Working Paper for SEAMEO Basic Education Standards (SEA-BES): Common Core Regional Learning Standards in Mathematics

Executive Summary

Background and Purpose

The goal of regional integration in the development of an 'ASEAN Community' provides the opportunity for the development of an educational policy framework for all SEAMEO Member countries in order to enhance access to educational opportunities, to support the development of quality basic education and to encourage regional mobility. Such a framework will support all Governments as the main providers of basic education to meet the learning needs of all students.

Indeed the SEAMEO Education Agenda #7 "Adopting a 21st Century Curriculum" states to pursue a radical reform through systematic analysis of knowledge, skills, and values needed to effectively respond to changing global contexts, particularly to the ever-increasing complexity of the Southeast Asian economic, socio-cultural, and political environment, developing teacher imbued with ASEAN ideals in building ASEAN community within 20 years (2015-2035).

As an initiative effort we establish SEA-BES project. In envisage to face the challenges of the future, 21st century skills and competencies (OECD, 1997) are emphasized in the proposed curriculum. 21st century skills encompass learning skills, literacy skills and life skills. Other than knowledge and well-cultivated values, a competent learner should be able to use tools such as language and technology to convey ideas and thoughts, can act autonomously based on rational decisions and ability to interact well with others in the community.

A well-designed and balanced curriculum will support the aim of producing children who will are brave to face complex demands in their daily lives. The learner will grow and develop with knowledge and skills that enable them to find jobs, being responsible, self-reliant and contributing to society.

Purposes

The SEAMEO Basic Education Standards initiative would support SEAMEO Member countries in the following respects:

a) to use it as an analytical tool to support future development of regional integrated curriculum necessary for ASEAN integration with emphasis on 21st century skills;
b) to strengthen ASEAN collaboration on curriculum standards and learning assessment across different educational systems to effectively respond to the changing global context and complexity of ASEAN ;

c) to promote in every member country the establishment of best practices to overcome differences in curriculum;
d) to produce systematic discussion process for the establishment of the regional integrated curriculum and assessment;
e) to use as a platform for curriculum development and professional development for all stakeholders developing teachers imbued with ASEAN ideals in building ASEAN community;
f) to serve as a platform for the Southeast Asia Primary Learning Metrics (SEA-PLM).

On this purposes, SEAMEO defines basic education standards as the competency in teaching and learning of science and mathematics that are achieved through engagement in education in order to function successfully in society taking into account cultural differences and the importance of ASEAN values.

Nature and Characteristics

SEA-BES is a regional curriculum project the purpose of which is to develop standards. It envisions to developing standards in learning and teaching of science and mathematics. Initially, SEA-BES will develop learning standards in Science and Mathematics based on a curriculum review of SEAMEO Member Countries' National curriculum. The SEA-BES aims to improve curriculum quality, efficiency and equity in SEAMEO Member Countries.

The diagram in Figure 1 below shows the conceptual framework.

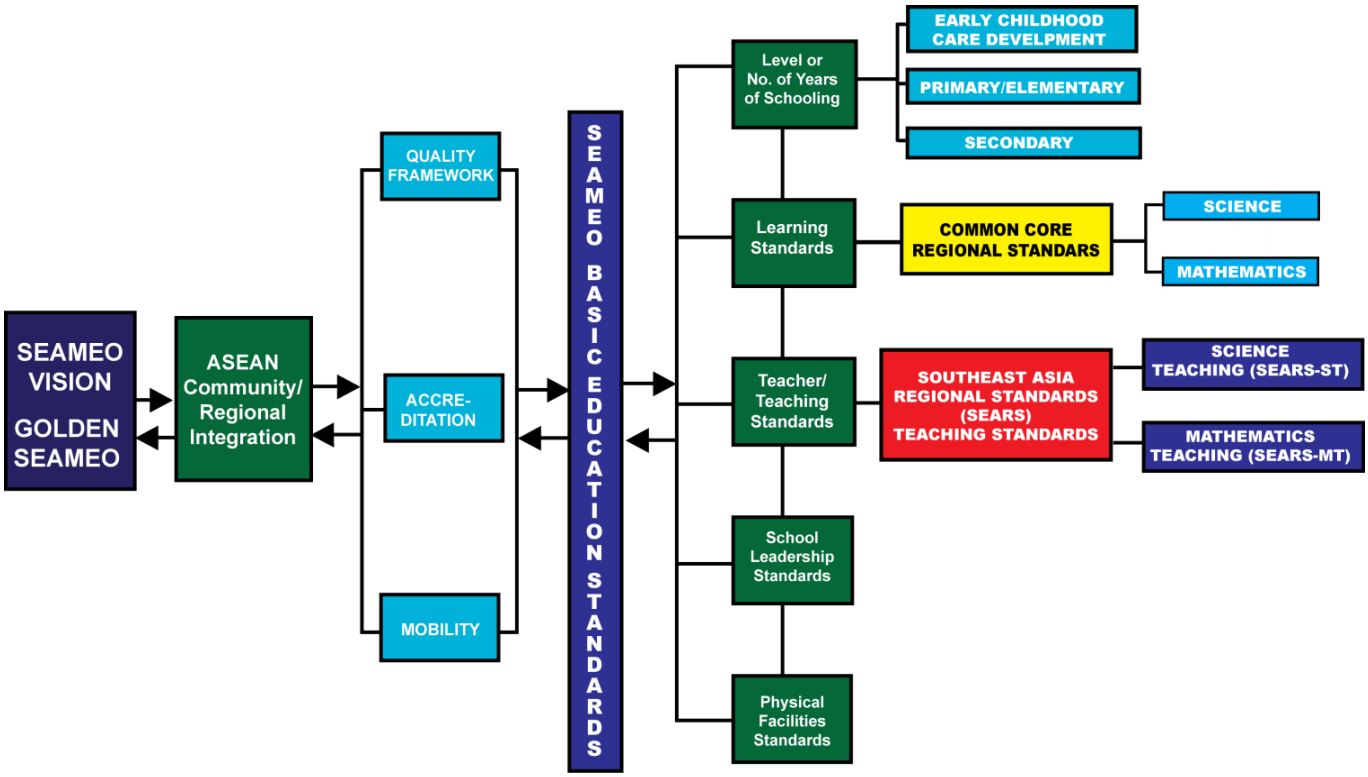

Figure 1. SEA-BES conceptual framework

Definition of Terms

Common- means the shared and agreed standards that can be related to national curriculum context of SEAMEO Member Countries.

Core – means those aspects of curriculum (i.e. knowledge, skills, and attitudes) to which all students will have access and expected to learn.

Learning Standards – are written descriptions of what students are expected to know and be able to do at a specific stage of their education. Learning standards describe educational objectives – i.e., what students should have learned by end of a grade or grade span – but they do not describe any particular teaching practice, curriculum or assessment method.

Regional Standards – are those standards that have been adopted by SEAMEO Member Countries to be applied to national curriculum.

Key Stages - means the blocks of years covering the period of basic education, namely; Key Stage 1 covers Grades 1, 2 and 3; Key Stage 2 covers Grades 4, 5 and 6; and Key Stage 3 covers Grades 7, 8 and 9.

Development Process of the Common Core Regional Learning Standards

The CCRLS in Science were developed based from the strengths of the existing national education standards of the SEAMEO Member Countries. The various activities undertaken in the development of the draft (Working Paper) CCRLS in Science and Mathematics include:

- Comparing of the national education curriculum of the seven SEAMEO Member Countries in Science and Mathematics, namely Brunei Darussalam, Cambodia, Indonesia, Malaysia, Philippines, Singapore and Thailand;
    - identifying similarities and differences in terms of content/domain/topics/strand by country;
    - mapping/tracking of content/domain/topics/strands across grade levels from the primary to secondary level; and
    - Consolidating of content standards and performance standards by subject and by grade levels from primary to secondary levels.
- Benchmarking with the learning standards of high-performing countries in international student assessments such as Hong Kong, Japan, Australia, United Kingdom and US; relative documents such as 2015 TIMSS Framework and NCTM as well as research studies and literature available on what students need to know and be able to do to be successful in college, career, and life

Figure 2 shows the flow process of the development of the common core regional learning standards in science and mathematics.

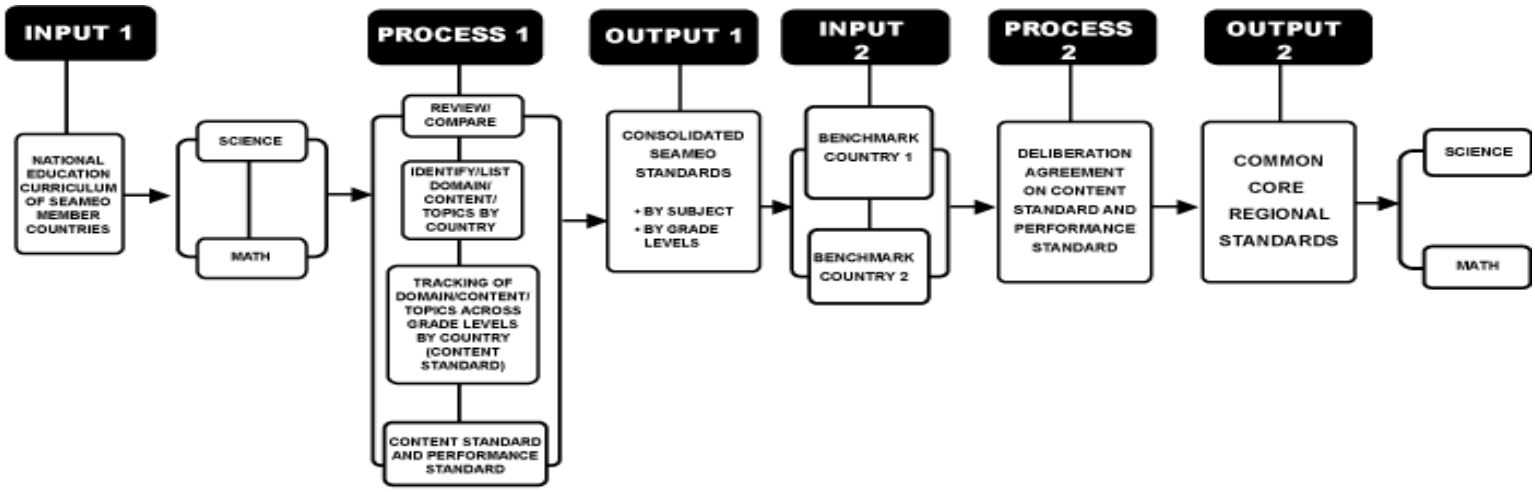

Figure 2. Framework in developing the CCRLS in Science and Mathematics for SEA-BES (Mangao, D., Tahir, S., and Zakaria, M.J., 2015)

Series of SEA-BES Workshops

A series of workshops which aims to develop the draft of the Common Core Regional Learning Standards (CCRS) in Science and Mathematics were conducted on the different dates, levels and venues as follows:

A series of workshops which aims to develop the draft of the Common Core Regional Learning Standards (CCRLS) in Science and Mathematics were conducted on the different levels, dates and venues as follows:

A. **National Level (RECSAM in Penang, Malaysia)**

- 2 April 2015 (25 participants)
- 11 May 2015 (23 participants)
- 21-22 May 2015 (23 participants)
- 23 July 2015 (22 participants)
- 27 August 2015 (28 participants)
- 17 September 2015 (25 participants)
- 27-28 January 2016 (30 participants)
- 24-25 March 2016 (35 participants)

B. **Regional Level**

- 4-5 November 2014 (SEAMEO RECSAM, Malaysia)
- 20-22 October 2015 (61 participants at SEAMEO RECSAM, Malaysia)
- 15-18 February 2016 (14 participants at University of Tsukuba, Tokyo, Japan – for Mathematics Standards only participated in by MOE Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore and IPST Thailand and RECSAM specialists
- 5-12, 13-20 and 19-25 June 2016 (three RECSAM Mathematics Specialists at University of Tsukuba, Tokyo, Japan)
- 13-20 June 2016 (two RECSAM Science Specialists at Toho University, Shizuoka University, and Chiba University as well as National institute for Educational Policy Research (NIER, MEXT), Tokyo, Japan)

Participation and Involvement of Experts and Educators

Maximum participation and involvement of experts and teachers across the Southeast Asian region and beyond were solicited in the development of the draft CCRLS. Their tasks include being a member of curriculum working group giving inputs and providing specific, constructive feedback on the draft Standards. The following groups were involved:

- Consultants (Professor Masami Isoda, Center of Research on International Cooperation in Educational Development, University of Tsukuba, Japan; Dr. Mark Windale, Centre for Science Education, Sheffield Hallam University, United Kingdom; and Professor Kerry J. Kennedy, Hong Kong Institute of Education, Hong Kong
- curriculum experts in science and mathematics from the 11 Ministries of Education of SEAMEO Member Countries,
- SEAMEO Secretariat
- science and mathematics specialists from SEAMEO centers (i.e. RECSAM, QITEP in Science, QITEP in Mathematics, SEAMOLEC)
- science and mathematics lecturers from Malaysian educational institutions (i.e., Universiti Sains Malaysia, Teacher Education Institutes (IPGs)
- science and mathematics specialists from the National Science and Mathematics Centers (i.e., Institute for the Promotion of Teaching Science and Technology

(IPST), University of the Philippines – national Institute for Science and Mathematics Education Development (UPNISMED)
- elementary and secondary science mathematics master/experienced teachers from Penang State

Aim of SEA-BES CCRLS in Science and Mathematics

SEA-BES is a regional project designed to produce learning standards that can support the SEAMEO Member Countries to provide world-class curriculum for all students. SEA-BES will develop two learning standards namely; Common Core Regional Learning Standards (CCRLS) in Science and Common Core Regional Learning Standards (CCRLS) in Mathematics.

Basically, the aim of the SEA-BES CCRLS in Science and CCRLS in Mathematics states:

> **"**To provide world-class learning standards in Science and Mathematics, including 21st century skills that can be used as benchmarks in SEAMEO Member Countries to ensure all students have access to fundamental knowledge, skills and values in order to be socially responsible, globally competitive and sustainable."

SEA-BES Common Core Regional Learning Standards in Mathematics Framework

Mathematics has been recognized as a necessary literacy for citizens who do not only lived economically. A part of 3Rs, but also to establish a society with fruitful arguments and creations for better living. It has been taught as a language for academic subjects which uses visual and logical-symbolic representations. In this information society, mathematics has increased its role to establish 21st century skills through reviewing mathematics as the patterns of science for future prediction and designing with big data which produce innovation not only for technology advancement but also for business model. Mathematics is an essential subject to establish common reasoning for sustainable development of society through viable argument in understanding each other and develop critical reasoning as the habit of minds with mathematics.

SEA-BES Common Core Regional Learning Standards in Mathematics Framework was developed based on those essential and pressing demands of mathematical competency for the 21st century based on the analysis of national curriculums in SEAMEO countries.

The Descriptions of the Frameworks of CCRLS in Mathematics

The framework is the general structure that organizes the learning and teaching in the mathematics subjects. The structure comprises a set of interwoven components including:

- Content knowledge and skills (expressed in strands)
- Mathematical processes
- Values and attitudes for mathematics

The framework in Figure 3 sets the direction and provides guidance in the learning and teaching of mathematics. It reflects also the integration of the 21st Century Skills.

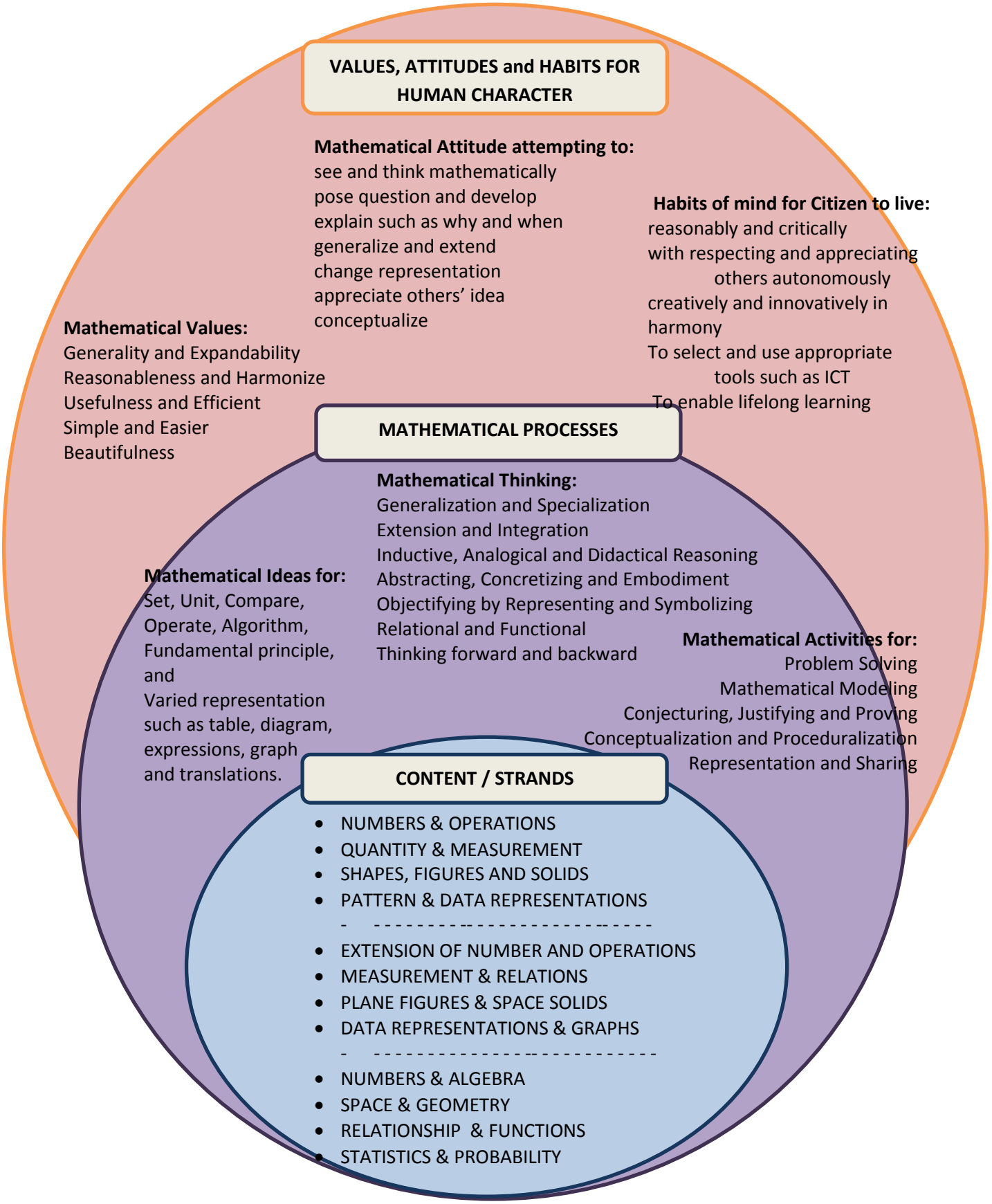

Figure 3. SEA-BES Common Core Regional Learning Standards in Mathematics Framework for the 21st Century

Aims of Mathematics Education

The framework in Figure 3 depicts the aims of the school mathematics education undertake by each respective government to prepare human capital of the next generation in this 21st century. Mathematics is regarded as a universal subject for ASEAN citizenship that enable the shaping of human characters to meet the demand of technological and economical sustainable development of ASEAN community.

The aim to promote mathematical competency can be explained with the appropriate contexts such as below:

- developing mathematical curiosity when solving and formulating problems through inductive and deductive reasoning
- applying the mathematics learnt and appreciate the usefulness, power and beauty of mathematics
- enjoying mathematics and develop patience and perseverance when solving problems
- feeling excited to solving unknown problems and solutions and feel affection of getting ideas with Eureka
- developing communication skills through the use of language, symbols and notation of mathematics
- assessing any situations critically by applying the knowledge and skills mathematics
- exploring ideas with examples and counter examples
- developing confidence in using mathematics to analyze and solve contextual problems both in school and in real-life situations
- developing the knowledge, skills and attitudes necessary to pursue further studies in mathematics
- developing abstract, logical and critical thinking and the ability to critically assess upon their work and the work of others
- fostering critical reasoning and appreciating others' perspective through mathematical discourse
- promoting a critical appreciation of the use of information and communication technology in mathematics
- appreciating the universality of mathematics and its multicultural and historical perspectives.

In the contexts of human character formation, the following nature of mathematics learning processes are considered:

Mathematical thinking can be developed through problem solving activities in real life which may include problems related to sustainable development of economy, technology, science, and engineering. In the process of problem solving, exploration leads to the acquiring of skills for making generalization and specialization, extension and integration, logical reasoning, abstracting, concretizing and embodiment of ideas, and making appropriate representation.

The process of mathematical activity encompasses problem solving that can be done through vari ous strategies and mathematical models. Exploration of ~~the~~ problems enable engagement of conj ecturing, justifying and proving. The meaningful and procedural contextualize outcome can be re presented in various modes for sharing.

Mathematical ideas serve as the basis of content knowledge related to promoting and developing mathematical thinking. The fundamental ideas of set, unit, leads to a more hierarchical and simple structural relationship. The ability to compare, operate, and perform algorithm of related functions ~~to~~ enable efficient ways of learning and solving real life mathematics.

Based on these nature of mathematical learning process, human characters such as values, attitudes and habits of mind can be developed. In this context, values, attitudes and habits of mind are also the driving force for engaging in mathematical process. Teachers may need to challenge to teach the content through mathematical processes and appreciate the beauty of mathematical structure to develop human characters. Process skills and its values can be developed through critical reflections of process and appreciation of metacognition. Mathematical communication is necessary not only to develop shareable mathematical concepts in classroom but also to develop habits to appreciate others with understandable and reasonable representation beyond the critics, and accommodate others' ideas to create a harmonious community.

Values and Attitudes

The development of values and attitudes are essential elements of the school curriculum. Values and attitudes should be permeated in the learning and teaching of mathematics to foster mathematical thinking and ways of working, such as curiosity, creativity, objectivity, integrity, perseverance, self-discipline, truth, honesty, trust, interdependence and sustainability.

Values of mathematics such as recognizing beautifulness of pattern are learned through the appreciation of mathematical experience. Appreciation of others' idea which includes understanding ideas that make sense. Communication such as proof and refutation are common ways for mathematician to develop mathematics. The ways of communication also can be learned through experience of communication such as explanations using known-shared idea, appropriate representation, logical reasoning. Includes the ways of argument such as proof and showing counter examples. The opportunity to understand others' reasoning functions to reconstruct one's idea by him/herself. Thus, mathematical argumentation through listening and comparison of others ideas and one's idea gives opportunities to develop deep understanding.

Attitudes include creative, critical, open-minded, responsible, appreciative, empathetic, self-directed learners, active contributors, thoughtful learners, belief and interest, caring and concern, socially aware, self-awareness, concerned citizen, respect for evidence, inventiveness, tolerate uncertainty, caring for the living and non-living environment.

In this information society, mathematics are well used for the technological innovation of the society such as it produces business models by using large data. Mathematics education provides

necessary learning experiences for using ICT appropriately depending on the context such as scientific exploration and social economical entrepreneurship. Such endeavors involve the engagement and application of the following;

- use ICT appropriately depending on demands for using data and making decision.
- use ICT for getting predictions and proof by reasoning
- learning and critic the idea of others and try to produce reasonable ideas beyond border using ICT.

Aims and Format of Frameworks

SEA-BES Common Core Regional Learning Standards in Mathematics Framework is developed for regional integration of mathematics curriculum would support SEAMEO Member countries through the following activities: a) analytical tool, b) collaboration, c) best practices d) systematic discussion e) a platform for curriculum development and professional development, and f) assessment.

On these demand, SEABES-CCRLS in mathematics framework is formatted by three key learning stages, four content strands for every stages and process-humanity strand for every stages. Content strands described every content standards and process-humanity strand describe every process-humanity standards across different content strands[1].

The Common Core Regional Learning Standards (CCRLS) in Mathematics encompass three key learning stages of schooling, namely; Key Stage 1 – lower primary level (Grade 1 to Grade 3); Key Stage 2 - upper primary level (Grade 4 to Grade 6); and Key Stage 3 – lower secondary level (Grade 7 to Grade 9). The CCRLS is used as an analytical tool to support future development of regional integrated curriculum necessary for ASEAN integration with emphasis on 21st century skills. Following the description of every stage support the discussion on meeting basic proficiency level of mathematics knowledge which is necessary in the preparation for continuously learning in their life.

Key Stage 1 serves as the foundation of knowledge covering the basic facts and skills developed through simple hands-on activities, manipulation of concrete objects, pictorial and symbolic representations. This stage focuses on arousing interest, enjoyment and curiosity in the subject through exploration of pattern, characterization, identification and describing shapes, performing the four fundamental operations, identify its algorithm, and understanding basic mathematical concept and skills experienced in daily life. Calculation of quantities will also be established to

[1] The delegates from SEAMEO member countries worked together at the SEAMEO RECSAM-University of Tsukuba Joint Seminar: Searching for Quality Mathematics Curriculum Framework on the Era of Globalization, February 15-18, 2016 (The University of Tsukuba is an affiliated member of SEAMEO) for the establishment of agreement on the format of curriculum. In the meeting, 21st century curriculum frame work and every countries frame work were presented. The four content strands and one process-humanity strand for every learning stage were agreed. The hierarchy under content strands are also deduced as follows: every content strand, topic is described in a sentence beginning from a verb in a gerund form to embed context into content, every topic standard is described in sentences with a verb and adjective to emphasize the activity and value.

carefully and willfully understand the attribution of objects that are used to make direct and indirect comparison.

Key Stage 2 builds from the competencies acquired from the first stage. This stage provides the extension of numbers, measurement and relations, plane figures and solid figures and data representations and graphs. This level will enable deepening of experiences in their life and allows the use of mathematical terminologies, performing investigations and establish the base for analyzing, evaluating and creating. Appreciating the beauty of structure of mathematics will enable them to enjoy and sustain the learning.

Key Stage 3 builds from the competencies acquired from the second stage. This stage discusses number and algebra, relations and function, space and geometry and statistics and probability. This presents higher cognitive demands dealing with abstract ideas and concepts that enhances critical thinking, creative thinking through the application of knowledge and understanding of abstract concepts and principles in daily life in participating discussions, dialogue, arguments pertaining to contemporary societal, economic, technological, political, environmental and mathematical issues. The knowledge enable to create better future predictions for the betterment of the living environment. This knowledge also bridges the further mathematics learning in different job demands.

The Content Strands

The arrangement of major learning elements in Mathematics is now put into four content strands in every key stage, in total of twelve content strands. In every stage, four content strands are mutually related[2]. The same content strand names are not used to indicate progression beyond each stage. For example, in key stage 1, "Numbers and Operations", Key Stage 2, Extension of Numbers and Operation and key stage 3, Numbers and Algebra. The name of the content strands is progressing beyond the stages shows the extension and integration of content. In the case of measurement, key stage 1 relates with quantity and setting the units. In key stage 2, it extends to non-additive quantity beyond dimension. In Key stage 3, measurement is not used as one content strand because the idea of unit is embedded everywhere. For example, square root is an irrational number which means unmeasurable, Pythagorean theorem in geometry used for measuring, proportional function is used for counting the number of nails by weight, and in statistics, new measurements units are expressed such as quartile for boxplot.

Numbers and Operations for Key stage 1

Number concepts are introduced with situations, concrete objects, pictorial and symbolic representations. The ways of counting and distributions are extended through addition, subtraction, multiplication and division. Base ten numeral system is the key roles for extending

[2] Strands used to explain mutual relation of content (Jeremy Kilpatrick, Jane Swafford, Bradford Findell. "Adding it up", National Academies Press. 2001). The term domain is sometimes used for compartmentalization though categorization of content.

the numbers and operations for standards algorithm in vertical form. Procedure of calculations and algorithms are also focused. Through the establishment of fluency of calculations with connection of situations, number sense will be developed. Concept of fraction and decimals are introduced with manipulative.

Quantity and Measurement for Key Stage 1

Attribute of objects are used to make direct and in-direct comparison. For comparison, the non-standard unit and standard are use. Counting activities denominate units of quantities such as cups for volumes, arm-length and hand-spans for length. Standards units such as m, cm, kg and L are introduced. Time, durations and Calendar which are not based ten system are introduced. Moneys are good model for based 10 system. Through the calculation of the quantities, the concept of conservation of the quantities will be established.

Shapes, Figures and Solids for Key stage 1

In this strand, the basic skills of exploring, identifying, characterizing and describing shapes, figures and solid based on their features are proposed. Activities such as paper folding enable exploration of various features of shapes. Identification of similarities and differences about shapes and solids enable classification to be done for defining figures. Using appropriate materials and tools, relationship in drawing, building and comparing the 2D shapes and 3D objects are considered. Through these activities, the skills for using the knowledge of figures and solids will be developed. The compass is introduced to draw circles and take the same length.

Pattern and Data Representations for Key stage 1

In this strand, various types of patters are treated such as the number sequences and repetition of shapes. Size of pictures can be represented by the number sequences. Tessellation of shapes and paper folding can be represented by the repetition of shapes. Exploration of pattern and features are also considered to represent data structure in our life with pictograph. Patterns and features produce meaning and represents mathematical information. Patterns are represented by diagrams and mathematical sentences which are also used for communication in identifying and classifying situations to produce meaningful interpretations.

Extension of Numbers and Operations for Key stage 2

Numbers are extended to more digits, fractions and decimals. Multiplication and division algorithms are completed and acquiring fluency. Fraction becomes numbers through the redefinition as a quotient instead of part - whole relationship. Multiplication and division of decimals and fractions are also explored to produce the procedure for calculation. Various representations are used to elaborate and produce meaning for the calculation. Number sense such as approximate numbers, relative size of numbers and value are enhanced for the practical reasoning in the appropriate context of life.

Measurement and Relations for Key stage 2

Additive quantity such as angles, areas and volume and relational quantity such as population density, and speed are introduced. Additive quantity can be introduced by establishment of the standard unit which is the same way as the quantity of Key Stage Relations are introduced with the patterns such as sum is constant, difference is constant, product is constant and quotient is constant on the table and represented by mathematical sentence and symbols. Proportion and ratio are introduced with representations of diagrams, graphs and tables for multiplication, and connected with decimal and fraction. Percent are introduced with diagrams in relation to ratio and proportion. Relational quantity is well established with the supported understanding of proportion and ratio. Areas of a circle are discussed through relationship between radius and the circumference. Idea of ratio and proportion are fluently applied for real world problem solving.

Plane Figures and Space Solids for Key stage 2

Through tessellation, figures can be extended through plane figures. Parallelogram and perpendicular lines are tools to explain properties of triangles and the quadrilaterals as plane figures. For identifying and recognizing symmetry and congruence also need parallelogram and perpendicular lines. Plane figures are used to produce solid in space. Opening up faces of solids would produce plane figures which is referred as nets. Those activities related to building solids from plane figures are emphasized and encouraged because finding the area of a circle through numerous sectors of the circle to construct a rectangle. Circles are used for explaining the nets of cylinders.

Data Representations and Graphs Key stage 2

In this strand, the process of data handling is introduced through data representation such as table, bar graph, line graph, bar chart and pie chart. For producing the graph the differences between qualitative and quantitative data are distinguished. The establishment of category is the key discussion for producing the Bar graph. The discussion of producing the line graph includes taking data at specific intervals, suitable scale used and slope. Histogram which is necessary for reading the ~~date~~ data representation of social study and science is also used as special type of bar chart. Average are introduced based on the idea of ratio for making the variability of histogram evenly, and used for summarizing and comparing data on table. Logical analysis to understand the whole possible cases such as tree diagram are introduced for knowing the ways of reasoning

Numbers and Algebra for Key stage 3

Numbers are extended to positive and negative numbers, and square roots. Algebraic expressions are already introduced by the mathematical sentence and symbols at Key Stage 2. At Key Stage 3 algebra are operated by expressions and equation until the second degree. On the extension of the calculation from numbers to symbolic algebra, various possibilities are explored over ways of calculations to determine appropriate ones. Like and unlike terms are introduced in an algebraic sentence and the expressions are then operated by equation and expressions with similar terms with fluency in simplifying, solving, distributing, changing of subject and factorizing. ~~E~~xplaining appropriateness of calculation by the rules such as the three laws called distributive, associative, and commutative properties of real numbers are included.

Space and Geometry Key stage 3

Space and Geometry provides the ways of reasoning for exploring properties in geometry and produce the ways of argument to explain justifications of visible reasoning. For developing the habit of reasoning on plane figures, Geometry includes the activities to explain the relationship of figures using transformation-identify the properties of congruency and describing similarities, ways using calculation of angles and proofs are means for developing the habit of reasoning on plane figures. The calculations of angles are not just simple calculation but also the ways of using the geometric propositions to justify answers through explaining why it is correct based on basic properties. The conditions of congruence and similarities, properties of circles, are also used to explain and prove appropriateness of geometric conjectures in relation to triangle, squares, and circles. Dynamic geometric software as well as simple compass and ruler are used for exploration of assumptions and well synchronized with searching general idea by special cases. Counter example is used for explaining ~~in~~ appropriateness of reasoning.

Relationship and Functions for Key stage 3

In this strands, relationships are represented by equations and system of equations. Functional relations are treated amongst situations, tables, and equations of function that are introduced based on patterns and relations with algebraic representation on Key Stage 2 and Key Stage 3. Solution of simple equation is done by equivalence deduction based on algebra learnt earlier. Two variables simultaneous equations as simple system of equations are solved by substitution and additive-subtractive methods. Three representations, table, equation and graph, are used as methods to analyze the properties of every function. Direct and indirect proportions are redefined with those representations mentioned. Direct proportional function are extended to line functions. The comparison of indirect proportion and line functions make clear the property of line with 'constant ratio of change'. The concept of proportion is extended to function of y = a (x^2) Ways of translations between table and equation, equation and graph, graph and table are specific skills for every function and can become procedural that enable every function to be treated fervently.

Statistics and Probability for Key stage 3

In this strand, data handling are extended to explore the viability of histogram with mean, median, mode and range. Exploratory analysis of given data using ICT is enhanced such as histogram show different viability if we change the range. Probability is introduced as ratio with the law of large number. Sample space with assumption of equiprobability become the point of discussion. Histogram can be seen relatively and produce frequency distribution polygon. Difference between sample and senses also discussed. Boxplots with quartile which is extension of median and range also used for the comparisons of distributions.

Mathematics Processes and Humanity Strand: Ways of Thinking, Processes, and Values and attitude

Mathematical activity which explained in previous section is represented with various contexts. Such contexts are necessary for developing the ways of thinking, engaging in mathematical process to use and develop mathematics, and appreciating the values of mathematics through reflection. Those context will be simplify the following three processes: developing mathematics, argumentation for understanding others and sophistication through critique, and applying mathematics through modeling and replacement. Extension and generalization are a key for developing mathematics. Producing understandable explanations are usually related with understandable representation such as diagram and materials for showing simple structure. Example is used for demonstration by the specific case and counter example is used for checking generality. Process of modeling usually include problem formation, solving mathematically, and explain the meaning. On those three contexts, values of mathematics such as recognizing beautifulness of pattern are learned through the appreciation of mathematical experience. Appreciation of others' idea which includes understanding ideas with sense such as usefulness or not-usefulness of learned.

Mathematical Processes: Key Stage 1

Enjoyable mathematical activities are designed to enhance understanding of number patterns through comparison, ordering and inductive reasoning. Exploration of various number sequence, skip counting, addition and subtraction operations help to develop number sense that is essential to support explanation of contextual scenario and mathematical ideas. Mathematical ways of posing questions on the life are also necessary learned at this stage. At initial stage, concrete model is enjoyable however most necessary is drawing diagram for explaining complicated situations by simple way of representation.

Mathematical Processes: Key Stage 2

As a follow up of key stage 1, activities are designed to enable an appreciation of learned and the ways of learning such as the knowledge of number sense to solve daily problems. Mathematical processes such as communication, reasoning are utilized to provide explanation for mathematical problems and modeling. The ability to connect and reason mathematical ideas would trigger an excitement among learners. Discussions of misconceptions are usually enjoyable. Mathematics learning usually began from the situation at key stage 1. On key stage 2, beginning from the development of mathematics is possible such as the discussion for the extension of the forms. Appreciation learned ideas and representations become the part of enjoyable activities. Though the consistent using of representation such as diagram, application of learned become meaningful.

Mathematical Processes: Key Stage 3

Mathematical activities of Key stage 3 enhance the logical argument in mathematics for communication with others. Challenging activities proposed promote thinking at different level of argument to make sense of mathematics. Translating real life activities into mathematical

model and solving problems using appropriate strategies are emphasized in the functional situation. The processes of doing mathematical activities include patience which develop perseverance in learners and take responsibility of one's own learning. At this stage, the habitual practice of self-learning will eventually develop confidence, thus, opportunity for challenges to extend mathematics and planning learning sequence are also enhanced.

Remarks

The SEA-BES Common Core Regional Learning Standards in Science and Mathematics are works in progress. Both Standards are constantly developing and evolving as current issues and trends are being accommodated. Though substantial work has been accomplished, yet much more need to be done. For this Working Paper of the SE-BES CCRLS to be considered of world-class quality and truly reflect ASEAN values, more opportunities for in-depth discussion and seeking agreement from all SEAMEO Member Countries has to be provided to show ownership and unity of purpose. Relative to this, technical and financial support should be extended by all SEAMEO Member Countries. Likewise, the much-needed financial assistance and technical expertise should be availed of from donor agencies and international organizations and other local, regional and international institutions. It is hoped that the SEA-BES CCRLS in Science and Mathematics could truly be a significant instrument to achieve the goals of ASEAN Community in the near future.

SEAMEO BASIC EDUCATION STANDARDS (SEA-BES): DEVELOPMENT OF THE COMMON CORE REGIONAL LEARNING STANDARDS IN MATHEMATICS

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First Regional Consultative Meeting on SEAMEO Basic Education Standards and SEA-Primary Learning Metrics (4-5 November 2014)

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2nd Regional Consultative Meeting and Workshop on SEAMEO Basic Education Standards (20-22 October 2015)

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