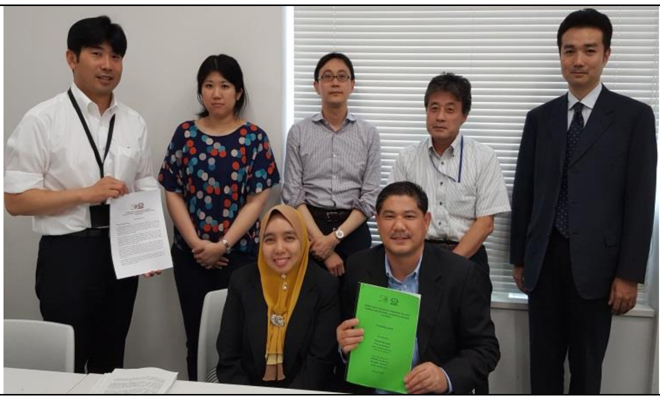
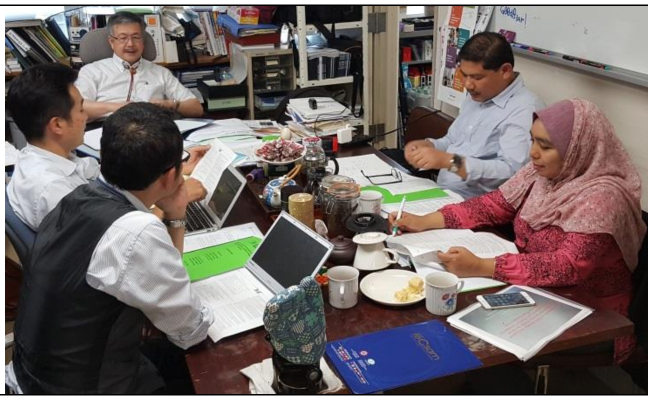
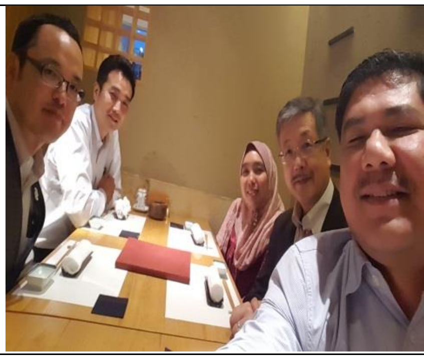
TRAVEL REPORT IN JAPAN

RESEARCH MEETING IN JAPAN ON SEAMEO-BASIC EDUCATION PROJECT: DEVELOPMENT OF COMMON CORE REGIONAL LEARNING STANDARDS IN SCIENCE

13-17 June 2016, Tokyo, Japan







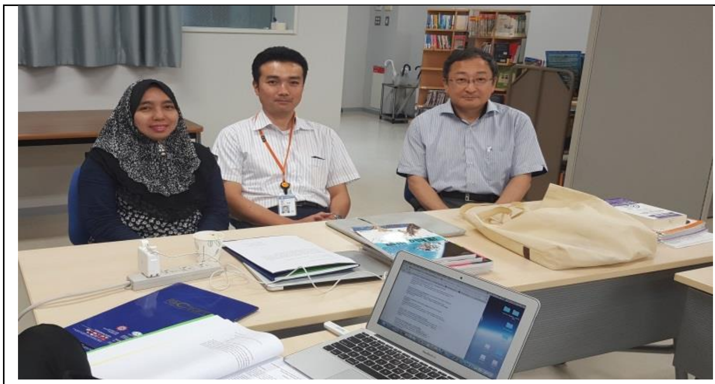
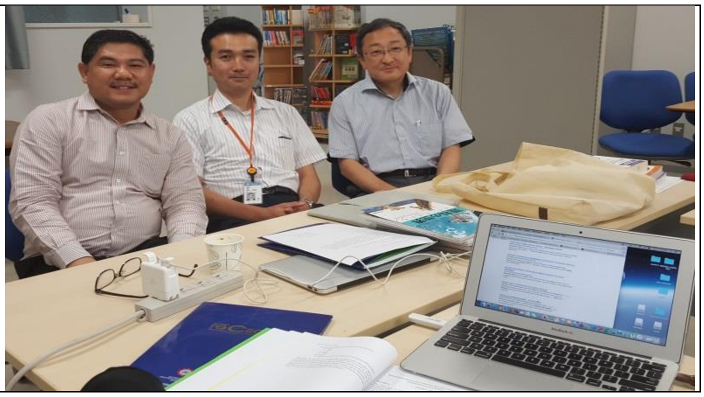
Submitted by

Dr. Nur Jahan Ahmad, Deputy Director, R & D

Mr. Dominador Dizon Mangao, Specialist, R & D

Report on Discussion Points on the Science Framework and the Six Strands of the Common Core Regional Learning Standards in Science

DAY 1 and DAY 3- Research Meeting at Toho University, Tsudanuma, Chiba, Japan

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Prof. Izumi Imai (Chemistry Curriculum)
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SEAMEO RECSAM:
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Mr. Dominador Dizon Mangao, Specialist (Science Education), R & D

Discussion Points:

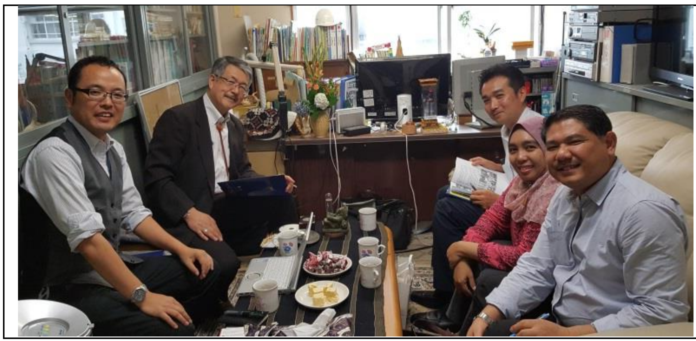
- **Science Framework**
  - ➢ Scientific thinking and processes: too many in the list; maybe there is need to prioritize
  - ➢ Are scientific thinking and processes covered in Strand 1: Scientific inquiry?
- **Strand 1: Scientific Inquiry**
  - ➢ How many SEAMEO Member Countries take this as a separate strand?
  - ➢ Standards/competencies seem too many /too much in some Key Stages and little or none in some Key Stages
  - ➢ Standards/competencies be categorized/classified as " core" or "supplementary" depending on importance/relevance (what criteria)
  - ➢ Suggest to use codes in providing feedback on the specific standards/competencies as follows:
  - ✓ Change into **BOLD** the learning standard if you think it is important
  - ✓ Let it REMAIN as is if you think the learning standard is appropriate/suitable for the proposed Key Stage
  - ✓ Change into *ITALICS* if you think the learning standard is important but may seem difficult for the proposed Key Stage

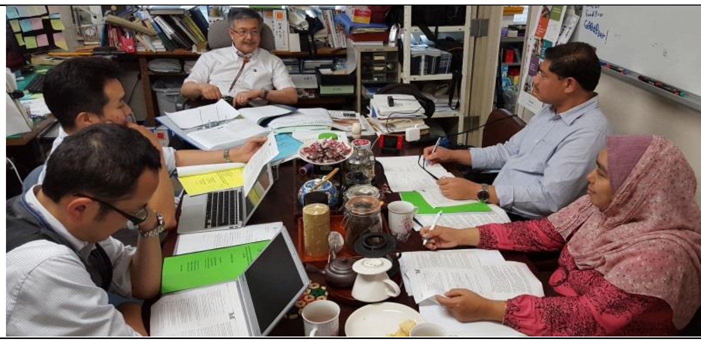
✓ <u>Add/Encode and underline additional learning standard or topic/sub-topic you think is important in each Key Stage</u>

- ➢ Suggest Key Stages be explicitly labeled as " Grades 1-3; Grades 4-6 and Grades 7-9

- **Strand 3: Material World/Chemistry**
  - ➢ Topics 4, 5 and 6 maybe combined together as one topic
  - ➢ Sub-topic: Conservation of Mass
  - ➢ Key Stage 3
  - ➢ Use the mole concept to express the mass of substances
  - ➢ The concept of the "amount of substance" occupies an important position in modern chemistry, and it is necessary to understand quantitative relation in chemical reactions. However, the concept is very difficult to understand for senior high schools students. Several teaching aids have mainly been employed by some school teachers and science education researchers in order to provide a better understanding of the concept. But it is known that Japanese high school students do not like the term "mole".

DAY 2 – Research Meeting at Shizuoka University, Shizuoka, Japan





Shizuoka University

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Discussion Points:

- OECD Framework of Scientific Literacy does not include STEM
- STEM Education is integrated in the New Generation Science Standards (NGSS K -12)
- NGSS is composed of 3 dimensions
  - ➢ Science and Engineering Practices

- Disciplinary Core Ideas (Physical Science, Life Science, and Engineering, Technology and Applications of Science
- Crosscutting Concepts

- Science and Engineering Practices in NGSS is composed of 8 standards:
    - Asking questions and defining problems
    - Planning and carrying out investigations
    - Analyzing and interpreting data
    - Developing and using models
    - Constructing explanations and designing solutions
    - Engaging in argument from evidence
    - Using mathematics and computational thinking
    - Obtaining, evaluating and communicating

Disciplinary Core Ideas in Physical Science	Disciplinary Core Ideas in Life Science	Disciplinary Core Ideas in Erath and Space Science	Disciplinary Core Ideas in Engineering, Technology, and Applications of Science
1. Matter and Its Interactions 1.1 Structure and Properties of Matter 1.2 Chemical Reactions 1.3 Nuclear Processes **2. Motion and Stability: Forces and Interactions** 2.1 Forces and Motion 2.2 Types of Interactions 2.3 Stability and Instability in Physical Systems **3. Energy** 3.1 Definitions of Energy 3.2 Conservation of Energy and Energy Transfer 3.3 Relationship Between Energy and Forces 3.4 Energy in Chemical Processes and Everyday Life **4. Waves and Their Applications in Technologies for Information Transfer** 4.1 Wave Properties	**1. From Molecules to Organisms** 1.1 Structure and Function 1.2 Growth and Development of Organisms 1.3 Organization for Matter and Energy Flow in Organisms 1.4 Information Processing **2. Ecosystems: Interactions, Energy, and Dynamics** 2.1 Interdependent Relationships in Ecosystems 2.2 Cycles of Matter and Energy Transfer in Ecosystems 2.3 Ecosystem Dynamics, Functioning, and Resilience 2.4 Social Interactions and Group Behavior **3. Heredity: Inheritance and Variation of Traits** 3.1 Inheritance of	**1. Earth's Place in the Universe** 1.1 The Universe and Its Stars 1.2 Earth and the Solar System 1.3 The History of Planet Earth **2. Earth's Systems** 2.1. Earth Materials and Systems 2.2 Plate Tectonics and Large-Scale System Interactions 2.3 The Roles of Water in Earth's Surface	**1. Engineering Design** 1.1 Defining and Delimiting an Engineering Problem 1.2 Developing Possible Solutions 1.3 Optimizing the Design Solution **2. Links Among Engineering, technology, Science and Society** 2.1 Interdependence of Science, Engineering, and Technology 2.2 Influence of Engineering, technology, and Science on Society and the Natural World

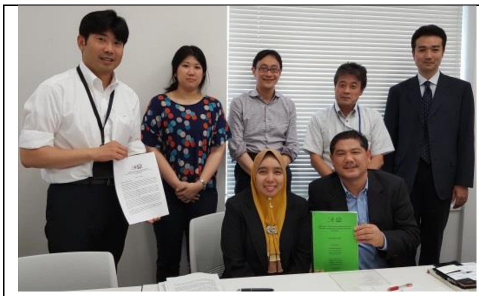
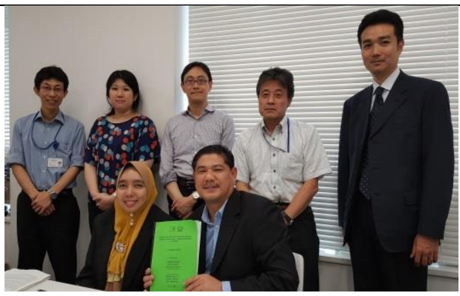
4.2 Electromagnetic Radiation 4.3 Information Technologies and Instrumentation	Traits 3.2 Variation of Traits **4. Biological Evolution: Unity and Diversity** 4.1 Evidence of Common Ancestry and Diversity 4.2 Natural Selection 4.3 Adaptation 4.4 Biodiversity and Humans	Processes 2.4 Weather and Climate 2.5 Biogeology 3. **Earth and Human Activity** 3.1 Natural Resources 3.2 Natural Hazards 3.3 Human Impacts on Earth Systems 3.4 Global Climate Change	

- Crosscutting Concepts
    - Patterns
    - Cause and Effect: Mechanism and Prediction
    - Scale, Proportion and Quantity
    - Systems and System Models
    - Energy and Matter: Flows, Cycles, and Conservation'
    - Structure and Function
    - Stability and Change
- Definition and scope of 21st Century Skills
- Definition of Competencies and Skills (US and Europe)
- **Strand 1: Scientific Inquiry**
    - Check about the Nature of Science
    - Engineering in STEM: Teachers usually complain they do not know much about Engineering in terms of its content and how to teach it, or how to introduce the importance of STEM.
    - TED videos are good sources of information about STEM
    - STEM in Japanese K-12 is not yet fully accepted /realized by MEXT
    - Japan Innovation encourages students , engineers, scientists to produce innovation
    - Dr. Davis, Director of NSTA stressed that there is a need to visit STEM schools and look for evidence how STEM works.
    - Suggests Strand 1 be named "**Scientific Inquiry and Engineering Practice"**
    - Suggests that Technology and Engineering Practices be embedded in all the strands
- Strand 6: Science, Technology, Environment and Society (STES) and Science, Technology, Engineering, and Mathematics
    - Education for Sustainable Development: include how to develop innovation, creativity
    - ESD: employs Project-based Learning, Problem-based learning
    - Science involves inquiry and ends with report / results
    - Engineering ends with model/product
    - Suggests name as **Strand 6: Education for Sustainable Development**

- ➢ Suggests Topic 1 – STEM (Sub-topic1 – Innovations, Sub-topic 2 – creativity)
- ➢ Topic 2- Energy
- ➢ Topic 3 – Environment
- ➢ Topic 45- Disaster Risk Reduction Mitigation, Management
- ➢ Topic 5- Ethics
- ➢ Topic 6 – Global Climate Change
- ➢ Topic 7 – Global Citizenship
- ➢ OECD – context-based is important
- ➢ Competencies in STEM maybe hidden in " design"
- ➢ Engineering is more on the scope of the University level;
- ➢ Engineering is and Science are more of theory and process
- ➢ Technology is more on the scope of secondary level
- ➢ Technology is more of product

- **Strand 5 : Earth and Space**
  - ➢ Systems approach: Earth System, Solar System, Universe
  - ➢ Invitation to the Earth Science Olympiad

DAY 4 – Research Meeting at Ministry of Education, Culture, Sports, Science and Technology (MEXT)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Prof. Shirouzu Hajime
Center for Research and Development of Higher Education
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Discussion Points

- **Science Framework**
  - Need to give a clear descriptions of each layer/dimension and their interrelationships: Strands, Scientific thinking and processes, and Values and attitudes
  - Need to explain/elaborate background of framework . . . development process . . . not just the product
  - Scientific thinking and processes have so many listings – need to prioritize
  - Scientific thinking and processes need to be backed up with "theory"
  - 3 layers/dimensions are important
  - 3 layers are incorporated in teaching and learning
  - There is concern on how teachers develop these scientific thinking and processes as well as values and attitudes in the actual teaching-learning situations
  - Good if teachers use monitoring sheet
  - There is a need to explain/describe the relationship of the Framework with the 3 Key learning stages (i.e. progression, scope, sequence, etc.)
  - What encompass ASEAN values and attitudes?
  - Relate how to use the content/strand in developing values and attitudes
  - Values and attitudes are difficult to teach
  - Japanese curriculum values "love for nature"
  - Make reference to three dimensions of New Generation Science Standard: Scientific Inquiry, Disciplinary Core Ideas, and Crosscutting Themes
  - With reference to the Science Framework with its 3 layers/dimensions, teachers need to imagine how to develop a lesson
  - Knowledge based on big ideas, lessons deal with mental operations by providing context and looking forward to develop values and attitudes: teachers relate these three in developing a lesson
  - Need to describe more the relationships of the three key learning stages/developmental ; naming of the grade levels;
  - To what extent would this Standards be used in the SEAMEO Member Countries?
- **Some strategies to scale up: Pilot studies with research component**
  - Develop actual lesson by 10-15 teachers; discussion/agreement with advice from experts; teachers go back to school and implement lesson; share results and experiences (lesson study approach)

- ➢ Keep evidence such as video, students' outputs, portfolio
- ➢ If focus is developing competency a Unit Lesson is better taught to several class periods/sessions (6 lessons)
- ➢ If focus is on knowledge/content, one lesson is possible
- ➢ Region-wide assessment: PISA Framework – focused on scientific thinking and processes and less on knowledge; or portfolio
- ➢ Create Performance Tasks like in Australia, New Zealand
- ➢ Competencies: focus on thinking skills, writing skills, communications skills

- **Aim of the Science Standards**
  - ➢ Clarify on the ultimate aim of the standards; to develop students working like scientists ; acquire competency like a scientist, need to reflect into three learning stages/developmental stages; importance of scientific way of thinking per key stages; domain knowledge is important but need to be accompanied with skills and competencies

- **Discussion on STEM**
  - ➢ STEM-related elements is in Scientific Thinking; refer to Ontario Canada Curriculum 2007; divided into three (1) Scientific Inquiry /Experimentation Skills, (2) Scientific Inquiry / Research Skills, and (3) Scientific Inquiry/ Technological and Problem Solving Skills
  - ➢ Suggest to rename Strand 1; In some countries STEM is integrated in Science and Technology
  - ➢ In MEXT, technology does not mean high technology . . . but to make/create products. . . students can relate theory into practice
  - ➢ If more technology is incorporated in science, teachers maybe reluctant to teach
  - ➢ If technology process is empathized, science knowledge is needed
  - ➢ Technology should be more emphasized in daily life/in context
  - ➢ There is a needs to come-up with a model lesson on how technology, engineering are integrated in cultivating competencies

DAY 5 – Research Meeting at Chiba University, Chiba, Japan


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Professor Yoshihiko Tsuruoka
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Discussion Points

- **Strand 4: Life and the Living World (Biology)**
    - Singapore Science Curriculum is organized into four areas: Diversity, Interaction, Systems and Patterns
    - In Japan Science is taught at : Grades 3,4,5,6 (Primary); Grades 7,8 and 9 (Lower Secondary)
    - In Japan Science is organized into four areas: Structure and Function, Diversity and Commonness of Life, Continuity of Life, and Interaction Between Living Things and the Environment
    - Interrelationships of topics is very important in the framework
    - Need to consider the aim of Biology is to use knowledge of Biology to improve human life and the environment
    - Suggest to re-group the topics into four or five areas with the addition of Applied Biology
    - Applied Biology would include topics such as Health, Hygiene, Biotechnology, Drugs, Drug Addiction, Smoking, Communicable Diseases (HIV AIDS, Dengue, etc.)

- **Strand 1: Science Inquiry**
    - Stressed that Science Inquiry should be present in Strands; need to add in all Descriptions of all Strands
    - In the Science Framework it corresponds to Scientific thinking and processes
    - We teach Nature of Science
    - We keep ideas . . . but not as Strand… but can be moved to a different part. . . or Strand 0
    - Scientific content is very important when we teach Scientific inquiry
    - In Japan Grade 5 Science introduces study of Variables . . . study of pendulum, dry cells
    - If so decided Scientific Inquiry as a Strand, teachers need to discuss when and how to integrate them with the other Strands
- **Strand 6: STES, STEM**
    - If ESD, there is a need to include Peace Education also
    - Suggest to rename to " Education for Sustainable Society"; "Science and Technology for a Sustainable Future"; "Science and Our Future"; "Creating A Sustainable Society/Future through Science and Technology"
    - Suggest to think of an acronym composed of the content topics