Standards for Mathematical Literacy across the three grades. Progression should be clearly evident across the Band.

3 Identify the content to be taught.

Analyse the Assessment Standards of each Learning Outcome to identify the skills, knowledge, attitudes and values to be addressed in each grade. Also consider the content and context in which they will be taught.

4 Identify three-year plan of assessment.

Consider what forms of assessment will be best suited to each of the Learning Outcomes and Assessment Standards and list these for the three grades. This ensures that assessment remains an integral part of the learning and teaching process in Mathematical Literacy and that learners participate in a range of assessment activities.

5 Identify possible LTSM (resources).

Consider which LTSM will be best suited to the learning, teaching and assessment of Mathematical Literacy in Grades10-12 using the skills, knowledge, attitudes and values as guidance and list these per grade.

3.3.2 Designing Work Schedules for Mathematical Literacy

This is the second phase in the design of a Learning Programme. In this phase teachers develop Work Schedules for each grade. The Work Schedules are informed by the planning undertaken for the Subject Framework. The Work Schedules should be carefully prepared documents that reflect what teaching and assessment will take place in the 30-33 weeks of the school year. The following steps provide guidelines on how to approach the design of a Work Schedule per grade for Mathematical Literacy:
1 Package the content.

Study the Learning Outcomes and Assessment Standards prescribed for the particular grade in Mathematical Literacy and group these according to natural and authentic links. Revisit the content and context discussed in the Subject Framework for the particular grade, and refine it according to the skills, knowledge, attitudes and values that appear in each grouping of Learning Outcomes and Assessment Standards.

2 Sequence the content.

Determine the order in which the groupings of Learning Outcomes and Assessment Standards as arrived at in Step 1 will be presented in the particular grade in Mathematical Literacy. Besides the conceptual progression in the Assessment Standards for Mathematical Literacy, context can also be used to sequence the groupings in Mathematical Literacy.

3 Pace the content.

Determine how much time in the school year will be spent on each grouping of Learning Outcomes and Assessment Standards as arrived at in Step 1 in the particular grade.

4 Review forms of assessment.

Revisit the forms of assessment discussed for the particular grade in the Subject Framework, and refine them to address the skills, knowledge, attitudes and values of each grouping of Learning Outcomes and Assessment Standards as arrived at in Step 1.

5 Review LTSM.

Revisit the LTSM (resources) discussed for the particular grade in the Subject Framework, and refine them to address the skills, knowledge, attitudes and values of each grouping of Learning Outcomes and Assessment Standards as arrived at in Step 1.
An example of a possible Work Schedule for Mathematical Literacy (first four weeks only)

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Context</th>
<th>Lesson focus, activities and resources</th>
<th>Learning Outcome(s)</th>
<th>Assessment Standard(s) (bold text is used to highlight the areas addressed by the lesson)</th>
<th>Assessment Task</th>
</tr>
</thead>
</table>
| 1 & 2 | Understanding your water account | Supply learners with water consumption tariffs for two different municipalities and let them:  
- Calculate the cost of water for a range of consumption levels in each of the municipalities (LO1)  
- Draw graphs for the different municipalities on the same graph paper and determine which municipality is more economical for different consumption levels. (LO2)  
- Relate the answers determined by calculation to the answers read of the graph. (LO1 & LO2) | LO1: Numbers and Operations in Context (The learner is able to use knowledge of numbers and their relationships to investigate a range of different contexts which include financial aspects of personal, business and national issues.);  
LO2: Functional Relationships (The learner is able to recognise, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts.); | 10.1.1 Solve problems in various contexts, including financial contexts, by estimating and calculating accurately using mental, written and calculator methods where appropriate, inclusive of:  
- working with simple formulae (e.g. A = P(1+i)n);  
- using the relationships between arithmetical operations (including the commutative, distributive and associative laws) to simplify calculations where possible;  
- working with positive exponents and roots.  
10.1.2 Relate calculated answers correctly and appropriately to the problem situation by:  
- interpreting fractional parts of answers in terms of the context;  
- reworking a problem if the first answer is not sensible, or if the initial conditions change;  
- interpreting calculated answers logically in relation to the problem and communicating processes and results. | Assignment |
| 2 & 3 | Understanding your water account | Have learners measure the amount of water different typical daily activities use using appropriate measuring instruments  
- Combine data for the class discussing why different people got different values for similar activities (LO3)  
Have learners keep a water use diary for their home recoding how many of each typical daily activity occurs for each day of a week.  
- Summarise class data by means of appropriate data graphs (LO4) | LO3: Space, Shape and Measurement (The learner is able to measure using appropriate instruments, to estimate and calculate physical quantities, and to interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions.); | 10.2.1 Work with numerical data and formulae in a variety of real-life situations, in order to establish relationships between variables by:  
- finding the dependent variable;  
- finding the independent variable;  
- describing the rate of change.  
10.2.2 Draw graphs in a variety of real-life situations by:  
- point-by-point plotting of data;  
- working with formulae to establish points to plot;  
- using graphing software where available. | Investigation |
| 4 | | Consolidate the mathematical knowledge and skills that the activities have addressed. Namely:  
- Calculating values based on information/formulae provided in tables  
- Drawing algebraic graphs based in values calculated  
- Measuring using a measuring instrument  
- Recording values  
- Converting between metric units (ml to l)  
- Summarising data and drawing data graphs | LO4: Data Handling (The learner is able to collect, summarise, display and analyse data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions.) | 10.3.1 Solve problems in 2-dimensional and 3-dimensional contexts by:  
- estimating, measuring and calculating values which involve:  
  - lengths and distances,  
  - perimeters and areas of common polygons and circles,  
  - volumes of right prisms,  
  - angle sizes (0°-360°);  
- checking values for solutions against the contexts in terms of suitability and degree of accuracy.  
10.4.1 Investigate situations in own life by:  
- formulating questions on issues such as those related to:  
  - social, environmental and political factors,  
  - people’s opinions,  
  - human rights and inclusivity;  
- collecting or finding data by appropriate methods (e.g. interviews, questionnaires, the use of data bases) suited to the purpose of drawing conclusions to the questions.  
10.4.2 Select, justify and use a variety of methods to summarise and display data in statistical charts and graphs inclusive of:  
- tallies;  
- tables;  
- pie charts;  
- histograms (first grouping the data);  
- single bar and compound bar graphs;  
- line and broken-line graphs. | Assignment |

LEARNING PROGRAMME GUIDELINES: MATHEMATICAL LITERACY – 29 APRIL 2005
3.3.3 Designing Lesson Plans for Mathematical Literacy

Each grade-specific Work Schedule for Mathematical Literacy must be divided into units of deliverable learning experiences, i.e. Lesson Plans. A Lesson Plan adds to the level of detail for each issue addressed in the Work Schedule. It also indicates other relevant issues to be considered when teaching and assessing Mathematical Literacy. The following steps provide guidelines on how to design Lesson Plans for Mathematical Literacy:

1. **Indicate the content, context, Learning Outcomes and Assessment Standards.**
   Copy this information from the Work Schedule for the particular grade.

2. **Develop activities and select teaching method.**
   Decide how to teach the Learning Outcomes and Assessment Standards indicated in Step 1 and develop the activity or activities that will facilitate the development of the skills, knowledge, attitudes and values in the particular grouping. Thereafter, determine the most suitable teaching method(s) for the activities and provide a description of how the learners will engage in each activity.

3. **Consider diversity.**
   Explore the various options available within each activity that will allow expanded opportunities to those learners that require individual support. The support provided must ultimately guide learners to develop the skills, knowledge, attitudes and values indicated in the grouping of Learning Outcomes and Assessment Standards being addressed in the individual activities.

4. **Review assessment and LTSM (resources).**
   Indicate the details of the assessment strategy and LTSM to be used in each activity.

5. **Allocate time.**
   Give an indication of how much time will be spent on each activity in the Lesson Plan using the grouping of Learning Outcomes and Assessment Standards as a guide.

When designing learning, teaching and assessment activities for Mathematical Literacy, teachers have to understand the link between the Learning Outcomes in the Revised National Curriculum Statement Grades R – 9 (Schools) and the Learning Outcomes in the Further Education and Training Band. See Section 2.4 for an indication of this link. Grade 10 teachers in particular have to familiarise themselves with the skills, knowledge, values and attitudes covered in GET to build on prior learning.

3.3.4 Reflection and review of the Mathematical Literacy Learning Programme

After the Learning Programme has been delivered by means of Lesson Plans in the classroom, the teacher must reflect on what worked, how well it worked and what could be improved. Teachers need to note these things while the experience is still fresh in their minds, so that if necessary, they can adapt and change the relevant part of the Mathematical Literacy Learning Programme for future implementation. It is advisable to record this reflection on the Lesson Plan planning sheets.