Chapter 3 Curriculum Planning

This chapter provides guidelines to help schools and teachers to develop a flexible and balanced curriculum that suits the needs, interests and abilities of their students, and the context of their school, in accordance with the central framework provided in Chapter 2.

3.1 Guiding Principles

The Mathematics Curriculum (S4 – 6) allows flexibility for adaptation to cope better with the varied needs of students. To provide a rich variety of experiences and a balanced repertoire of mathematical knowledge and skills, a coherent school-based curriculum emphasising the active role of students in the learning process should be developed.

In planning their school-based mathematics curricula, schools and teachers are encouraged to consider:

(a) The cognitive development of students

In Mathematics, there are many abstract concepts that are not always easy to understand and handle. Teachers should be aware of the cognitive development of students in planning progression across year levels and the arrangement of learning units within year levels. In the learning and teaching of the curriculum, teachers should use as many examples and illustrations as possible to help students grasp the mathematical concepts.

(b) Students' prior knowledge, abilities and inclinations

The learning and teaching of the Mathematics Curriculum (S4 – 6) should be built upon the prior knowledge of students gained from the school-based mathematics curriculum at the junior secondary level. Before the introduction of a new concept, teachers should find out whether students have acquired sufficient prerequisite knowledge. The school-based mathematics curriculum should address both the needs of average students and of those at both ends of the ability scale. Attention should not be focused only on academically lower achievers nor on those who perform better. Opportunities to learn should be maximised for all students.

(c) Post-secondary pathways of students

As mathematics provides the necessary language and tools for deeper understanding and study of concepts and applications in many disciplines, curriculum planning should be suited to the needs of students with different choices of elective subjects and diverse post-secondary pathways.

(d) Coherence of the curriculum

In planning the curriculum, it is important to establish coherence among the topics in the Compulsory Part and across the Compulsory Part and the modules. Essential skills and prerequisite knowledge should be covered in the Compulsory Part before the learning and teaching of particular topics in the modules.

(e) Pedagogical strategies

The curriculum should be able to help students develop a capacity for self-directed, lifelong learning. Elements of independent learning and generic skills should be embedded in relevant learning activities, and the learning and teaching activities should be suitably contextualised to promote effective learning. There should be a flexible integration of mathematical knowledge and skills in the learning and teaching of different learning units, such as 'Inquiry and Investigation'.

(f) Use of information technology

The widespread availability of computers and calculators should be taken into account when designing learning and teaching activities in mathematics. Schools should make full use of the advantages of using information technology to assist students in understanding, visualising and exploring mathematical knowledge and skills.

(g) Assessment for learning

Assessment is more than an end-of-unit test. It informs students and teachers about what students understand and can do. Ongoing assessment is highly recommended to provide students with relevant feedback to enable them to improve their future performance. Schools and teachers are encouraged to review and plan the curriculum flexibly and make appropriate re-adjustments when necessary, taking into account the SBA implementation arrangements for the subject as specified in Chapter 5 – Assessment.

(h) Flexible time-tabling

The Mathematics Curriculum (S4 – 6) allows flexibility (e.g. Compulsory Part and Extended Part, Foundation Topics and Non-Foundation Topics) for planning a school-based mathematics curriculum. Schools are encouraged to make use of this flexibility in time-tabling.

3.2 Curriculum Planning Strategies

3.2.1 School-based Curriculum Planning

Schools and teachers are encouraged to adapt the central mathematics curriculum and develop their own school-based curricula, taking into consideration the needs, abilities and interests of their students and their school contexts, through varying:

- content, contexts and examples;
- learning and teaching strategies;
- pace of learning and teaching; and
- modes of assessment.

In designing school-based mathematics curricula, schools are encouraged to:

(a) set and work on clear and manageable aims and targets taking into account the school contexts and the overall aims of the Mathematics Curriculum (S4 – 6);
(b) allow students to select modules in the Extended Part and group students into different classes if possible;
(c) adapt the depth of treatment of the learning objectives and the logical coordination of the learning contents;
(d) allow suitable and flexible lesson time for different groups of students for the Compulsory Part and the modules across year levels;
(e) choose and adapt appropriate textbooks and other learning resources;
(f) set and work on learning activities to be carried out in the school year; and
(g) set and work on the methods and modes of assessment to enhance assessment for learning.

3.2.2 Cross-curricular Links

The Mathematics Curriculum (S4 – 6) provides students with a foundation for understanding concepts and carrying out investigations, with a tool for making inferences and analysing data, and with a language for presenting findings and constructing models.

The following table presents some examples of the kinds of tasks or activities that students should be encouraged to make connections with other Key Learning Areas:

Key Learning Area	***Examples of Activities***
Chinese Language Education	• Compare and discuss the development of mathematics in Chinese culture • Explore and discuss the application of mathematics in ancient China • Appreciate the development of mathematics in China and Chinese mathematicians' contribution to mathematics • Investigate the history of Pi • Discuss the uses and abuses of mathematics in discourse • Invoke logical reasoning in discourse • Study the biographies of mathematicians
English Language Education	• Compare and discuss the development of mathematics in Western culture • Explore and discuss the application of mathematics in ancient Greece and Egypt • Appreciate the development of mathematics in Europe • Discuss the uses and abuses of mathematics in discourse • Invoke logical reasoning in discourse • Study the biographies of mathematicians
Personal, Social and Humanities Education	• Explore strategies to solve simple financial problems • Apply mathematics to finance, business, accounting and economics • Discuss the uses and abuses of mathematics in different social contexts • Invoke logical reasoning in discourse

Key Learning Area	*Examples of Activities*
Science Education	• Make use of the knowledge of vectors and calculus to solve problems in Physics • Construct mathematical models by making use of information from Chemistry • Use the necessary analytical tools in the process of investigation
Technology Education	• Use the necessary mathematical tools to explore, investigate and communicate in the study of modern technology • Use geometrical knowledge in 2-dimensional and 3-dimensional space to explore the methods of product modelling • Use the necessary mathematical tools in the workplace and in support of the subjects in Applied Learning
Arts Education	• Appreciate visual arts from a geometrical perspective • Appreciate the application of mathematics in music, e.g. the harmonic sequence and harmony
Physical Education	• Engage in learning tasks or activities that examine the pros and cons of various health and physical activities • Interpret graphs related to situations encountered in human body and movement analysis

In view of the broad cross-curricular links with other disciplines, Mathematics teachers should collaborate with teachers of other Key Learning Areas to set achievable goals, draw up schedules of work, and design learning and teaching activities, so that students can apply their mathematics knowledge in different contexts.

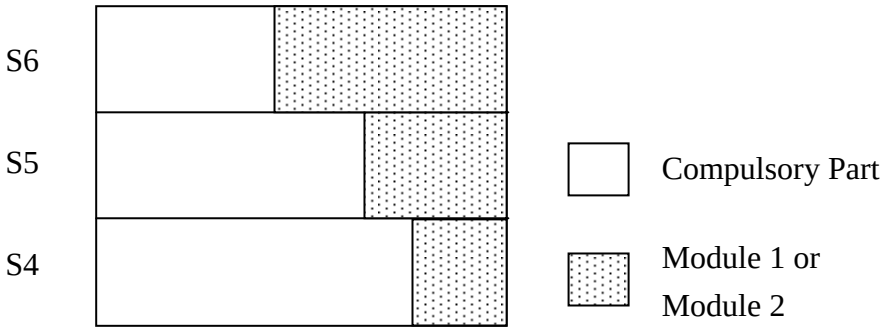
For students taking an Applied Learning course as an elective subject, Mathematics teachers are encouraged to incorporate more contextualised examples related to the Applied Learning course to assist students in the elective subject. This, in turn, will benefit the learning and teaching of Mathematics, as these students will have opportunities to apply mathematical knowledge in related Applied Learning contexts.

3.3 Progression

In implementing the Mathematics Curriculum (S4 – 6), schools do not have to spread the allocated lesson time uniformly over the three years. They may arrange the lesson time flexibly according to the needs of different classes.

Flexible time allocation

For classes taking the Compulsory Part with one module, schools may start the learning and teaching of the Compulsory Part and the module at the same time in S4. However, if teachers find it inappropriate for their students to start the module at the beginning of S4, they may consider making use of most of the allocated lesson time for Mathematics in S4 to teach the Compulsory Part first until students are more mathematically mature and are equipped with enough mathematical concepts and knowledge for the learning of the module. The figure below illustrates a possible progression pathway.



Studying mathematics-related elective subjects and Applied Learning courses

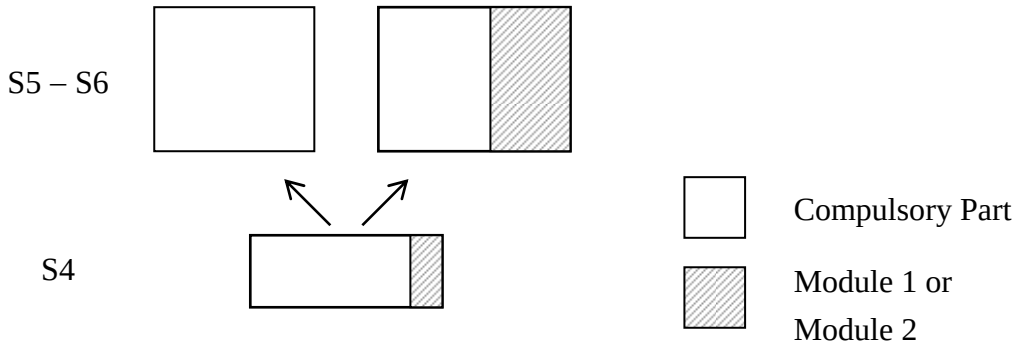
For students taking elective subjects or courses in Applied Learning which require a foundation knowledge of Mathematics, teachers may allocate more lesson time in S4 and relatively less lesson time in S5 and S6 on Mathematics to facilitate the learning and teaching of the elective subjects or the Applied Learning courses concerned.

Change of module at S5

Some students in S5 may wish to change the module they selected in S4 (from Module 2 to Module 1 or vice versa) or to study a module they did not intend to choose at the beginning. To allow for this flexibility, teachers may focus more on the Compulsory Part in S4. In this way, students who did not select the module at the start need not spend too much time and effort in catching up on the areas of the module which have not been covered. Even for those students who decide to drop the module in S5, the influence on their studies will be minimum.

A "Taster" of a module in S4

Some students may be interested in studying a module along with the Compulsory Part. However, they might like to get some ideas of what it is like first in S4 before they decide whether or not to take it. For such cases, a small portion of the lesson time may be allocated to the study of a module in S4. In S5, some students may drop the module while others may continue to study it. Alternatively, in S5, some students may even change from studying one module to the other. The figure below illustrates a possible progression pathway.



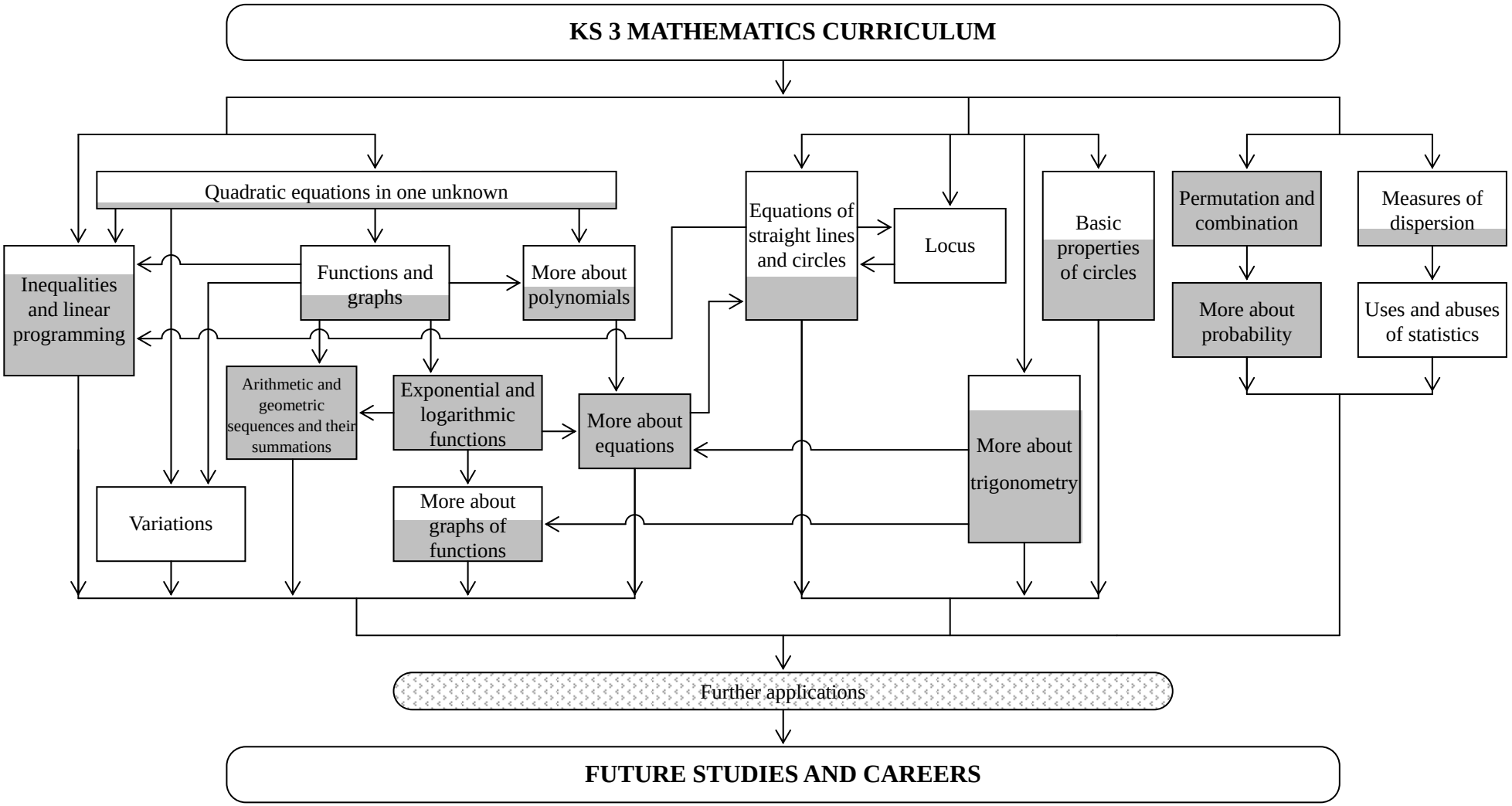
Sequence of learning and teaching

In planning the school-based mathematics curriculum, teachers can refer to the learning targets and the learning objectives of the Compulsory Part, Module 1 and Module 2. It should be noted that the ordering of the targets and objectives in Chapter 2 does not represent a prescribed sequence of learning and teaching. Teachers may arrange the learning content in any logical sequence which takes account of the needs of their students.

It should be noted also that there are many ways of sequencing the learning units. Mathematical knowledge is interrelated both within and across strands or areas. Teachers should exercise their professional judgment in arranging the sequence of learning units, paying special attention to the prerequisite knowledge required.

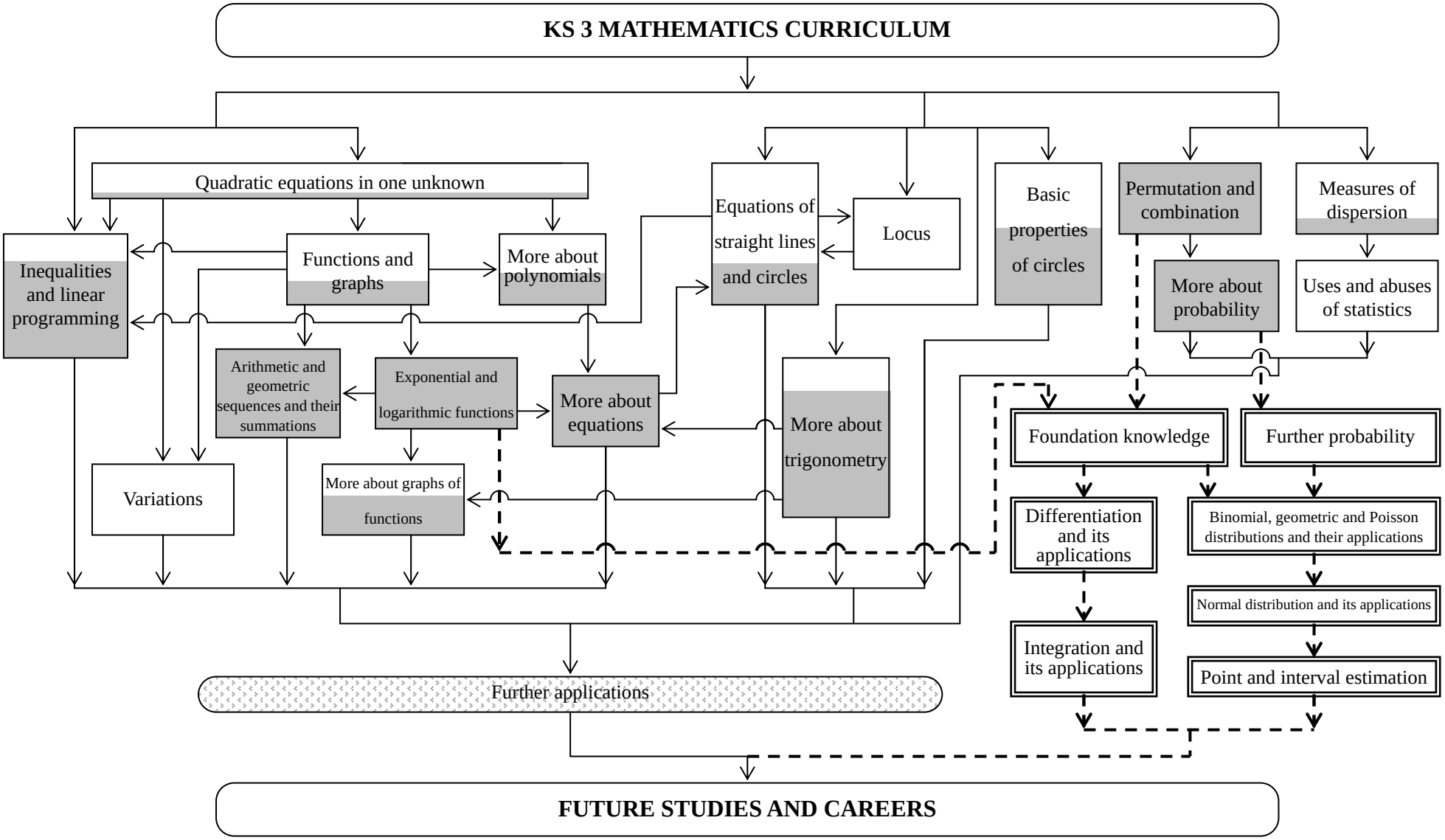
Flow charts are provided on the following pages to show possible progression pathways for the learning units in the Compulsory Part, Module 1 and Module 2. Strong links between learning units are shown, but these are merely illustrative, as it is not feasible to illustrate all links in the flow charts. The flow charts are included for teachers' consideration in curriculum planning.

Flow Chart : Compulsory Part



represents Non-foundation Topics.

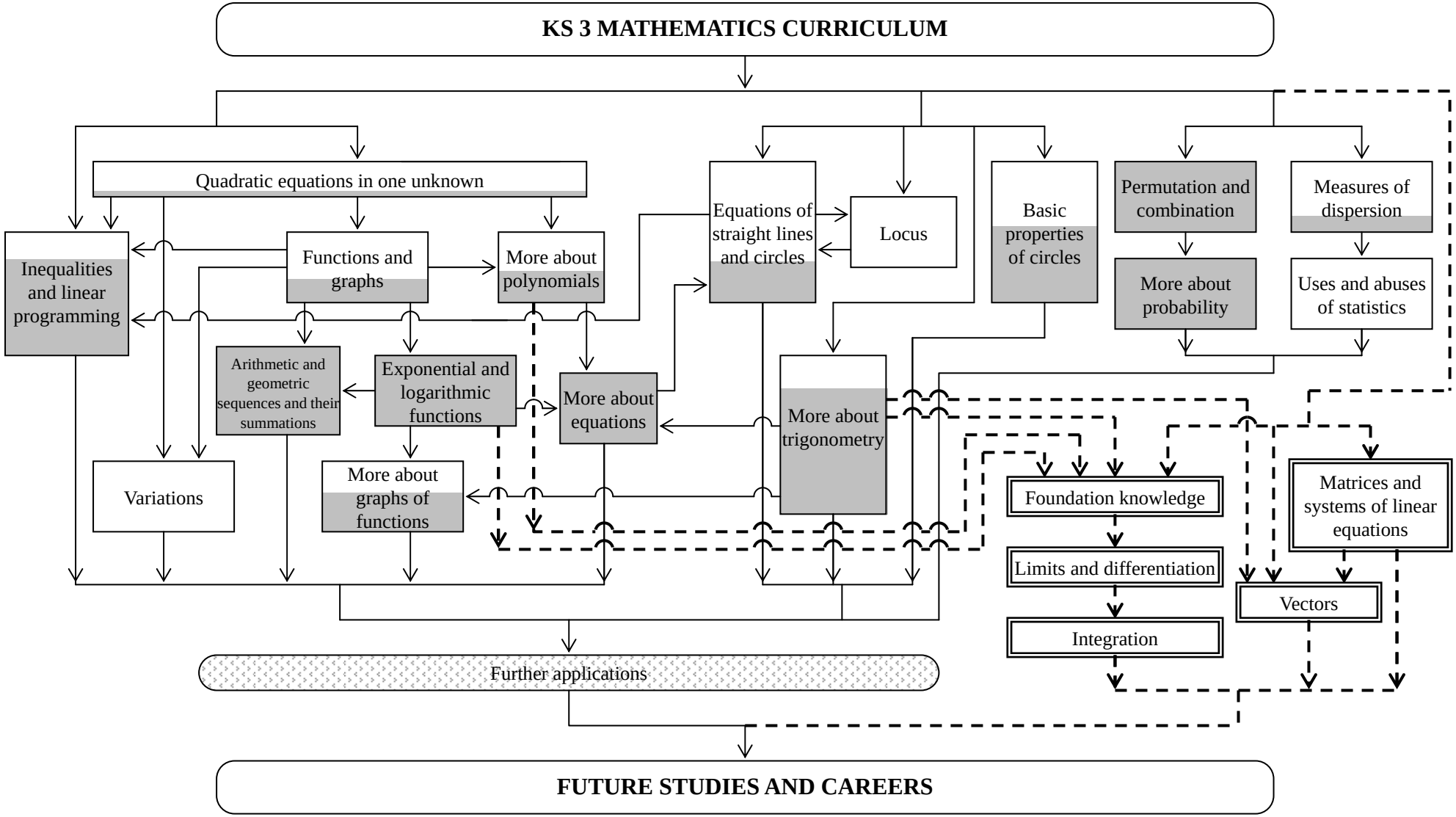
Flow Chart : Compulsory Part with Module 1 (Calculus and Statistics)



represents Non-foundation Topics.

represents learning units in Module 1.

Flow Chart : Compulsory Part with Module 2 (Algebra and Calculus)



represents Non-foundation Topics.

represents learning units in Module 2.

3.4 Curriculum Management

In managing the mathematics curriculum, curriculum leaders in schools are expected to:

- formulate well-defined policies for their Mathematics panel, including learning and teaching strategies, assessment and the development of school-based mathematics curricula, and to establish effective practices for the implementation of the agreed policies;
- disseminate relevant information to Mathematics teachers and discuss matters relevant to both administration and Mathematics teaching, such as policies and guidelines, the selection of textbooks, the procurement of teaching aids and reference books, and likely teaching difficulties;
- familiarise Mathematics teachers with the Mathematics Curriculum (S1 – 6) and recent development in mathematics teaching;
- promote and create the time for teachers' professional development;
- encourage collaboration and maintain effective communication between teachers of Mathematics and other Key Learning Areas, so that Mathematics teachers are well aware of the developments in other Key Learning Areas;
- encourage the development of a learning culture and a learning community, including face to face communication, electronic networks and experience-sharing with other schools; and
- encourage assessment for learning and the use of evidence to adjust teaching methodologies and the curriculum.

In the planning, development and management of the school-based mathematics curriculum, the school head, panel chairperson and Mathematics teachers must work together taking up their various roles as change agents committed to helping students learn how to learn.

(a) School Heads

School heads are key players in directing and supporting school-based mathematics curriculum development. They should understand the direction of the central curriculum and be sensitive to contextual factors such as the needs of the students, the strengths of their Mathematics panels and the culture of their schools. They have to establish school curriculum development policies and plans, coordinate the teaching of

all subjects, and take effective measures to improve student learning in their schools. School heads should also:

- provide support for trying out new initiatives in the learning, teaching and assessment of Mathematics at the senior secondary level;
- create a supportive environment in the school, so that students have ample opportunities to think critically and creatively, to conceptualise, inquire and reason, and to use mathematics to formulate and solve problems in daily life;
- provide flexibility in the deployment of teachers and time-tabling;
- provide students with flexibility in the study and choice of modules in the Extended Part and in the grouping of students;
- help parents to understand the school's vision, rationale and practices in implementing the Mathematics Curriculum (S4 – 6); and
- encourage networking with other schools on a face to face and electronic basis to promote exchange of professional information and the sharing of good practices.

(b) Mathematics Panel Chairpersons

Mathematics panel chairpersons help to lead, plan and monitor the school-based mathematics curricula. They are the "bridge" between the school administrative personnel and Mathematics panel members. A panel chairperson has both administrative and teaching roles. He/she is the coordinator of the subject and has to be fully aware of the needs of the teachers and their students in learning and teaching mathematics. To implement the school-based senior secondary mathematics curricula, Mathematics panel chairpersons should:

- set up well-defined goals for the learning, teaching and assessment of senior secondary Mathematics;
- ensure a smooth articulation between the school-based mathematics curricula at the junior secondary and senior secondary levels;
- formulate well-defined policies and establish effective practices for the implementation of the agreed policies;
- hold regular panel meetings to discuss matters such as schemes of work, assessment policies, teaching problems which have arisen, and the selection of textbooks;
- keep abreast of the latest curriculum development and assist Mathematics teachers to implement effective learning and teaching strategies;
- enhance the effectiveness of classroom teaching by organising experience-sharing, lesson observations or collaborative lesson preparation, etc;

- monitor the quality of student learning by gathering feedback from assessment; and
- keep all documents related to the learning, teaching and assessment of senior secondary Mathematics.

(c) Mathematics Teachers

Mathematics teachers can contribute to the development of a school-based mathematics curriculum both as individuals and in collaboration with other Mathematics teachers. They may also initiate innovative curricular changes to enable students to cope confidently with the mathematics needed in future studies, the workplace and daily life. Mathematics teachers should:

- develop in students generic skills, positive attitudes and an interest in mathematics learning;
- keep abreast of the latest curriculum development;
- take initiatives in trying out innovative learning and teaching strategies and assessment strategies;
- initiate the sharing of teaching ideas, knowledge and experience to foster peer support and improvement in mathematics learning/teaching and assessment; and
- participate in professional development courses, workshops, seminars, etc. to enhance their professionalism.