KEMENTERIAN PENDIDIKAN MALAYSIA

KURIKULUM STANDARD SEKOLAH MENENGAH

Matematik

Dokumen Standard Kurikulum dan Pentaksiran

Tingkatan 3

(EDISI BAHASA INGGERIS)

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Bahagian Pembangunan Kurikulum

APRIL 2017

Terbitan 2017

CONTENT

RUKUN NEGARA

BAHAWASANYA Negara kita Malaysia mendukung cita-cita hendak:
Mencapai perpaduan yang lebih erat dalam kalangan seluruh masyarakatnya;
Memelihara satu cara hidup demokratik;
Mencipta satu masyarakat yang adil di mana kemakmuran negara
akan dapat dinikmati bersama secara adil dan saksama;
Menjamin satu cara yang liberal terhadap tradisi-tradisi
kebudayaannya yang kaya dan berbagai corak;
Membina satu masyarakat progresif yang akan menggunakan
sains dan teknologi moden;

MAKA KAMI, rakyat Malaysia, berikrar akan menumpukan seluruh tenaga dan usaha kami untuk mencapai cita-cita tersebut berdasarkan prinsip-prinsip yang berikut:

KEPERCAYAAN KEPADA TUHAN
KESETIAAN KEPADA RAJA DAN NEGARA
KELUHURAN PERLEMBAGAAN
KEDAULATAN UNDANG-UNDANG
KESOPANAN DAN KESUSILAAN

FALSAFAH PENDIDIKAN KEBANGSAAN

“Pendidikan di Malaysia adalah suatu usaha berterusan ke arah lebih memperkembangkan potensi individu secara menyeluruh dan bersepadu untuk melahirkan insan yang seimbang dan harmonis dari segi intelek, rohani, emosi dan jasmani, berdasarkan kepercayaan dan kepatuhan kepada Tuhan. Usaha ini adalah bertujuan untuk melahirkan warganegara Malaysia yang berilmu pengetahuan, berketerampilan, berakhlak mulia, bertanggungjawab dan berkeupayaan mencapai kesejahteraan diri serta memberikan sumbangan terhadap keharmonian dan kemakmuran keluarga, masyarakat dan negara”

Sumber: Akta Pendidikan 1996 (Akta 550)

DEFINISI KURIKULUM KEBANGSAAN

3. Kurikulum Kebangsaan

(1) Kurikulum Kebangsaan ialah suatu program pendidikan yang termasuk kurikulum dan kegiatan kokurikulum yang merangkumi semua pengetahuan, kemahiran, norma, nilai, unsur kebudayaan dan kepercayaan untuk membantu perkembangan seseorang murid dengan sepenuhnya dari segi jasmani, rohani, mental dan emosi serta untuk menanam dan mempertingkatkan nilai moral yang diingini dan untuk menyampaikan pengetahuan.

Sumber: Peraturan-Peraturan Pendidikan (Kurikulum Kebangsaan) 1997
[PU(A)531/97.]

KATA PENGANTAR

Kurikulum Standard Sekolah Menengah (KSSM) yang dilaksanakan secara berperingkat mulai tahun 2017 akan menggantikan Kurikulum Bersepadu Sekolah Menengah (KBSM) yang mula dilaksanakan pada tahun 1989. KSSM digubal bagi memenuhi keperluan dasar baharu di bawah Pelan Pembangunan Pendidikan Malaysia (PPPM) 2013-2025 agar kualiti kurikulum yang dilaksanakan di sekolah menengah setanding dengan standard antarabangsa. Kurikulum berasaskan standard yang menjadi amalan antarabangsa telah dijelmakan dalam KSSM menerusi penggubalan Dokumen Standard Kurikulum dan Pentaksiran (DSKP) untuk semua mata pelajaran yang mengandungi Standard Kandungan, Standard Pembelajaran dan Standard Prestasi.

Usaha memasukkan standard pentaksiran di dalam dokumen kurikulum telah mengubah landskap sejarah sejak Kurikulum Kebangsaan dilaksanakan di bawah Sistem Pendidikan Kebangsaan. Menerusinya murid dapat ditaksir secara berterusan untuk mengenal pasti tahap penguasaannya dalam sesuatu mata pelajaran, serta membolehkan guru membuat tindakan susulan bagi mempertingkatkan pencapaian murid.

DSKP yang dihasilkan juga telah menyepadukan enam tunjang Kerangka KSSM, mengintegrasikan pengetahuan, kemahiran dan nilai, serta memasukkan secara eksplisit Kemahiran Abad Ke-21 dan Kemahiran Berfikir Aras Tinggi (KBAT). Penyepaduan tersebut dilakukan untuk melahirkan insan seimbang dan harmonis dari segi intelek, rohani, emosi dan jasmani sebagaimana tuntutan Falsafah Pendidikan Kebangsaan.

Bagi menjayakan pelaksanaan KSSM, pengajaran dan pembelajaran (PdP) guru perlu memberi penekanan kepada KBAT dengan memberi fokus kepada pendekatan Pembelajaran Berasaskan Inkuiri dan Pembelajaran Berasaskan Projek, supaya murid dapat menguasai kemahiran yang diperlukan dalam abad ke-21.

Kementerian Pendidikan Malaysia merakamkan setinggi-tinggi penghargaan dan ucapan terima kasih kepada semua pihak yang terlibat dalam penggubalan KSSM. Semoga pelaksanaan KSSM akan mencapai hasrat dan matlamat Sistem Pendidikan Kebangsaan.

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Pengarah
Bahagian Pembangunan Kurikulum

INTRODUCTION

Mathematics KSSM is a core subject that must be learned by all pupils under the National Education System. In Malaysia, each pupil gets the opportunity to go through at least six years of basic education in primary school and five years in secondary school. Mathematics programme at the secondary school level is divided into Mathematics at lower secondary, Mathematics at upper secondary and Additional Mathematics at upper secondary.

The secondary school Mathematics content is essentially a continuation of knowledge and skills learnt at the primary school level. Its aims, among others, are to develop the knowledge and skills of the pupils to enable them to solve problems in their daily lives, further their studies to a higher level and able to function as an effective workforce.

Rearrangement of Mathematics KSSM takes into consideration the continuity from primary school to secondary school and onto a higher level of education.

In addition, benchmarking of the Mathematics Curriculum in Malaysia with high performing countries in the international assessments has been carried out. This measure is to ensure that the Mathematics Curriculum in Malaysia is relevant and at par with other countries in the world.

In the effort to develop potential and increase the level of individual's intellectual and human development, Mathematics is the best medium because of its nature that encourages logical and systematic thinking. Thus, the development of the Mathematics curriculum, besides based on the needs of developing the country, also takes into consideration factors that contribute to the development of individuals who can think logically, critically, analytically, creatively and innovatively. This is consistent with the need to provide adequate mathematical knowledge and skills to ensure that the country is able to compete internationally and to meet the challenges of the 21st century. The different backgrounds and abilities of the pupils are given special attention in determining the knowledge and skills learned in the programme.

AIMS

Mathematics KSSM aims to produce individuals who are mathematically *fikrah*, which means individuals who can think mathematically, creative and innovative as well as competent in applying mathematical knowledge and skills effectively and responsibly to solve problems and make decisions, based on the attitudes and values so that they are able to deal with challenges in their daily lives, in line with the development of science and technology as well as the challenges of the 21st century.

OBJECTIVES

Form 3 Mathematics KSSM enables pupils to achieve the following objectives:

1. Develop an understanding of the concepts, laws, principles and theorems related to Number and Operations, Measurement and Geometry, Relationship and Algebra, Statistics and Probability, and Discrete Mathematics.

2. Develop capacity in:
   - formulating situations into mathematical forms.
   - using concepts, facts, procedures and reasoning.
   - interpreting, applying and evaluating mathematical outcomes.

3. Apply the knowledge and skills of mathematics in making reasonable judgements and decisions to solve problems in a variety of contexts.

4. Enhance mathematical skills related to Number and Operations, Measurement and Geometry, Relationship and Algebra, Statistics and Probability, and Discrete Mathematics such as:
   - collecting and handling data.
   - representing and interpreting data.
   - recognising relationship and representing them mathematically.
   - using algorithms and relationship.
   - making estimation and approximation.
   - measuring and constructing.

5. Practise the mathematical process skills consistently which include problem solving, reasoning, mathematical communication, making connection and representation.

6. Cultivate the use of mathematical knowledge and skills in making reasonable judgements and decisions effectively and responsibly in daily life.

7. Realise that mathematical ideas are inter-related, comprehensive and integrated body of knowledge, and are able to relate mathematics with other disciplines of knowledge.

8. Use technology in concept building, mastery of skills, investigating and exploring mathematical ideas and solving problems.

9. Foster and practice good moral values, positive attitudes towards mathematics and appreciate the importance and the beauty of mathematics.

10. Develop higher-order, critical, creative and innovative thinking.

11. Practise and further develop generic skills to face challenges of the 21st century.

THE FRAMEWORK OF SECONDARY SCHOOL STANDARD-BASED CURRICULUM

KSSM is built on the basis of six fundamental strands which are Communication; Spiritual; Attitude and Values; Humanities; Personal Competence; Physical Development and Aesthetics; and Science and Technology. These six strands are the main domain that support one another and are integrated with critical, creative and innovative thinking. The integration aims to produce human capital who appreciate values based on spiritual practices, knowledge, personal competence, critical and creative as well as innovative thinking as shown in Figure 1. The Mathematics curriculum is developed based on the six strands of the KSSM Framework.

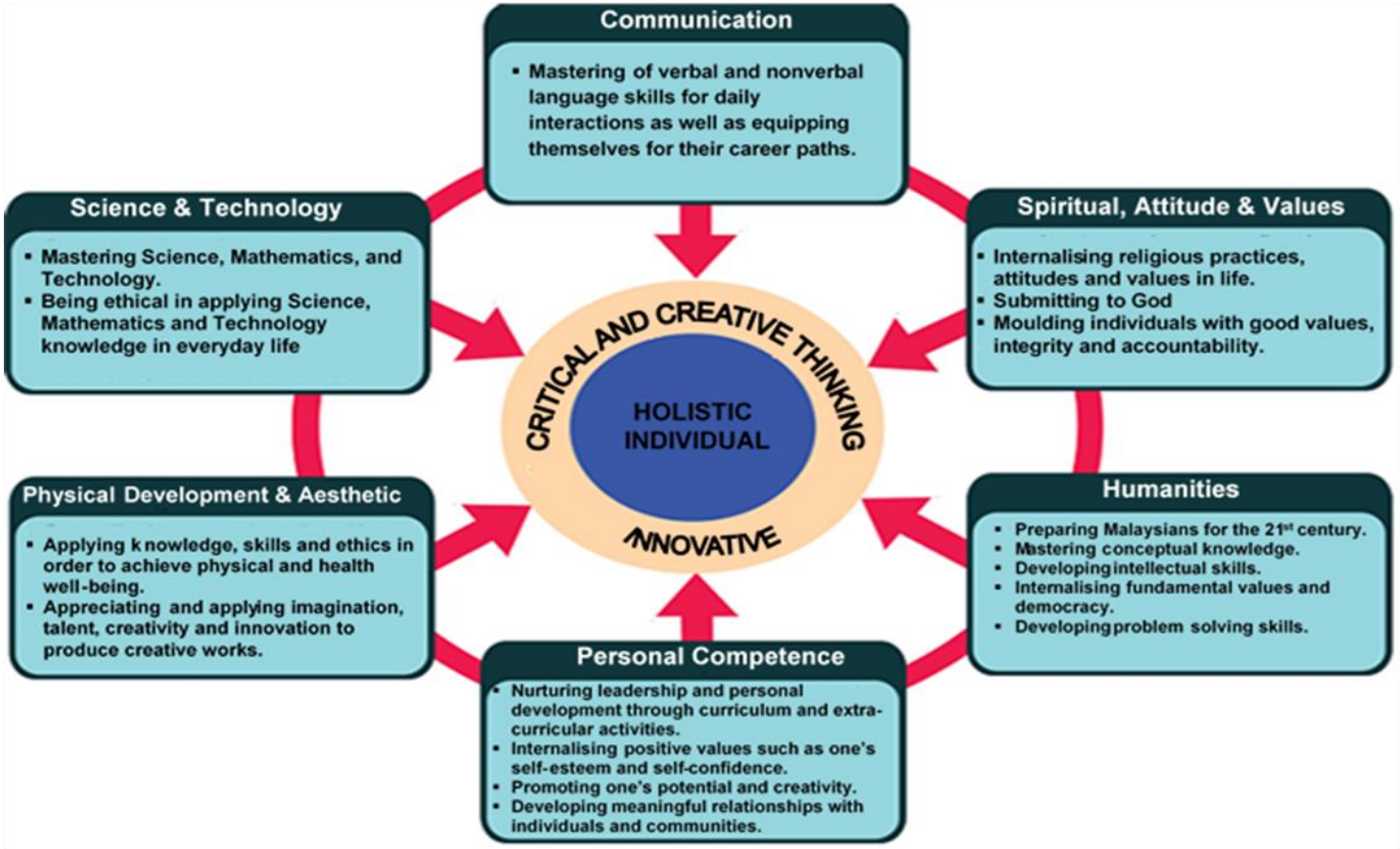


Figure 1: The Framework of Secondary School Standard-Based Curriculum

FOCUS

Mathematics KSSM focuses on developing individuals who internalise and practise mathematical *fikrah*. The Mathematics Curriculum Framework as illustrated in Figure 2, is fundamental to the implementation of the mathematics curriculum in the classroom.

Four key elements which contribute to the development of human that posses mathematical *fikrah* are:

- Learning areas
- Values
- Skills
- Mathematical processes

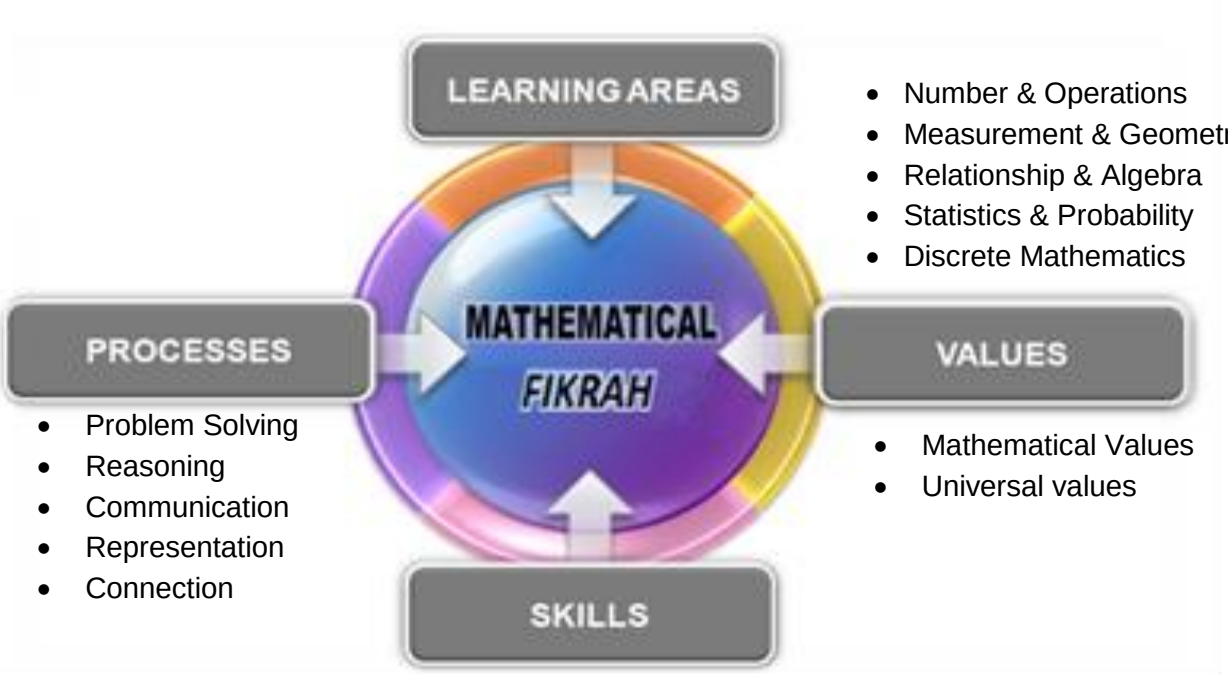


Figure 2: The Mathematics Curriculum Framework for Secondary Schools

Mathematical *Fikrah*

In the Fourth Edition of Kamus Dewan (2005), *fikrah* has the same meaning as the power of thinking and thought. In the context of mathematics education, mathematical *fikrah* refers to the quality of pupils to be developed through the national mathematics education system. Pupils who acquired mathematical *fikrah* are capable of doing mathematics, understanding mathematical ideas, and applying the knowledge and skills of mathematics responsibly in daily life, guided by good attitudes and values.

Mathematical *Fikrah* also intends to produce individuals who are creative, innovative and well-equipped to face the challenges of the 21st century, as the country is highly dependent on the ability of human capital to think and generate new ideas.

Learning Area

The content of Mathematics covers five main learning areas that are inter-related, namely:

- Numbers and Operations
- Measurement and Geometry
- Relationship and Algebra
- Statistics and Probability
- Discrete Mathematics.

Mathematical Processes

Mathematical processes that support effective and meaningful teaching and learning are:

- Problem solving
- Reasoning
- Mathematical communication
- Making connection
- Representation.

These five inter-related mathematical processes need to be implemented and integrated across the curriculum.

Problem solving is the heart of mathematics. Hence, problem-solving skills need to be developed comprehensively and integrated across the mathematics curriculum. In accordance with the importance of problem solving, mathematical processes are the backbone of the teaching and learning of mathematics and should be able to produce pupils who are creative, innovative and capable of using a variety of problem-solving strategies and higher order thinking skills. Teachers need to design teaching and learning

sessions that make problem solving the focus of discussion. Activities carried out should engage the pupils actively by posing a diversity of questions and tasks that contain not only the routine but non-routine questions as well. Solving problems involving non-routine questions needs thinking and reasoning at a higher level. These skills should be consistently cultivated by the teachers to produce pupils who are able to compete at a global level.

The following problem-solving steps should be emphasised so that pupils can solve problems systematically and effectively:

- Understanding and interpreting problems
- Devising a strategy
- Implementing the strategy
- Doing reflection.

The application of various strategies in problem solving including the steps involved has to be used widely. Among the strategies commonly used are drawing diagrams, identifying patterns, making tables/charts or systematic lists; using algebra, trying simpler cases, reason out logically, using trial and improvement, making simulation, working backwards as well as using analogies.

The following are some of the processes that need to be emphasised and developed through problem solving, that is to develop pupils' capacity in:

- Formulating situations involving various contexts such as personal, community, scientific and occupation mathematically.
- Using and applying concepts, facts, procedures and reasonings in solving problems.
- Interpreting, evaluating and reflecting on the solutions or decisions made and determining whether they are reasonable.

Reflection is an important step in problem solving. Reflection allows pupils to see, understand and appreciate perspectives of others from different angles as well as enables pupils to consolidate their understanding of the concepts learned.

Reasoning is an important basis for understanding mathematics more effectively and meaningfully. The development of mathematical reasoning is closely related to pupils' intellectual development and communication. Reasoning does not only develop the capacity of logical thinking but also increases the capacity of critical thinking that is fundamental in understanding mathematics in depth and meaningfully. Therefore, teachers need to provide space and opportunity through designing teaching and

learning activities that require pupils to do mathematics and be actively involved in discussing mathematical ideas.

The elements of reasoning in the teaching and learning prevent pupils from considering mathematics as just a set of procedures or algorithms that should be followed to obtain a solution without understanding the actual mathematical concepts in depth. Reasoning not only changes the paradigm of pupils' conscious procedural knowledge but also gives thought and intellectual empowerment when pupils are guided and trained to make and validate conjectures, provide logical explanations, analyze, evaluate and justify the mathematical activities. Such training would enhance pupils' confidence and courage, in line with the aim of developing powerful mathematical thinkers.

Communication in mathematics is the process of expressing ideas and understanding inverbal, visual or written form using numbers, notations, symbols, diagrams, graphs, pictures or words. Communication is an important process in learning mathematics because mathematical communication helps pupils to clarify and reinforce their understanding of mathematics. Through communication, mathematical ideas can be better expressed and understood. Communication in mathematics, either verbally, in written form or using symbols and visual representations (charts, graphs, diagrams, etc), help pupils to understand and apply mathematics more effectively.

Teachers should be aware of the opportunities that exist during teaching and learning sessions to encourage pupils to express and present their mathematical ideas by using appropriate questioning techniques. Communication that involves a variety of perspectives and points of view helps pupils to better improve their mathematical understanding whilst enhancing their self-confidence.

The significant aspect of mathematical communication is the ability to provide effective explanation as well as to understand and apply the correct mathematical notations. Pupils should use the mathematical language and symbols correctly to ensure that a mathematical idea can be explained precisely.

Effective communication requires an environment that is always sensitive to the needs of pupils so that they feel comfortable while speaking, asking and answering questions, explaining and justifying their views and statements to their classmates and teachers. Pupils should be given the opportunity to communicate actively in a variety of settings, for example while doing activities in pairs, groups or while giving explanation to the whole class.

Representation is an important component of mathematics and often used to represent real-world phenomena. Therefore, there must be a similarity between the aspects of the world that is represented and the world that is representing. Representation can be defined as any notations, letters, images or concrete objects that symbolise or represent something else.

At the secondary school level, representing ideas and mathematical models generally make use of symbols, geometry, graphs, algebra, figures, concrete representations and dynamic softwares. Pupils must be able to change from one form of representation to another and recognize the relationship between them, and use various representations, which are relevant and required to solve problems.

The use of various representations helps pupils to understand mathematical concepts and relationships; communicate their thinking, reasoning and understanding; recognise the relationship between mathematical concepts and use mathematics to model situations, physical and social phenomena. When pupils are able to represent concepts in different ways, they will be flexible in their thinking and understand that there are a variety of ways to represent mathematical ideas that enable problems to be solved more easily.

Connection between areas in mathematics such as counting, geometry, algebra, measurement and statistics is important for pupils to learn concepts and skills integratedly and meaningfully. By recognizing how the concepts or skills of different areas are related to each other, mathematics will be seen and studied as a discipline that is comprehensive, connected to each other thus allowing abstract concepts to be understood easily.

When mathematical ideas are connected to daily life experiences within and outside the classroom, pupils will be more aware of the use, the importance, the strength and the beauty of mathematics. Besides, they are also able to use mathematics contextually in other disciplines and in their daily lives. Mathematical models are used to describe real-life situations mathematically. Pupils will realise that this method can be used to solve problems or to predict the likelihood of a situation based on the mathematical model.

In implementing the Mathematics Curriculum, the opportunity to make connections should be established so that pupils can relate conceptual knowledge to procedural knowledge and be able to relate topics in mathematics in particular and relate mathematics to other fields in general. This will increase pupils' understanding of mathematics; making it clearer, more meaningful and interesting.

Mathematics Process Standards

The following are the process standards to be achieved by pupils through the implementation of this curriculum.

Table 1: Mathematics Process Standards

PROBLEM SOLVING
• Understand the problems. • Extract relevant information in a given situation and organise information systematically. • Plan various strategies to solve problems. • Implement the strategies according to the plan. • Generate solutions to meet the requirements of the problem. • Interpret the solutions. • Review and reflect upon the solutions and strategies used.
REASONING
• Recognise reasoning and proving as fundamentals to mathematics. • Recognise patterns, structures, and similarities within real-life situations and symbolic representations. • Choose and use various types of reasoning and methods of proving. • Make, investigate and verify mathematical conjectures. • Develop and evaluate mathematical arguments and proofs. • Make decisions and justify the decisions made.
COMMUNICATION IN MATHEMATICS
• Organise and incorporate mathematical thinking through communication to clarify and strengthen the understanding of mathematics. • Communicate mathematical thoughts and ideas clearly and confidently. • Use the language of mathematics to express mathematical ideas precisely. • Analyse and evaluate the mathematical thinking and strategies of others.
REPRESENTATION
• Illustrate mathematical ideas using various types of representations. • Make interpretations from given representations. • Choose the appropriate types of representations. • Use various types of mathematical representations to: i) simplify complex mathematical ideas ii) assist in problem solving iii) develop models and interpret mathematical phenomena iv) make connections between various types of representations.

CONNECTION
• Identify and use the connection between mathematical ideas. • Understand how mathematical ideas are inter-related and form a cohesive unity. • Relate mathematical ideas to daily life and other fields.

Skills

The skills that must be developed and instilled amongst pupils through the teaching of this subject include the Mathematical Skills, 21st Century Skills and Higher Order Thinking Skills (HOTS).

The mathematical skills refer to, among others, the skills of measuring and constructing, estimating and rounding, collecting and handling data, representing and interpreting data, recognising relationships and representing mathematically, translating real-life situations into mathematical models, using the precise language of mathematics, applying logical reasoning, using algorithms and relationships, using mathematical tools, solving problems, making decisions and so on. In addition, the curriculum also demands the development of pupils' mathematical skills in aspects related to creativity, the needs of originality in their thinking and the ability to see things around them with new and different perspectives in order to develop creative and innovative individuals. The use of mathematical tools strategically, accurately and effectively is strongly emphasised in the teaching and learning of mathematics. The mathematical tools include papers and pencils, rulers, protractors, compasses, calculators, electronic spreadsheets, dynamic softwares and so on.

The rapid progress of various technologies in todays' life has resulted in the use of technologies as an essential element in the teaching and learning of mathematics. Effective teachers will maximise the potential and technological capabilities so that pupils can build understanding and increase their proficiency and interest in mathematics. Due to the capacity and effectiveness of technology in the teaching and learning of mathematics content, teachers need to embrace the use of technology, particularly scientific calculators, graphing calculators, computer softwares like Geometer's Sketchpad, Geogebra, electronic spreadsheets, learning softwares (courseware), the Internet and others.

However, technology must be used wisely. Calculator for example is not to be used to the extent that the importance of mental calculations and basic computations is neglected. Efficiency in carrying out the calculations is important especially in the lower

level and pupils should not totally rely on calculators. For example, although the graphing calculator helps pupils to visualize the nature of a function and its graph, fundamentally the use of paper and pencil is still the learning outcome to be achieved by all pupils. Similarly, in seeking the roots of the quadratic equations, the basic concept must first be mastered by the pupils. Technology should be used wisely to help pupils form concepts, enhance understanding, visualize concepts and so on while enriching pupils' learning experiences.

Specifically, the skills in using technology that need to be nurtured among the pupils through the teaching and learning of Mathematics are the pupils' ability in:

- Using technology to explore, carry out research, construct mathematical modelling, and hence form a deep understanding of the mathematical concepts
- Using technology to help in calculations to solve problems effectively
- Using technology, especially electronic and digital technology to find, manage, evaluate and communicate information
- Using technology responsibly and ethically.

The use of technology such as dynamic softwares, scientific calculators, graphing calculators, the Internet and so on needs to be integrated into the teaching and learning of mathematics to help pupils form deep understanding of concepts especially abstract concepts.

Values in Mathematics Education

Values are affective qualities intended to be formed through the teaching and learning of mathematics using appropriate contexts. Values are usually taught and learned implicitly through the learning sessions. Good moral values develop great attitudes. The application of values and attitudes in the teaching and learning of mathematics are meant to produce individuals who are competent in terms of knowledge and skills as well as having good characters. Embracing good moral values would produce a virtuous young generation with noble personal qualities and good attitudes.

Values that need to be developed in pupils through the teaching and learning of mathematics are:

- Mathematical values – values within the knowledge of mathematics which include emphasis on the properties of the mathematical knowledge; and
- Universal values - universal noble values that are applied across all the subjects.

The development of values through teaching and learning of mathematics should also involve the elements of divinity, faith, interest, appreciation, confidence, competence and tenacity. Belief in the Power and Greatness of God can basically be nurtured through the content of the curriculum. The relationship between the content learned and the real world enables pupils to see and validate the Greatness and the Power of the Creator of the universe.

The elements of history and patriotism should also be inculcated through relevant topics to enable pupils to appreciate mathematics as well as to boost interest and confidence in mathematics. Historical elements such as certain events involving mathematicians or a brief history of a concept or symbol are also emphasised in this curriculum.

21st Century Skills

One of the aims of KSSM is to produce pupils who possess the skills of the 21st century by focussing on thinking skills, living skills and career guided by the practice of good moral values.

21st Century Skills aim to produce pupils who have the characteristics specified in the pupils' profile as in Table 2, so that they are able to compete at a global level. The mastery of the Content Standards and the Learning Standards in the Mathematics Curriculum contributes to the acquisition of the 21st Century Skills among the pupils.

Table 2: Pupils' Profile

PUPILS' PROFILE	DESCRIPTION
Resilient	Pupils are able to face and overcome difficulties and challenges with wisdom, confidence, tolerance, and empathy.
Competent communicator	Pupils voice out and express their thoughts, ideas and information confidently and creatively, in verbal and in written form, using various media and technology.

PUPILS' PROFILE	DESCRIPTION
Thinker	Pupils think critically, creatively and innovatively; are able to solve complex problems and make ethical decisions. They think about learning and themselves as learners. They generate questions and be open towards other individual's and communities' perspectives, values, and traditions. They are confident and creative in handling new learning areas.
Team Work	Pupils can co-operate effectively and harmoniously with others. They shoulder responsibilities together as well as respect and appreciate the contributions from each member of the team. They acquire interpersonal skills through collaborative activities, and this makes them better leaders and team members.
Inquisitive	Pupils develop natural inquisitiveness to explore new strategies and ideas. They learn skills that are necessary for inquiry-learning and research, as well as display independent traits in learning. The pupils continuously enjoy life-long learning experiences.
Principled	Pupils have a sense of integrity and sincerity, equality, fairness and respect the dignity of individuals, groups and community. They are responsible for their actions, consequences and decisions.

PUPILS' PROFILE	DESCRIPTION
Informed	Pupils obtain knowledge and develop a broad and balanced understanding across the various disciplines of knowledge. They explore knowledge efficiently and effectively in terms of local and global contexts. They understand issues related to ethics or laws regarding information acquired.
Caring	Pupils show empathy, compassion and respect towards the needs and feelings of others. They are committed to serve the society and ensure the sustainability of the environment.
Patriotic	Pupils demonstrate their love, support and respect for the country.

HIGHER ORDER THINKING SKILLS

Higher Order Thinking Skills (HOTS) are explicitly stated in the curriculum so that teachers are able to translate into their teaching and learning to promote a structured and focused thinking among students. Explanation of HOTS focuses on four levels of thinking as shown in Table 3.

Table 3: Level of Thinking in HOTS

LEVEL OF THINKING	EXPLANATION
Application	Using knowledge, skills and values in different situations to perform a task.
Analysis	Breaking down information into smaller parts in order to understand and make connections between these parts.
Evaluation	Making considerations and decisions using knowledge, experience, skills, and values as well as giving justification.
Creation	Producing creative and innovative ideas, products or methods.

HOTS is the ability to apply knowledge, skills and values to make reasoning and reflection to solve problems, make decisions, innovate and able to create something. HOTS includes critical and creative thinking, reasoning and thinking strategies.

Critical thinking skills is the ability to evaluate a certain idea logically and rationally in order to make sound judgements using logical reasoning and evidences.

Creative thinking skills is the ability to produce or create something new and worthy using authentic imagination and thinking out of the box.

Reasoning skills is an individual's ability to make logical and rational considerations and evaluations.

Thinking strategies is a structured and focused way of thinking to solve problems.

HOTS can be applied in classrooms through reasoning, inquiry-based learning, problem solving and projects. Teachers and pupils need to use thinking tools such as thinking maps and mind maps as well as high-level questioning techniques to encourage pupils to think.

TEACHING AND LEARNING STRATEGIES

Good teaching and learning of mathematics demands teachers to carefully plan activities and to integrate diversified strategies that enable pupils to not only understand the content in depth, but challenge them to think at a higher level.

The teaching and learning of mathematics emphasises active pupil participation, which among others, can be achieved through:

- inquiry-based learning, which includes investigation and exploration of mathematics
- problem-based learning
- the use of technology in concept building.

Inquiry-based is an approach that emphasises learning through experience. Inquiry generally means to seek information, to question and to investigate real-life phenomena. Discovery is a major characteristic of inquiry-based learning. Learning through discovery occurs when the main concepts and principles are investigated and discovered by pupils themselves. Through the activities, pupils will investigate a phenomenon, analyze patterns and thus form their own conclusions. Teachers then guide pupils to discuss and understand the concept of mathematics through the inquiry results. KSSM Mathematics emphasises deep conceptual understanding, efficiency in manipulation, the ability to reason and communicate mathematically. Thus, the teaching and learning that involves inquiry, exploration and investigation of mathematics should be conducted wherever appropriate. Teachers need to design teaching and learning activities that provides space and opportunities for pupils to make conjectures, reason out, ask questions, make reflections and thus form concepts and acquire knowledge on their own.

A variety of opportunities and learning experiences, integrating the use of technology, and problem solving that involves a balance of both routine and non-routine questions,are also emphasised in the teaching and learning of mathematics. Non-routine questions requiring higher-order thinking are emphasised in order to achieve the vision of producing human capital who can think mathematically, creatively as well as innovatively, are able to compete in the era of globalization and to meet the challenges of the 21st century.

Mathematics is a discipline of knowledge consisting of concepts, facts, characteristics, rules, patterns and processes. Thus, the strategies used in the teaching and learning of mathematics require diversity and balance. The traditional strategy is sometimes still necessary when teaching a procedural-based content. On the

other hand, certain content requires teachers to provide learning activities that enable pupils to discover the concept on their own. Thus, structured questioning techniques are needed to enable pupils to discover the rules, patterns or the properties of mathematical concepts.

The use of teaching aids and carrying out tasks in the form of presentations or project work need to be incorporated into the learning experiences in order to develop pupils who are competent in applying knowledge and skills of mathematics in solving problems that involve everyday situations as well as to develop soft skills among them. In addition, teachers need to use diversified approaches and strategies in teaching and learning such as cooperative learning, mastery learning, contextual learning, constructivism, project-based learning and so on.

Thoughtful learning of mathematics should be incorporated into the teaching and learning practices. Thus, teaching and learning strategies should be student-centred to enable them to interact and master the learning skills through their own experiences. Approaches and strategies of learning, such as inquiry-discovery, mathematical exploration and investigation and student-centred activities with the aid of mathematical tools that are appropriate, comprehensive and effective can make the learning of mathematics fun, meaningful, useful and challenging which in turn will form the basis of a deep understanding of concepts.

Teachers need to diversify the methods and strategies of teaching and learning to meet the needs of pupils with various abilities, interests and preferences. The active involvement of pupils in meaningful and challenging teaching and learning activities should be designed specifically to cater to their needs. Every pupil should have an equal opportunity to form conceptual understanding and procedural competence. Therefore, teachers should be mindful in providing the ecosystem of learning and intellectual discussions that require pupils to collaborate in solving meaningful and challenging tasks.

Creativity and innovation are key elements in the development of a knowledgable society in the 21st century. Both of these elements will significantly contribute to the social and individual prosperity of a country. Malaysia needs creative and innovative human capital in order to compete in todays' world which is increasingly competitive and dynamic. Education is seen as a means in developing skills of creativity and innovation among the people.

Creativity and innovation are interrelated. In general, creativity refers to the ability to produce new ideas, approaches or actions. Innovation is the process of generating creative ideas in a certain context. Creativity and innovation capabilities are the skills that can be developed and nurtured among pupils through the teaching and learning in the classroom. Mathematics is the science of patterns and relationship which has aesthetic values that are closely related to the natural phenomena. Hence, mathematics is the cornerstone and the catalyst for the development of creativity and innovative skills among pupils through suitable tasks and activities.

Teachers need to design teaching and learning activities that encourage and foster creativity and innovation. Among the strategies that can be used, is to involve pupils in complex cognitive activities such as:

- The implementation of tasks involving non-routine questions requiring diversified problem-solving strategies and high level of thinking
- The use of technology to explore, build conceptual understanding and solve problems
- Fostering a culture in which pupils showcase creativity and innovation in a variety of forms
- Design teaching and learning that provide space and opportunities for pupils to do mathematics and build understanding through inquiry-based exploration and investigation activities.

Other diversified teaching and learning approaches and strategies such as mastery learning, contextual learning, constructivism, project-based learning, problem-based learning and so on should be implemented in accordance to the needs and appropriateness.

STEM APPROACH (Science, Technology, Engineering and Mathematics)

STEM approach is the teaching and learning method which applies integrated knowledge, skills and values of STEM through inquiry, problem solving or project in the context of daily life, environment and local as well as global community, as shown in Diagram 3.

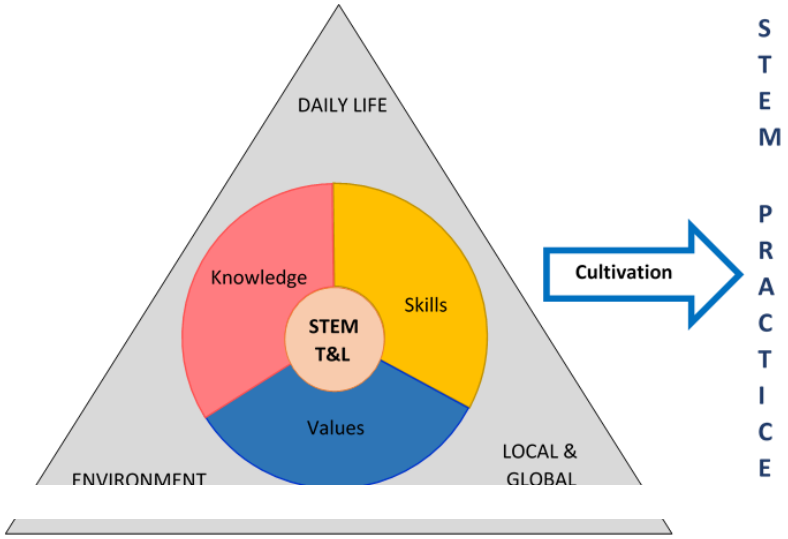


Diagram 3: STEM Teaching and Learning

STEM teaching and learning which is contextual and authentic is able to encourage in-depth learning among pupils. Pupils can work in groups or individually according to their ability to cultivate the STEM practices, as follows:

1. Questioning and identifying problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematical and computational thinking
6. Developing explanation and designing solutions
7. Engaging in argument and discussion based on evidence
8. Acquiring information, evaluating and communicating about the information.

CROSS-CURRICULAR ELEMENTS

Cross-curricular Elements (EMK) are value-added elements applied in the teaching and learning process other than those specified in the Content Standard. These elements are applied to strengthen the skills and competency of the intended human capital, capable of dealing with the current and future challenges. The elements in the EMK are as follows:

1. Language

- The use of proper language of instruction should be emphasised in all subjects.
- During the teaching and learning of every subject, aspects of pronunciation, sentence structure, grammar and vocabulary should be emphasised to help pupils organize ideas and communicate effectively.

2. Environmental Sustainability

- Developing awareness and love for the environment need to be nurtured through the teaching and learning process in all subjects.
- Knowledge and awareness on the importance of the environment would shape pupils' ethics in appreciating nature.

3. Good Moral Values

- Good moral values are emphasised in all subjects so that pupils are aware of the importance of such values; hence practice them.
- Good moral values include aspects of spirituality, humanity and citizenship that are being practised in daily life.

4. Science and Technology

- Increasing the interest in science and technology can improve literacy in science and technology among pupils.
- The use of technology in teaching can help and contribute to a more efficient and effective learning.
- Integration of science and technology in teaching and learning encompasses four main factors:
    - Knowledge of science and technology (facts, principles, concepts related to science and technology)
    - Scientific skills (thinking processes and certain manipulative skills);
    - Scientific attitude (such as accuracy, honesty, safety)
    - The use of technology in teaching and learning activities.

5. Patriotism

- The spirit of patriotism is to be fostered through all subjects, extra-curricular activities and community services.
- Patriotism develops the spirit of love for the country and instils a sense of pride to be Malaysians amongst pupils.

6. Creativity and Innovation

- Creativity is the ability to use imagination to collect, assimilate and generate ideas or create something new or original through inspiration or combinations of existing ideas.
- Innovation is the application of creativity through modification, improving and practising the ideas.
- Creativity and innovation go hand in hand and are needed in order to develop human capital that can face the challenges of the 21st century.
- Elements of creativity and innovation should be integrated into the teaching and learning.

7. Entrepreneurship

- Inculcation of entrepreneurial elements aims to establish the characteristics and the practice of entrepreneurship so that it becomes a culture among pupils.
- Features of entrepreneurship can be applied in teaching and learning through activities that could foster attitudes such as diligence, honesty, trustworthy, responsibility and to develop creative and innovative minds to market the idea.

8. Information and Communication Technology (ICT)

- Application of ICT element into the teaching and learning is to ensure that pupils can apply and consolidate the knowledge and basic ICT skills learnt.
- Application of ICT not only encourages pupils to be creative but also makes teaching and learning more interesting and fun as well as improving the quality of learning.
- ICT should be integrated in the lesson based on appropriate topics to be taught to further enhance pupils' understanding of the content.

9. Global Sustainability

- Global Sustainability elements aim to produce pupils who have sustainable thinking and are responsive to the environment in their daily lives by applying the knowledge, skills and values acquired through the elements of Sustainable Consumption and Production, Global Citizenship and Unity.
- The Global Sustainability elements are significant in preparing pupils to face the challenges and current issues at different levels; local, national and global.
- These elements are taught both directly and indirectly in the relevant subjects.

10. Financial Education

- Application of financial education elements aims at shaping the future generation that is capable of making right financial decisions, ethical practice and financial management skills to manage the financial affairs responsibly.
- Elements of financial education can be applied in teaching and learning directly or indirectly. Direct application is done through the titles that contain explicit financial elements such as the calculation of simple interest and compound interest. Indirect application is integrated through other titles across the curriculum. Exposure to financial management in real life is important to provide pupils with the knowledge, skills and values that can be applied effectively and meaningfully.

SCHOOL ASSESSMENT

School assessment is part of the assessment approaches, a process to obtain information on pupils' progress which is planned, carried out and reported by the teachers concerned. This on-going process occurs formally and informally so that teachers can determine the actual level of pupils' achievement. School assessment is to be carried out holistically based on inclusive, authentic and localized principles. Information obtained from the school assessments will be used by administrators, teachers, parents and pupils in planning follow-up actions towards improving the pupils' learning development.

Teachers can carry out formative and summative assessments as school assessments. Formative assessments are carried out in line with the teaching and learning processes, while summative assessments are carried out at the end of a learning unit, term, semester or year. In carrying out the school assessments, teachers need to plan, construct items, administer, mark, record and report pupils' performance level in the subjects taught based on the Standard-based Curriculum and Assessment Documents.

The information collected through the school assessments should help teachers to determine the strengths and weaknesses of pupils in achieving a Content Standard. The information collected should also help teachers to adapt the teaching and learning based on the needs and weaknesses of their pupils. A comprehensive school assessment should be planned and carried out continuously as part of classroom activities. Besides helping to improve pupils' weaknesses, teachers' efforts in implementing holistic school assessment will form a balanced learning ecosystem.

In order to ensure that the school assessment helps to increase pupils'capability and performance, teachers should use assessment strategies that have the following features:

- Taking into account the knowledge, skills and values that are intended in the curriculum
- Various forms such as observation of activities, tests, presentations, projects, folio and so on
- Designed to enable pupils to exhibit a wide range of learning abilities;
- Fair to all pupils
- Holistic, that is taking into account the various levels of cognitive, affective and psychomotor.

Assessment of Content

In general, Content Assessment is carried out topically, comprising of mathematical processes and skills. Topical assessments coupled with the integration of mathematical processes and skills, aims to gauge the extent of pupils' understanding of a certain Content Standard comprehensively and holistically. Performance Standards (SPi) for each topic is constructed based on the General Performance Level as in Table 4.

Table 4: General Performance Level

PERFORMANCE LEVEL	INTERPRETATION
1	Demonstrate basic knowledge such as stating a certain mathematical idea either verbally or non-verbally.
2	Demonstrate understanding such as explaining a certain mathematical concept either verbally or non-verbally.
3	Apply understanding such as performing calculations, constructing tables and drawing graphs.
4	Apply suitable knowledge and skills such as using algorithms, formulae, procedures or basic methods in the context of solving simple routine problems.
5	Apply suitable knowledge and skills in new situations such as performing multi-step procedures, using representations based on different sources of information and reason out directly in the context of solving complex routine problems.
6	Apply suitable knowledge and skills such as using information based on investigation and modelling in solving complex problems situations; reason out at high level, form new approaches and strategies in the context of solving non-routine problems creatively.

SPi outlines the elements to be taken into account in assessing and reporting pupils' achievement for each topic. The SPiis placed at the end of each topic to facilitate teacher.

Assessment of Values

Elements of attitudes and values that need to be displayed and practised by pupils are assessed continuously through various media such as observations, exercises, presentations, pupils' verbal responses, collaborative activities and so on. The achievement report of these elements can be done in mid-year and year-end to observe the progress of pupils and help them to improve the practice of good values, based on Table 5.

Table 5: Value Assessment in Mathematics Education

VALUE IN MATHEMATICS EDUCATION		INTERNALISATION LEVEL
1	Interested in learning mathematics.	**Low:** 1, 2 or 3 out of all the standards listed are observed
2	Appreciate the aesthetic values and the importance of mathematics.	
3	Confident and patient in learning mathematics.	
4	Willing to learn from mistakes.	
5	Work towards accuracy.	**Medium** 4, 5 or 6 out of all the standards listed are observed
6	Practise self-access learning.	
7	Dare to try something new	**High** 7, 8 or 9 out of all the standards listed are observed
8	Work systematically	
9	Use mathematical tools accurately and effectively.	

Level of value internalisation in Mathematics Educationis categorised into three levels, which is low, medium and high.

Teachers need to assess these elements holistically and comprehensively through detailed observation as well as using professional judgments to determine the level of internalisation of values that should be awarded to each pupil.

Reporting of Overall Performance Level

Overall reporting is required to determine pupils' achievement level at the end of a specific schooling session.

This reporting comprises the aspects of content, skills and mathematical processes which are emphasised in the curriculum, including higher order thinking skills. Thus, teachers need to evaluate pupils collectively, comprehensively, holistically, taking into consideration of pupils' activities on a continuous basis through various media such as achievement in examination scores, topical tests, observations, exercises, presentations, pupils' verbal responses, group work, projects and so on. Elements which are emphasised in the overall competency level should be developed integratedly among the pupils through various tasks. Therefore, teachers have to use their wisdom in making professional judgement to determine pupils' overall performance level. Reporting of overall performance level however does not include elements of values which have to be reported separately to facilitate the stakeholders to evaluate pupils' internalisation level in that particular aspect. Table 6 below is referred to when evaluating and reporting pupils' overall performance level.

Table 6: Overall Performance Level

PERFORMANCE LEVEL	CONTENTS, SKILLS AND MATHEMATICAL PROCESSES
1	Pupils are able to: • answer questions where all related information are given and questions are clearly defined • identify information and carry out routine procedures according to clear instructions.
2	Pupils are able to: • recognise and interpret situations directly • use single representation • use algorithms, formulae, procedures or basic methods • make direct reasoning and interpret the results obtained.
3	Pupils are able to: • perform procedures that are stated clearly, including multi-steps procedures • apply simple problem- solving strategies • interpret and use representations based on different sources of information

PERFORMANCE LEVEL	CONTENTS, SKILLS AND MATHEMATICAL PROCESSES
	• make direct reasoning and communicate briefly when giving interpretations, results and reasoning.
4	Pupils are able to: • use explicit models effectively in concrete complex situations, • choose and integrate different representations and relate to real world situations • use skills and reasonings flexibily based on deep understanding and communicate with explanations and arguments based on interpretations, discussions and actions.
5	Pupils are able to: • develop and use models for complex situations • identify constraints and make specific assumptions • apply suitable problem-solving strategies • work strategically using in-depth thinking skills and reasoning • use various suitable representations and display in-depth understanding • reflect on results and actions
	• conclude and communicate with explanations and arguments based on interpretations, discussions and actions
6	Pupils are able to : • conceptualise, make generalisations and use information based on investigations and modelling of complex situations • relate information sources and flexibly change one form of representations to another • possess high level of mathematical thinking and reasoning skills • demonstrate in-depth understanding; form new approaches and strategies to handle new situations • conclude and communicate with explanations and arguments based on interpretations, discussions, reflections and actions accurately.

Based on the Overall Competency Level, it is clear that teachers should use tasks with various levels of difficulty and complexity, which are able to access various elements, and pupils' mastery

level. Holistic assessmentis needed in developing pupils with global skills. Content mastery has to be supported by pupils' ability to achieve and apply processes, hence display the ability in solving complex problems especially those involving real-life situations. It is important that teachers carry out comprehensive assessmentsand provide fair and just reportof each pupil's Performance Level.

CONTENT ORGANISATION

KSSM Mathematics consists of three components: Content Standards, Learning Standards and Performance Standards.

Table 7: DSKP Organisation

Content Standard	Learning Standard	Performance Standard
Specific statement on what pupils should know and be able to do in a certain schooling period which encompasses the aspects of knowledge, skills and values.	Criterion set or indicators of the quality of learning and achievement that can be measured for each Content Standard.	Set of general criteria that shows the levels of performance that pupils should display as an indicator that they have mastered a certain matter.

There is also a **Notes** column that details out the:

- Limitations and scopes of the Content Standard and Learning Standard.
- Suggested teaching and learning activities.
- Information or notes related to mathematics that supports teachers' understanding.

Implementation of Mathematics curriculum is according to the Professional Circulars which is being enforced now. The contents of KSSM Mathematics are organised and arranged according to independent and complete subunits based on modular approach. Modular approach in teaching and learning enables teachers to arrange the topics and standards (SK or SP) accordingly based on number of hours allocated. This approach can be implemented in two ways as follow:

- Linear modular approach – SK or SP delivered sequentially according to the arrangement of the DSKP.
- Non-linear modular approach – SK or SP delivered unsequentially.

In preparing for the activities and learning environment that are suitable and relevant to the pupils' abilities and interests, teachers

need to use their creativities and professional judgements. The suggested activities are not absolute. Teachers are encouraged to use various resources like books and the Internet in preparing the appropriate teaching and learning activities according to the pupils' abilities and interests.

The scope of contents of Form 3 Mathematics is as shown in Table 8:

Table 8: KSSM Form 3 Mathematics Contents

LEARNING AREA	TOPIC
Number and Operations	• Indices • Standard Form • Consumer Mathematics: Savings and Investments, Credit and Debt
Measurement and Geometry	• Scale Drawings • Trigonometric Ratios • Angles and Tangents of Circles • Plans and Elevations • Loci in Two Dimensions
Relationship and Algebra	• Straight Lines

LEARNING AREA

NUMBER AND OPERATIONS

TITLE

1.0 INDICES

1.0 INDICES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
1.1 Index Notation	Pupils are able to: 1.1.1 Represent repeated multiplication in index form and describe its meaning. 1.1.2 Rewrite a number in index form and vice versa.	Note: The terms “base” and “index” need to be introduced.
1.2 Law of Indices	Pupils are able to: 1.2.1 Relate the multiplication of numbers in index form with the same base, to repeated multiplications, and hence make generalisation. 1.2.2 Relate the division of numbers in index form with the same base, to repeated multiplications, and hence make generalisation. 1.2.3 Relate the numbers in index form raised to a power, to repeated multiplication, and hence make generalisation.	Note: Exploratory activities which only involve integer indices need to be carried out for SP 1.2.1, 1.2.2 and 1.2.3. Index is also known as exponent or power.

STANDARD KANDUNGAN	LEARNING STANDARD	NOTES
	1.2.4 Verify that $a^0 = 1$ and $a^{-n} = \frac{1}{a^n}$; $a \neq 0$.	
	1.2.5 Determine and state the relationship between fractional indices and roots and powers.	Note: $a^{\frac{1}{n}} = \sqrt[n]{a}$ $a^{\frac{m}{n}} = (a^m)^{\frac{1}{n}} = (a^{\frac{1}{n}})^m$ $a^{\frac{m}{n}} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$
	1.2.6 Perform operations involving laws of indices.	
	1.2.7 Solve problems involving laws of indices.	

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of index form.
2	Demonstrate the understanding of index form.
3	Apply the understanding of laws of indices to perform simple tasks.
4	Apply appropriate knowledge and skills of laws of indices in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of laws of indices in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of laws of indices in the context of non-routine problem solving in a creative manner.

LEARNING AREA

NUMBER AND OPERATIONS

TITLE

2.0 STANDARD FORM

2.0 STANDARD FORM

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
2.1 Significant Figures	Pupils are able to: 2.1.1 Explain the meaning of significant figure, and hence determine the number of significant figures of a number. 2.1.2 Round off a number to certain numbers of significant figures.	Notes: Exploratory activities including those involving estimation, approximation and accuracy in real life situations need to be carried out. Cases of whole numbers involving zero after non-zero digit need to be discussed.
2.2 Standard Form	Pupils are able to: 2.2.1 Recognise and write numbers in standard form.	Notes: The use of standard form in real life including common prefix such as tera and nano need to be explored, with and without the use of technological tools. The relationship between standard form and laws of indices and significant figures need to be discussed.

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	2.2.2 Perform basic arithmetic operations involving numbers in standard form. 2.2.3 Solve problems involving numbers in standard form.	Notes: Solutions involving factorisation need to be carried out.

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of significant figures and standard form.
2	Demonstrate the understanding of significant figures and standard form.
3	Apply the understanding of significant figures and standard form to perform simple tasks.
4	Apply appropriate knowledge and skills of standard form in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of standard form in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of standard form in the context of non-routine problem solving in a creative manner.

LEARNING AREA

NUMBER AND OPERATIONS

TITLE

3.0 CONSUMER MATHEMATICS: SAVINGS AND INVESTMENTS, CREDIT AND DEBT

3.0 CONSUMER MATHEMATICS: SAVINGS AND INVESTMENTS, CREDIT AND DEBT

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
3.1 Savings and Investments	Pupils are able to:	Notes:
	3.1.1 Recognise various types of savings and investments.	Exploratory activities of the types of savings and investments, and the types of interests (simple and compound) involved, need to be carried out. Types of savings: • Saving account • Fixed deposit account • Current account Types of investments: • Shares • Unit trust • Real estate
	3.1.2 Perform calculations involving simple interest and compound interest for savings, and hence explain the impact of changes in period, rate of interest or return and compounding frequency on the future value of savings.	Notes: For savings which give simple interest, use the formula: $I = Prt$ I = interest P= principal r = rate t= time Suggested activity: Derivation of simple interest and total saving formulae are encouraged.

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
		Notes: For savings which give compound interest, use the formula: $MV = P(1+\frac{r}{n})^{nt}$ MV = matured value Matured value is the total of principal and interest. P = principal r = yearly interest rate n = number of periods the interest is compounded per year t = term in years For islamic banking, the rate of return is only as reference. The real rate of return will only be known at maturity or on the date the money is withdrawn.
	3.1.3 Perform calculations involving the value of return of investments, and hence explain the factors that affect the return of investments and its impacts.	Notes: Return of investment (ROI) and dividend of unit trust need to be involved. Real estate investments need to involve the rate of return and the real rate of return.

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	3.1.4 Compare and contrast potential risks, return and liquidity of various types of savings and investments.	Notes: Exploratory activities need to be carried out. Involve situations which require pupils to make wise decisions in the contexts of savings and investments, and give justifications.
	3.1.5 Calculate the average cost per share for the investment of shares using the ringgit cost averaging strategy and explain the benefits of the strategy.	Notes: Shares including unit trust.
	3.1.6 Solve problems involving savings and investments.	
3.2 Credit and Debt Management	Pupils are able to: 3.2.1 Explain the meaning of credit and debt, and hence describe the wise management of credit and debt.	Notes: Exploratory activities need to be carried out. Instant loan need to be discussed. Credit including credit cards and loans.
	3.2.2 Investigate and describe the advantages and disadvantages of credit card and ways to use it wisely.	Notes: Involving: (a) Incentive system (b) Qualifications to obtain credit cards (c) User responsibilities (d) Security aspects (e) Common charges

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	3.2.3 Investigate and describe the impact of minimum and late payments for credit card usage.	Notes: Finance charges calculations need to be involved. Emphasise on the interest on debts.
	3.2.4 Solve problems involving the use of credit cards.	Notes: Situations which require pupils to make wise decisions in the contexts of credit card expenditures and payments, and give justifications need to be involved. Problems include currency exchange and online purchases.
	3.2.5 Calculate the total amount of loan repayment and installment, with various interest rates and different loan periods.	Notes: Formula for loan with flat interest: $A = P + Prt$ A = total repayment P = principal r = rate t = time Loans with flat interest, such as car loan, personal loan and consumer goods loan. Interest on debts need to be discussed.

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	3.2.6 Solve problems involving loans.	Notes: Situations which require pupils to make wise decisions and give justifications need to be involved.

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of savings, investments, credit and debt.
2	Demonstrate the understanding of savings, investments, credit and debt.
3	Apply the understanding of savings, investments, credit and debt to perform simple tasks.
4	Apply appropriate knowledge and skills of savings, investments, credit and debt in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of savings, investments, credit and debt in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of savings, investments, credit and debt in the context of non-routine problem solving in a creative manner.

LEARNING AREA

MEASUREMENT AND GEOMETRY

TITLE

4.0 SCALE DRAWINGS

4.0 SCALE DRAWINGS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
4.1 Scale Drawings	Pupils are able to:	Notes:
	4.1.1 Investigate and explain the relationship between the actual measurements and the measurements of various sizes of drawings of an object, and hence explain the meaning of scale drawing.	The concept of proportion needs to be emphasised. Real life situations need to be involved.
	4.1.2 Interpret the scale of a scale drawing.	Notes: Scales are in the form of 1: n or 1: $\frac{1}{n}$ when n = 1, 2, 3, ...
	4.1.3 Determine the scales, measurements of objects or measurements of scale drawings.	
	4.1.4 Draw the scale drawings of objects and vice versa.	Notes: Grids of various sizes need to be involved.
	4.1.5 Solve problems involving scale drawings.	Suggested activity: Project work is encouraged.

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of scale drawings.
2	Demonstrate the understanding of scale drawings.
3	Apply the understanding of scale drawings to perform simple tasks.
4	Apply appropriate knowledge and skills of scale drawings in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of scale drawings in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of scale drawings in the context of non-routine problem solving in a creative manner.

LEARNING AREA

MEASUREMENT AND GEOMETRY

TITLE

5.0 TRIGONOMETRIC RATIOS

5.0 TRIGONOMETRIC RATIOS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
5.1 Sine, Cosine and Tangent of Acute Angles in Right-angled Triangles	Pupils are able to:	
	5.1.1 Identify the opposite side and adjacent side based on an acute angle in a right-angled triangle.	
	5.1.2 Make and verify the conjecture about the relationship between acute angles and the ratios of the sides of right-angled triangles, and hence define sine, cosine and tangent.	Notes: Connection with the concept of proportion needs to be done.
	5.1.3 Make and verify the conjecture about the impact of changing the size of the angles on the values of sine, cosine and tangent.	Notes: The impacts of changes need to be explained using the ratios of the sides of right-angled triangles. Angles of 0° and 90° need to be involved.
	5.1.4 Determine the values of sine, cosine and tangent of acute angles.	Notes: The relationship of $\tan\theta = \frac{\sin\theta}{\cos\theta}$ needs to be explored.
	5.1.5 Determine the values of sine, cosine and tangent of 30°, 45° and 60° angles without using a calculator.	Notes: Surd form needs to be involved.

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	5.1.6 Perform calculations involving sine, cosine and tangent.	Notes: The notations of $\sin^{-1}$, $\cos^{-1}$ and $\tan^{-1}$ need to be used.
	5.1.7 Solve problems involving sine, cosine and tangent.	Notes: Problems include 3D geometrical objects, angles of elevation and angles of depression.

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of the sides of right-angled triangles based on an acute angle.
2	Demonstrate the understanding of sine, cosine and tangent.
3	Apply the understanding of sine, cosine and tangent to perform simple tasks.
4	Apply appropriate knowledge and skills of sine, cosine and tangent in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of sine, cosine and tangent in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of sine, cosine and tangent in the context of non-routine problem solving in a creative manner.

LEARNING AREA

MEASUREMENT AND GEOMETRY

TITLE

6.0 ANGLES AND TANGENTS OF CIRCLES

6.0 ANGLES AND TANGENTS OF CIRCLES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
6.1 Angle at the Circumference and Central Angle Subtended by an Arc	Pupils are able to: 6.1.1 Make and verify conjectures about the relationships between (i) angles at the circumference, (ii) angles at the circumference and central angle subtended by particular arcs, and hence use the relationships to determine the values of angles in circles. 6.1.2 Solve problems involving angles in circles.	Notes: Various methods including the use of dynamic softwares need to be used. 6.1.1 (ii) include “angles in a semicircle”.
6.2 Cyclic Quadrilaterals	Pupils are able to: 6.2.1 Recognise and describe cyclic quadrilaterals. 6.2.2 Make and verify conjectures about the relationships between angles of cyclic quadrilaterals, and hence use the relationships to determine the values of angles of cyclic quadrilaterals. 6.2.3 Solve problems involving cyclic quadrilaterals.	Notes: Various methods including the use of dynamic softwares need to be involved.

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
6.3 Tangents to Circles	Pupils are able to: 6.3.1 Recognise and describe the tangents to circles.	
	6.3.2 Make and verify conjectures about (i) the angle between tangent and radius of a circle at the point of tangency, (ii) the properties related to two tangents to a circle, (iii) the relationship of angle between tangent and chord with the angle in the alternate segment which is subtended by the chord, and hence perform the related calculations.	Notes: Various methods including the use of dynamic software need to be involved. Geometrical constructions need to be involved to verify conjectures.
	6.3.3 Solve problems involving tangents to circles.	Notes: Problems of common tangents need to be involved.
6.4 Angles and Tangents of Circles	Pupils are able to: 6.4.1 Solve problems involving angles and tangents of circles.	

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of angles in circles, cyclic quadrilaterals and tangents to circles.
2	Demonstrate the understanding of angles in circles, cyclic quadrilaterals and tangents to circles.
3	Apply the understanding of angles in circles, cyclic quadrilaterals and tangents to circles to perform simple tasks.
4	Apply appropriate knowledge and skills of angles and tangents to circles in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of angles and tangents to circles in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of angles and tangents to circles in the context of non-routine problem solving in a creative manner.

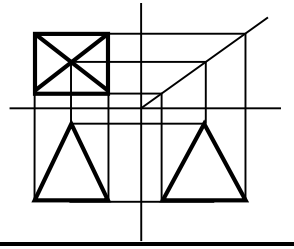
LEARNING AREA

MEASUREMENT AND GEOMETRY

TITLE

7.0 PLANS AND ELEVATIONS

7.0 PLANS AND ELEVATIONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
7.1 Orthogonal Projections	Pupils are able to: 7.1.1 Draw orthogonal projections.	Notes: Views from various directions for vertical and horizontal planes need to be involved. Concrete materials and technological tools such as dynamic softwares need to be used to develop understanding.
	7.1.2 Compare and contrast between objects and the corresponding orthogonol projections.	Notes: Length, angle and shape need to be involved.
7.2 Plans and Elevations	Pupils are able to: 7.2.1 Draw the plan and elevations of an object to scale.	Notes: Concrete materials and technological tools such as dynamic softwares need to be used to develop understanding. Drawing the plan and elevations in a diagram by showing the construction lines need to be used. Example: 

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
		Combined objects and original objects partially removed, need to be involved. Types of lines should be emphasised: (a) thick solid line (for visible side). (b) dash line (for hidden side). (c) thin solid line (for construction line).
	7.2.2 Synthesise plan and elevations of an object and sketch the object.	Notes: Technology such as dynamic softwares need to be used to develop understanding.
	7.2.3 Solve problems involving plans and elevations.	Notes: Project works which involve the followings need to be carried out: (a) construction of models such as building and furniture. (b) calculations such as cost, area and volume. (c) presentation. Integration of STEM elements can be implemented as follows: S – stability in the construction of building structures T – use of software to draw plans and elevations E – design models of building M – calculations of cost, area and volume

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of orthogonal projections.
2	Demonstrate the understanding of orthogonal projections.
3	Apply the understanding of plans and elevations to perform simple tasks.
4	Apply appropriate knowledge and skills of plans and elevations in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of plans and elevations in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of plans and elevations in the context of non-routine problem solving in a creative manner.

LEARNING AREA

MEASUREMENT AND GEOMETRY

TITLE

8.0 LOCI IN TWO DIMENSIONS

8.0 LOCI IN TWO DIMENSIONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
8.1 Loci	Pupils are able to: 8.1.1 Recognise loci in real life situations and hence explain the meaning of locus.	Notes: Exploratory activities involving loci in two and three dimensions (such as sphere and cylinder) need to be carried out. Locus is a set of points whose location satisfies certain conditions.
8.2 Loci in Two Dimensions	Pupils are able to: 8.2.1 Describe the locus of points that are of (i) constant distance from a fixed point, (ii) equidistant from two fixed points, (iii) constant distance from a straight line, (iv) equidistant from two parallel lines, and (v) equidistant from two intersecting lines, and hence construct the locus. 8.2.2 Determine the locus that satisfies two or more conditions. 8.2.3 Solve problems involving loci.	Notes: Hands-on activities need to be carried out. Various methods including the use of dynamic softwares need to be used. Notes: Problems include those involving condition of distance which is more or less than a certain value.

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of loci.
2	Demonstrate the understanding of loci.
3	Apply the understanding of loci in two dimensions to perform simple tasks.
4	Apply appropriate knowledge and skills of loci in two dimensions in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of loci in two dimensions in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of loci in two dimensions in the context of non-routine problem solving in a creative manner.

LEARNING AREA

RELATIONSHIP AND ALGEBRA

TITLE

9.0 STRAIGHT LINES

9.0 STRAIGHT LINES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
9.1 Straight Lines	Pupils are able to:	Notes:
	9.1.1 Make connection between the equation, $y = mx + c$, and the gradient and y-intercept, and hence make generalisation about the equation of a straight line.	Explore various graphs of linear functions with and without the use of dynamic softwares. Equations of straight lines which are parallel to y-axis and x-axis need to be involved.
	9.1.2 Investigate and interpret the equations of straight lines in other forms such as $ax + by = c$ and $\frac{x}{a} + \frac{y}{b} = 1$, and change to the form of $y = mx + c$, and vice versa.	Notes: For $\frac{x}{a} + \frac{y}{b} = 1$, $a \neq 0$ and $b \neq 0$.
	9.1.3 Investigate and make inference about the relationship between the points on a straight line and the equation of the line.	Notes: Points which are not on the straight line need to be involved.
	9.1.4 Investigate and make inference about the gradients of parallel lines.	
	9.1.5 Determine the equation of a straight line.	

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	9.1.6 Determine the point of intersection of two straight lines. 9.1.7 Solve problems involving straight lines.	Notes: Determination of point of intersection needs to be explored with and without the use of dynamic softwares. Calculator is **only allowed** to check the answer. Various methods including substitution, elimination and graph need to be involved.

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of gradient and y-intercept in the equation of a straight line.
2	Demonstrate the understanding of straight lines.
3	Apply the understanding of straight lines to perform simple tasks.
4	Apply appropriate knowledge and skills of straight lines in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of straight lines in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of straight lines in the context of non-routine problem solving in a creative manner.

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ACKNOWLEDGEMENT

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