Searching Values for Mathematics Education : SEAMEO -Basic Education Standards

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The aim of this paper is to share what values are described in the SEAMEO Basic Education Standards (SEA-BES): Common Core Regional Learning Standards (CCRLS) in Mathematics and Science (in Printing from SEAMEO RECSAM) in relation to mathematics education.

Introduction: Aims of SEA-BES

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). SEA-BES is the document for one of the projects for action agenda under #7 by SEAMEO-RECSAM and developed with consideration of the current status of the region as well as issues for curriculum reforms in the world: Indeed, OECD clarified the 21st century skills by the terms of competency (OECD, 2005). It defined competency for a successful life and well-functioning society. Societies are continuously changing for seeking success and welfare development. UNESCO sets the sustainable development goals (UNESCO, 2015) under the necessity of the development of every society as well as sustainability of social welfare. Those issues show us the necessity of the development of harmonious society under the competitive era. On these issues, Mathematics and Science are necessary subjects in education for success in various fields as well as welfare in our life based on mutual understanding. Mathematics and science are the tools for overcoming the challenges of diversities in Southeast Asia through developing the competency for competitiveness and understanding others for creating a harmonious society. The SEA-BES describes three major components: Firstly, for cultivating basic human characters through mathematical values, attitudes and habits of mind. Secondly, for developing creative human capital, process skills need to be developed. Thirdly, knowledge of mathematics and science are for cultivating - well qualified citizens. Before clarifying how these three components function within the mathematics framework, the nature of mathematics is initially considered and how the aims of SEA-BES in mathematics are deduced from it. Lastly, the format of the SEA-BES in mathematics will be described before the elaboration of every standard.

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 the 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; and
f) to serve as a platform for assessment such as the Southeast Asia Primary Learning Metrics (SEA-PLM).

On these purposes of the SEA-BES project, CCRLS defines the standards on mathematics and science based on the following principles:

i. The standards are the common ground to develop the fullest potential and capabilities to acquire competency in the 21st century.
ii. The standards are presumed for competitiveness in this globalization era and understanding others in creating the ASEAN harmonious society under global citizenship.
iii. The standards serve as tools for analysing curriculum for the purpose of the project as stated in (a) to (f).

This presentation focuses on the part of Mathematics for knowing what values are discussed in the SEA-BES

Excerpts of Descriptions for Values in SEA-BES for Mathematics

Following excerptions are discussions of Values to deduce the Aims of Mathematics Education for SEA-BES mathematics.

Necessity to learn Mathematics

Mathematics has been recognized as a necessary literacy for citizenship and not only living economically but also to establish a society with fruitful arguments and creations for better living. It has been taught as a basic language for all academic subjects using visual and logical-symbolic representations, currently, mathematics also provide necessary bases for STEM

education. At the same time, beyond the limitation of STEM education, mathematics has been increasing its role for future prediction and designing with big data which produces innovation not only for the technological product but also for various business models. Mathematics is also an essential to establish common reasoning for sustainable development of society through a viable argument in understanding each other and develop critical reasoning as the habits of mind.

Nature of Mathematics to propose the Framework

For clarifying the framework in SEA-BES on mathematics and by knowing the role of mathematics education, the humanistic and philosophical natures of mathematics are confirmed as follows; Humanistic nature of mathematics is explained by the attitudes of competitiveness and understanding of others by challenging mathematicians such as Blaise Pascal, Rene Descartes, Isaac Newton and Gottfried Wilhelm Leibniz. For example, if you read the letter from Pascal to Pierre de Fermat you recognize competitive attitude of Blaise Pascal to Fermat intelligence and seeking the way to be understood his Excellency of his finding on Pascal's Triangles. If we read Pascal's pensee you recognize how Pascal denies Descartes geometry using algebra from the aspect of ancient Greece geometry. On the other hand, Descartes tried to overcome the difficulties of ancient geometry by algebra. If you read the letter from Descartes to Elisabeth, you recognize how Descartes appreciated and felt happy the Royal Highness Elisabeth used his ideas of algebra in geometry. Despite being a princess, Elisabeth had been continuously learning mathematics in her life. There were discussions on who developed calculus between Britain and Continent. On that context, Johann Bernoulli, a continental mathematician, posed a question on the journal about the Brachistochrone problem, locus of the point on circumference of the circle when it rotates on the line. No one replied and Bernoulli extended the deadline of the answer and asked Newton to reply. Newton answered it within a day. Finally, six contributions of the appropriate answer including Newton and other Continental mathematicians were accepted. All those stories show that mathematics embraces the humanistic nature of proficiency for competitiveness and understand others for sharing ideas. Philosophical nature of mathematics can be explained by ontological and epistemological perspectives. On the ontological perspective, mathematics can be seen as a subject for universal understanding and common scientific language. Plato and Aristotle are usually compared on this perspective. Plato believes that the existence of the world of "idea" and mathematics existed in the world of "idea" on Platonism. On this context, mathematical creation is usually explained by the word "discover" which means taking out the cover from which it has already existed. At the moment of discovery, reasonable, harmony and beautifulness of mathematical system is usually felt. Aristotle tried to explain about reaching idea from the "material" to the "form". This explains that abstract mathematics can be understood with concrete materials using terms such as "modelling",

"instruments", "embodiment", "metaphor" and "change representation". From both ontological perspectives, mathematics can be understandable and acquirable by everyone and if acquired, it serves as a common scientific language which is used to express in any subjects. Once representing the ideas using the shared common language, the world can be possibly perceived in the same view autonomously. On the epistemological perspective, mathematics can be developed through processes which are necessary to acquire mathematical values and ways of thinking. From this perspective, idealism and materialism are compared. On the context of Hegel, a member of German idealism, Imre Lakatos explained the development of mathematics through proof and refutation. On this context, mathematics is not fixed but an expandable system that can be restructured through a process of dialectic in constructing viable arguments. Plato also used dialectic for reaching ideas with the examples of mathematics. The origin of dialectic is known as the origin of indirect proof. In education today, dialectic is a part of the critical thinking for creation. Parallel perspectives for mathematical developments are given by George Polya and Hans Freudenthal. For the discovery of mathematics, Polya explained mathematical problemsolving processes with mathematical ideas and mathematical ways of thinking in general. Freudenthal enhanced the activity to reorganize mathematics by the term mathematisation.

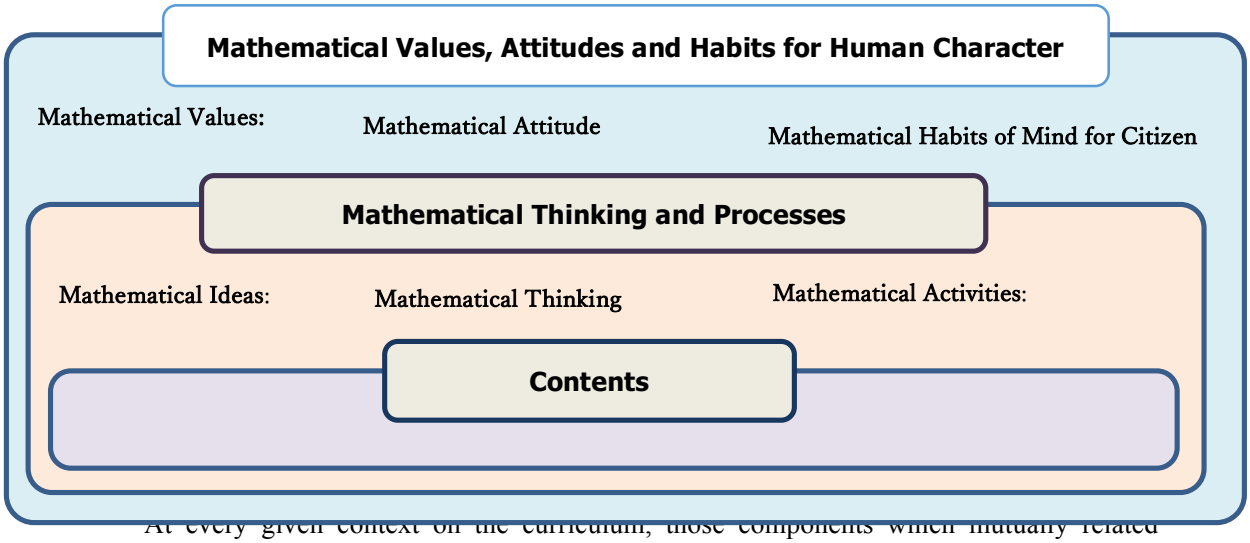
Genetic epistemologist Jean Piaget established his theory of operations based on various theories, including the discussion of Freudenthal and explained the mathematical development of operations by the term reflective abstraction. Reflection is also a necessary activity for mathematisation by Freudenthal. On materialism, under Vygotskyian perspective, intermediate tools such as language become the basis for reasoning in the mind. Under his theory, the high-quality mathematical thinking can be developed depending on the high-quality communication in mathematics classrooms. A Dialectical-critical discussion should be enhanced in the mathematics class. From both the epistemological perspectives, mathematics can be developed through the processes of communication, problem-solving and mathematisation which include reorganization of mathematics. Those processes are necessary to acquire mathematical values and ways of thinking through reflection.

Aims of Mathematics Education in SEA-BES

The aims of mathematics in SEA-BES for developing basic human characters, creative human capital, and well-qualified citizens in Southeast Asia for a harmonious society are as follows:

- Develop mathematical values, attitudes and habits of mind for human character,
- Develop mathematical thinking and able to engage in appropriate processes,
- Acquire proficiency in mathematics contents and apply mathematics in appropriate situations.

Framework for SEA-BES in Mathematics as shown in Figure 3 is developed based on the three components with discussions of the humanistic and philosophical nature of mathematics. This framework also depicts the concrete ideas of mathematics learning of the above aims.



At every given context on the curriculum, those components which mutually related explains various objective for education. Those components are functioning to interpret the objective of every learning standard in SEA-BES under this framework.

Mathematical Values

For cultivating basic human characters, values, attitudes and habits of mind are essentials to be developed through mathematics. Values are basis for setting objectives and making decisions for future directions. Attitudes are mind-sets for attempting to pursue undertakings. Habits of mind are necessary for soft skills to live harmoniously in the society. Mathematical values, mathematical attitudes and mathematical habits of mind are simultaneously developed and inculcated through the learning of the content knowledge.

Essential examples of values, attitudes and habits of mind are given in Figure 3. On values, in mathematics, generalizable and expandable ideas are usually recognised as strong ideas. Explaining why such as proving is necessary for mathematics, then it is usually seeking reasonableness. Harmony and beautifulness are described not only in relation to mathematical arts but also in the science of patterns and the system of mathematics. Usefulness and simplicity are used in the selection of mathematical ideas and procedures.

Reference

Dizon M., D., Ahmad, N., J., Isoda, M. (In printing). *SEAMEO Basic Education Standards (SEA-*

BES): Common Core Regional Learning Standards (CCRLS) in Mathematics and Science. SEAMEO-RECSAM