

and Big Data Era for Digital Society

Unplugged Computational Thinking on the Mathematical Thinking

Masami Isoda

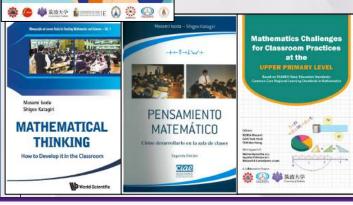
Professor of the Faculty of Human Sciences Director of CRICED, University of Tsukuba, Japan











PhD in Education (Waseda University, Japan) Honorary PhD in Mathematics Education (Khon Kaen University, Thailand) Honorary Professor, Pontificia Universidad Católica de Valparaíso (Faculty of Science), Chile Honorary Professor, Universidad San Ignacio de Loyola (Faculty of Education), Peru











What is Mathematics for you? On the Era of Generative AI, Mathematics is the reasoning!

Mathematics used to be any subject to develop Logical Thinking to grown up Philosopher on their **languages**.

- In Ancient Greece, μάθημα (máthēma) means the "the subjects of instruction and learning" in Ancitent Greek.
- At Roman Empire, its focused-on Geometry, Arithmetic, Astronomy and Music (mathematical science with figural representations).

 Mathema: Music, Astronomy and Music, Astronomy
- In the Middle Age, it become the four subjects of seven liberal arts in Latin.

Arabic Numeral and Algebra

After Renaissance, Universal Mathematics was proposed by Descartes to reintegrate mathematical sciences into one with Algebraic language.

Algebra become the bases for mathematical sciences.

Primary School Mathematics is under local language!

- Difficulty: Inconsistency in school mathematics curriculum.
- Through the overcoming, we develop human character!

stronomy and Music

Mathema: Music, Astronomy,

Arithmetic & Geometry

= Latin-Reasoning with

Figural Representation

Universal Mathematics:

= Algebraic Representation

Mathematical Science on Digital Era

= Computational & Visual Representation

Mathematics has been the ways of reasoning which have changed depending on the representations and Language.

Primary School Mathematics

Mathema: Any subject of Learning

= All Basic Literacy for Greek Reasoning

Generative Al runs

Generative
Al runs
through
Natural
Language!!

Mathematical Values Seeking -

- Generality and expandability
- Reasonableness and harmony
- Usefulness and efficiency
- Simpler and easier
- Beautifulness

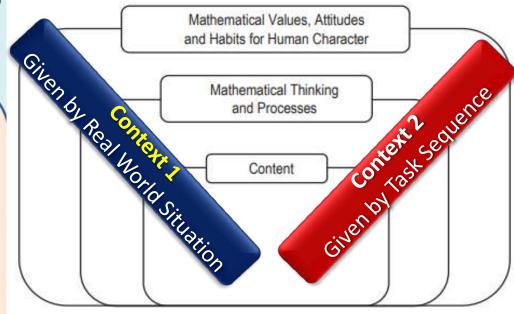
Mathematical Attitude Attempting to -

- See and think mathematically
- Pose questions and develop explanations
- Generalise and extend
- Appreciate others' ideas and change representations for meaningful elaborations

Mathematical Habits of Mind For living -

- Reasonably and critically while respecting and appreciating others
- Autonomously and socially
- Creatively, innovatively and harmoniously to develop citizenship
- Judiciously in using various tools
- With empowerment in predicting the future through lifelong learning

Mathematical Thinking can be developed through the task sequence.



Mathematical Thinking and Processes

Mathematical Ideas of:

Set, Unit, Comparison,
Operation, Algorithm,
Fundamental Principles,
Permanence of Form,
Various Representations
and Translation,
Pattern, Recursion and
Invariant.
Ordering

Ordering,

Appreciation

Reflection

cquisition

Maxima and Minima Symmetry.

Mathematical Ways of Thinking:

- Generalisation and Specialisation
- Extension and Integration
- Inductive, Analogical and Deductive Reasoning
- Abstracting, Concretising and Embodiment
- Objectifying by representation and symbolizing
- Relational and functional thinking
- > Thinking Forward and Backward

Mathematical Activities:

- Problem Solving
- Exploration and Enquiry
- Mathematical Modeling, Mathematisation and Programming
- Conjecturing, Justifying and Proving
- Conceptualisation and Proceduralisation
- Representation and Sharing

Contents

Key Stage 1

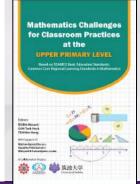
- Numbers & Operations
- Quantity & Measurement
- Shapes, Figures & Solids
- Pattern & Data Representations

Key Stage 2

- Extension of Numbers & Operations
- Measurement & Relations
- Plane Figures & Space Figures
- Data Handling & Graphs

Key Stage 3

- Numbers & Algebra
- Relations & Functions
- Space & Geometry
- Statistics & Probability





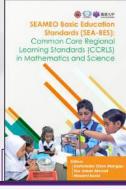


Figure 1. Revised CCRLS Framework in Mathematics





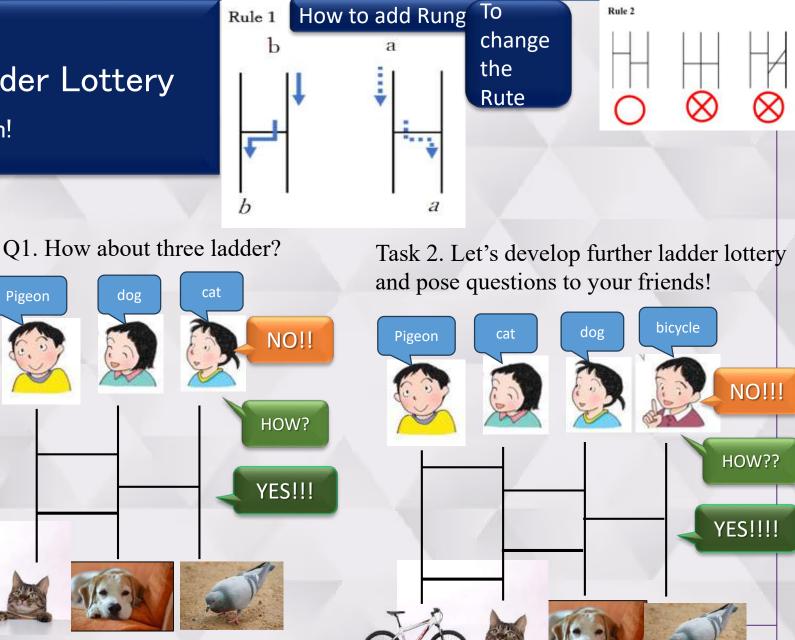


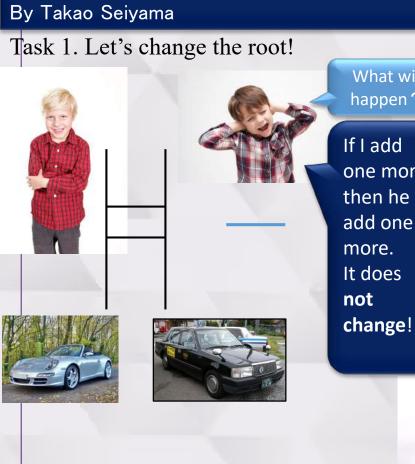






Chapter 2. Example 2.10 Connections: A Case of Ladder Lottery Let's think inductively to find the algorism! By Takao Seiyama Task 1. Let's change the root!





If I add one more then he add one more. It does

Pigeon

What will happen?



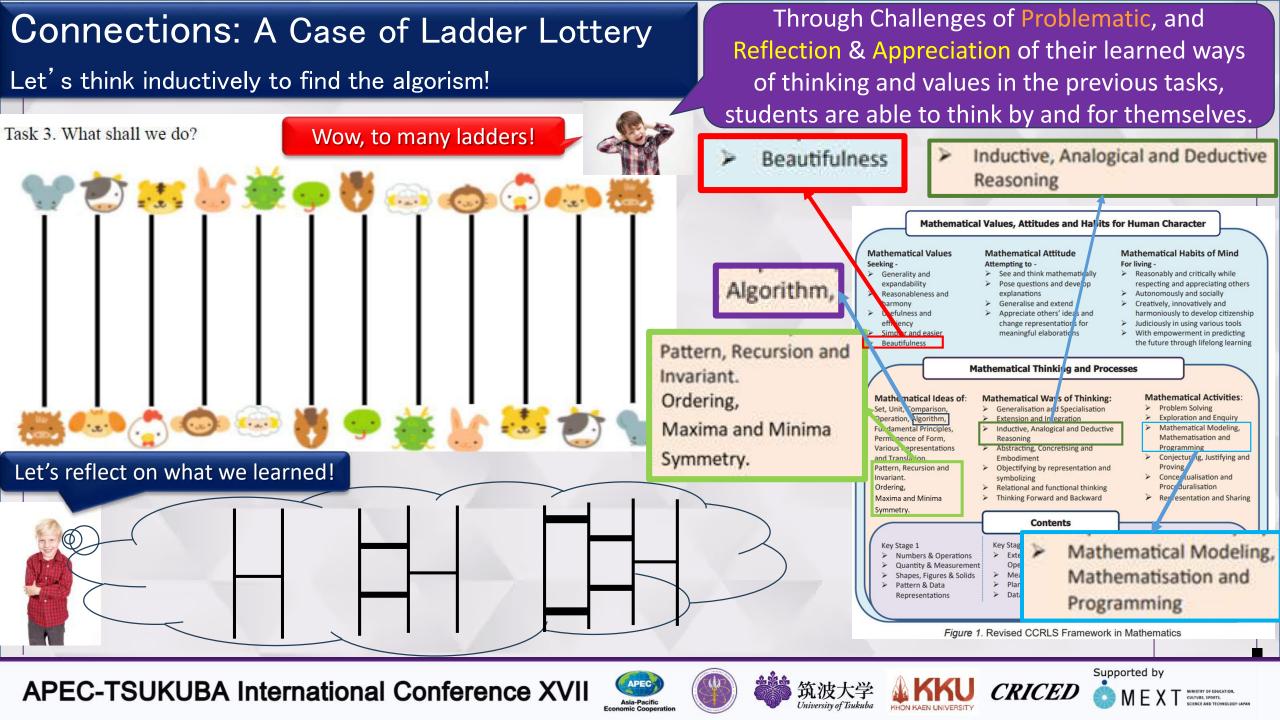












Mathematical Values, Attitudes and Habits for Human Character

Mathematical Values Seeking -

- Generality and expandability
- Reasonableness and harmony
- Usefulness and efficiency
- Simpler and easier
- Beautifulness

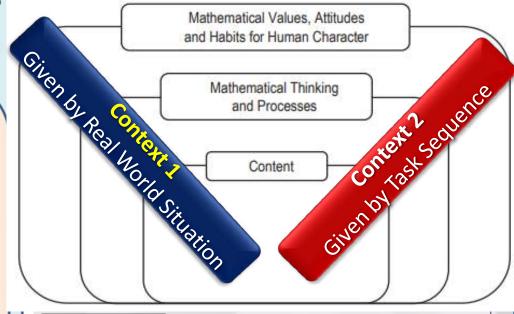
Mathematical Attitude Attempting to -

- See and think mathematically
- Pose questions and develop explanations
- Generalise and extend
- Appreciate others' ideas and change representations for meaningful elaborations

Mathematical Habits of Mind For living -

- Reasonably and critically while respecting and appreciating others
- Autonomously and socially
- Creatively, innovatively and harmoniously to develop citizenship
- Judiciously in using various tools
- With empowerment in predicting the future through lifelong learning

Mathematical Thinking can be developed through the task sequence.



Mathematical Thinking and Processes

Mathematical Ideas of:

Set, Unit, Comparison, Operation, Algorithm, Fundamental Principles, Permanence of Form, Various Representations and Translation, Pattern, Recursion and Invariant.

Ordering,
Maxima and Minima
Symmetry.

Appreciation

a

Ē

Mathematical Ways of Thinking:

- Generalisation and Specialisation
- Extension and Integration
- Inductive, Analogical and Deductive Reasoning
- Abstracting, Concretising and Embodiment
- Objectifying by representation and symbolizing
- Relational and functional thinking
- > Thinking Forward and Backward

Mathematical Activities:

- Problem Solving
- Exploration and Enquiry
- Mathematical Modeling, Mathematisation and Programming
- Conjecturing, Justifying and Proving
- Conceptualisation and Proceduralisation
- Representation and Sharing

Contents

Key Stage 1

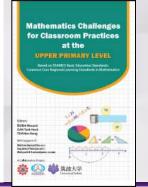
- Numbers & Operations
- Quantity & Measurement
- Shapes, Figures & Solids
- Pattern & Data Representations

Key Stage 2

- Extension of Numbers & Operations
- Measurement & Relations
- Plane Figures & Space Figures
- Data Handling & Graphs

Key Stage 3

- Numbers & Algebra
- Relations & Functions
- Space & Geometry
- Statistics & Probability





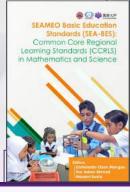


Figure 1. Revised CCRLS Framework in Mathematics













What is Mathematics for On the Era of Generative

Mathematics used to be any sub Philosopher on their languages.

- In Ancient Greece, μάθημα and learning" in Ancitent (
- At Roman Empire, its focuse (mathematical science with fig
- In the Middle Age, it become liberal arts in Latin.

Arabic Numeral and Algebra

After Renaissance, Universal

by **Descartes** to reintegrate

into one with Ale

Let's learn Ancients: ↓ Alo nematics

onsistency in school n

gn the overcoming, we develo

GUIDEBOOK



Masami Isoda

















Inprasitha, Isoda & Araya(2023) Mathematics is the subject to develop Mathematical Thinking and Values
ich can be applied any problem in our life with using our Mathematics is the subject to develop Mathematics is developed in the subject to develop Mathematics is developed in the subject to develop Mathematics is developed in t Mathematics is the subject to develop Mathematical Thinking and Values our Natural Language!

Which can be applied any problem in our life with using our Natural Language. on Digital Era ational and Visual ntation ays of reasoning which have presentations and Language. SHELDONIANO, AD. DOM. 1682