Competency for AI-Digital Economy Era: Transform on the 4th Industrial Revolution APEC Chile Report and Visions

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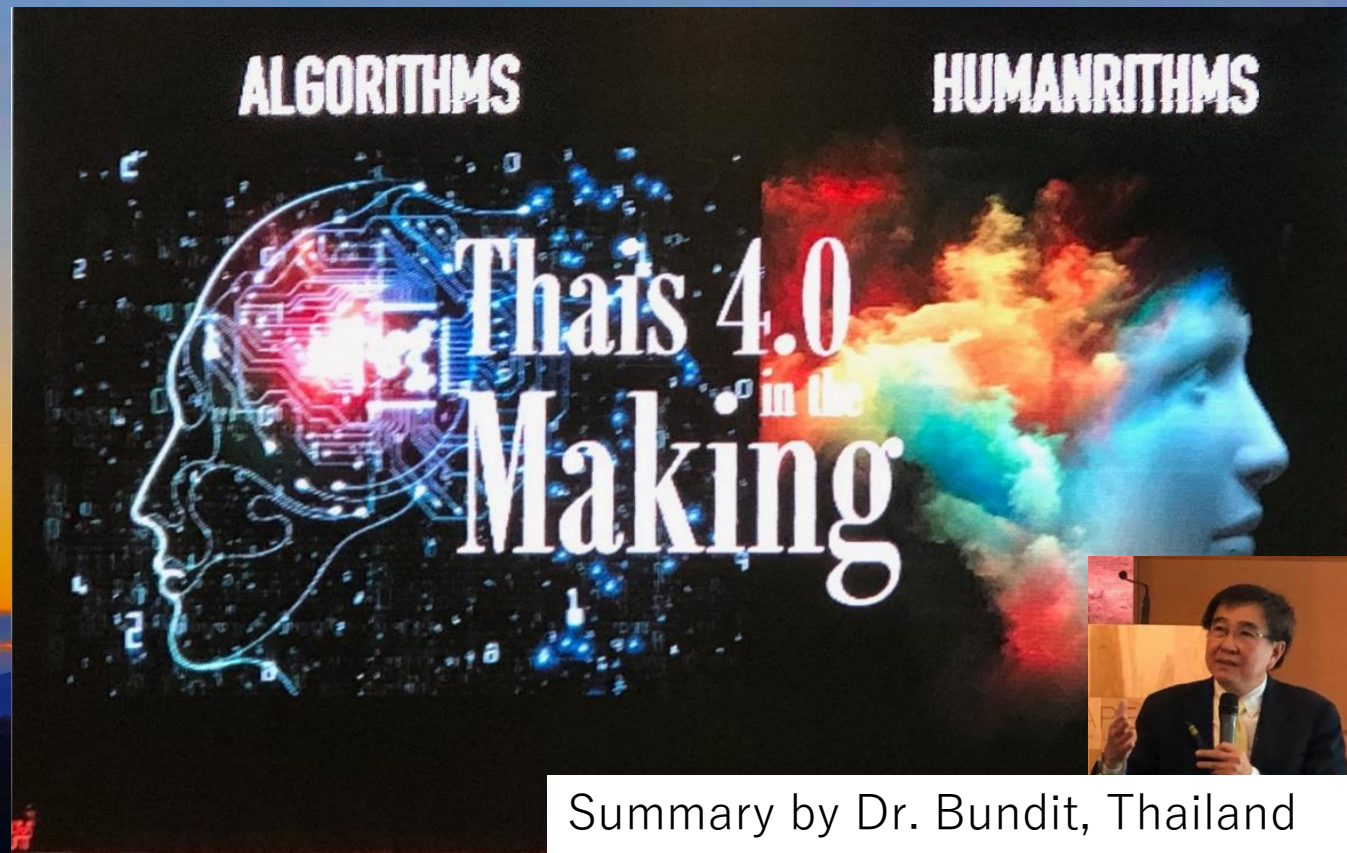
Director of CRICED, University of Tsukuba, Japan

What are the necessary competency for AI-Digital Era?
Humanity and Digital Competency

APEC 2019
Digital Society, Sustainable Growth, Integration 4.0, and Inclusive Growth

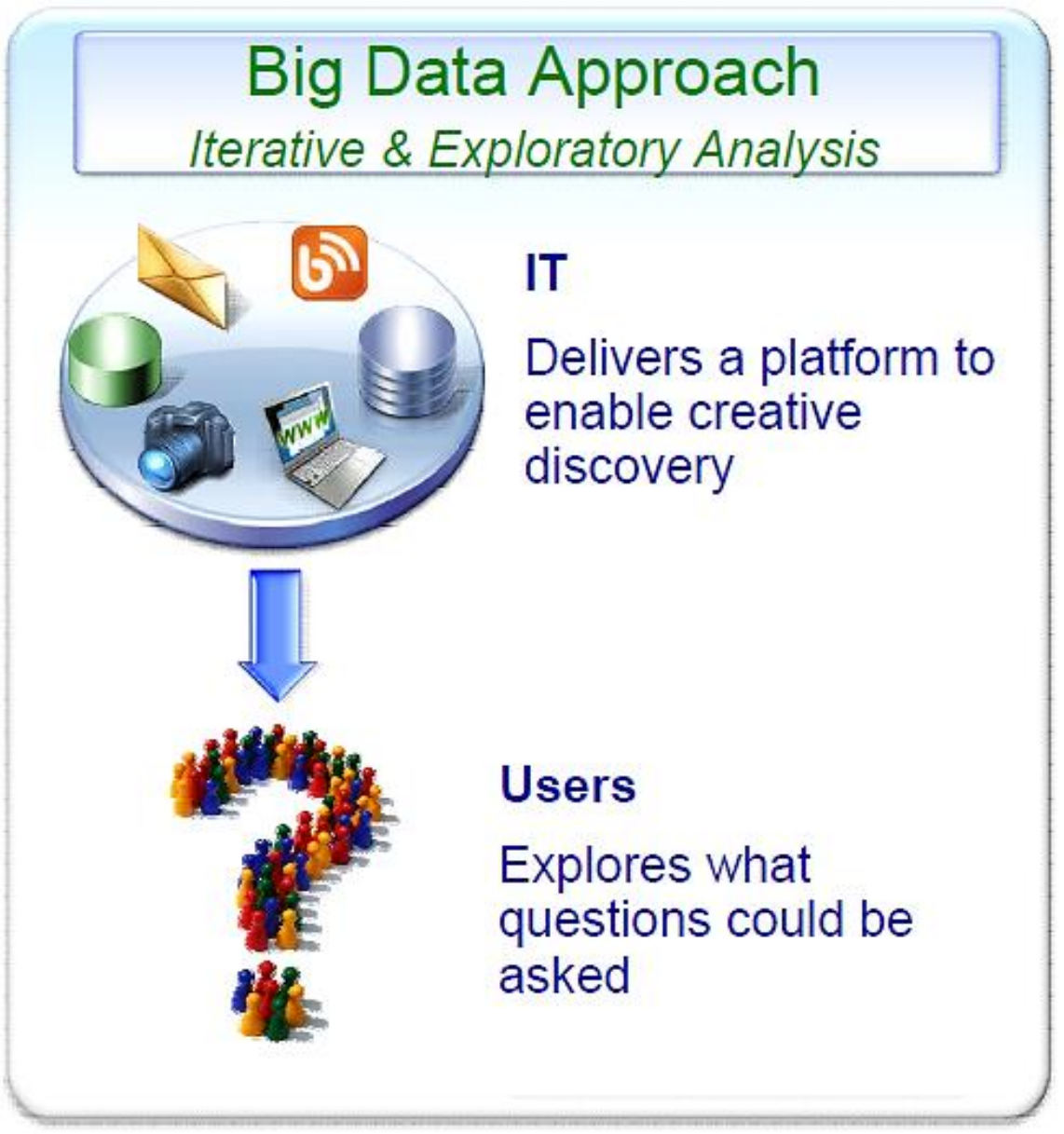
- OECD (2005) defined competency for successful life and well-functioning society.
- SEAMEO Standards (Dom, Jahan, Isoda; 2017) : Mathematics and Science are the tools for overcoming the challenges of diversities in Southeast Asia through developing the competency for competitiveness and understanding others for creating a harmonious society.

Necessity by Dr. Lew, Korea



Summary by Dr. Bundit, Thailand

Big Dataとは？



- **量Volume**: This refers to data at rest. Datasets with sizes in the order of terabytes, petabytes and zettabytes.
- **多様性Variety**: This refers to the many forms (e.g., text, images, videos, audio files, emails) and sources (e.g., spreadsheets, databases, social media and monitoring devices) of data.
- **速さVelocity**: This refers to data in motion: the speed at which data flows in from sources (e.g., real time streaming).
- **信憑性Veracity**: This refers to data in doubt. Depending on its origin, processing technologies, and collection methods, data can have biases and inaccuracies attached, which need to be identified and accounted for.
- **価値Value**: This refers to turning data into profit. Just having big data is of no use unless we can turn it into value.

Big Data Approach

Iterative & Exploratory Analysis

IT

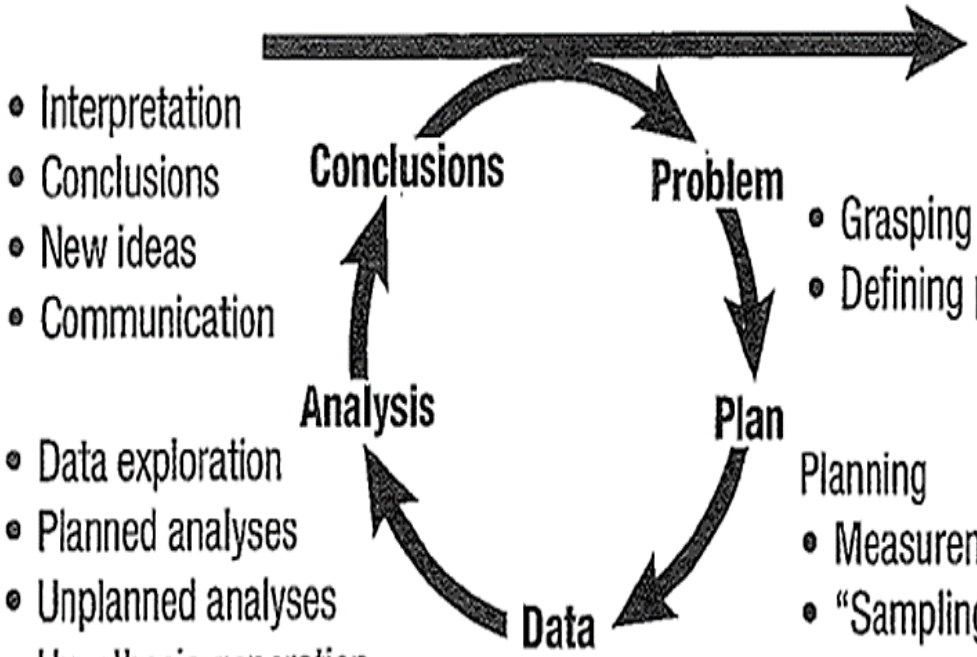
Delivers a platform to enable creative discovery

Users

Explores what questions could be asked

(a) DIMENSION 1: The Investigative Cycle

(PPDAC)



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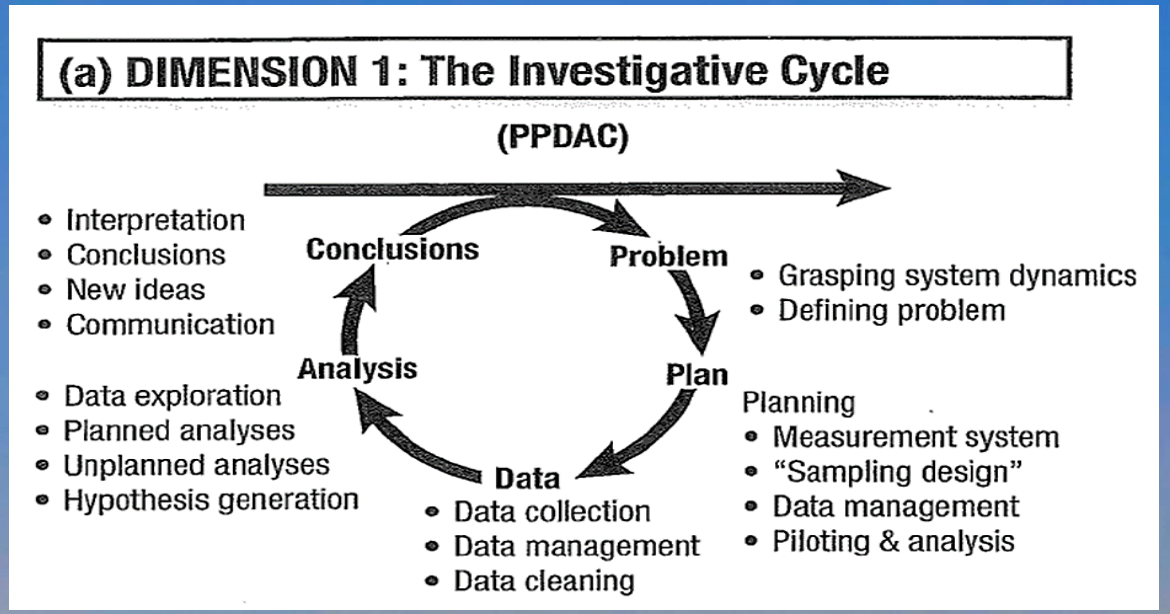


- Patterns and relationships from data.
- Questions.
- Objectives.
- Data mining.
- Understanding and/or designing.

AI vs Education: Current Ability of AI

The Project: Can AI pass the Univ. of Tokyo Exam? (by Arai, 2011-)

Deviation Value of National Univ. in Education Major:

79 The Univ. of Tokyo
77 Kyoto Univ.
71 Nagoya Univ.
70 The Univ. of Tsukuba
68 Hokkaido Univ., Tohoku Univ.
…
62 Tokyo Gakugei Univ.
61 Hirosima Univ.
59 Chiba Univ., Gifu Univ.
Aichi Univ. of Education

(Benesse, 2019)

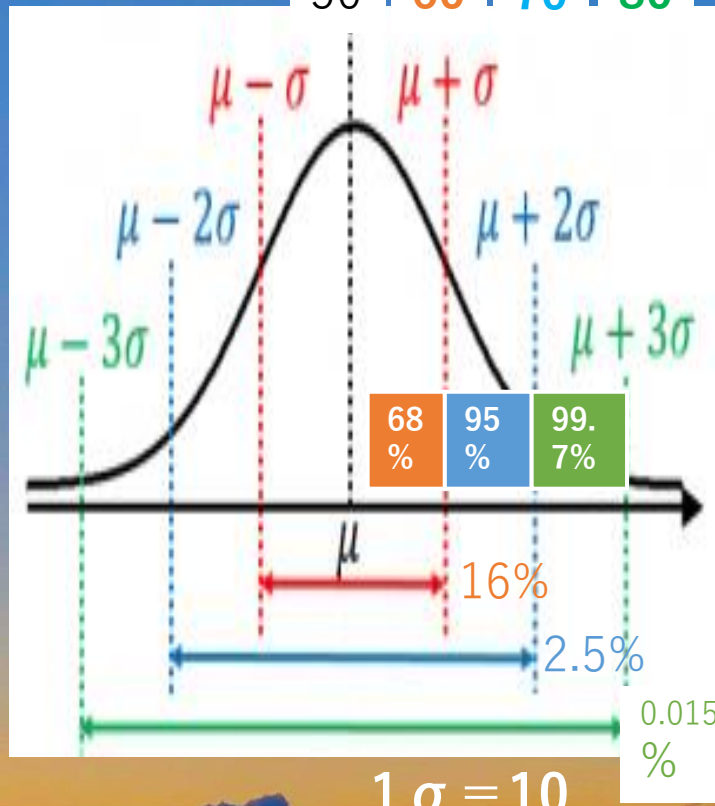
Deviation Value of Private Univ. in Education Major:

74 Waseda Univ.

70 Aoyama Gakuin Univ.
68 Kansei Gakuin Univ.
67 Bunkyo Univ.
…

The Private Universities Less than 65

Deviation value 50 60 70 80



Current AI will be Possible to Pass the Exam.

Changing Society: The Case of Japan

At the year 2030, 49 % of labors become the task for AI and Robots and so on. (Nomura Research Instituti

	>90%			10%>
Cashier 99.7% พนักงานแคชเชียร์	Supermarket clerk 99.2 % พนักงานซูเปอร์มาร์เก็ต	CPA 85.9% นักตรวจสอบบัญชีฯ	Glasses technical salesperson 51.7% พนักงานขายแว่น	Barber 1.2% ช่างตัดผม
Bus Driver 99.7% คนขับรถบัส	Hotel Room Clerk 98.7% พนักงานโรงแรม	Judicial scrivener 78.6% ผู้เชี่ยวชาญด้านกฎหมาย	Painter 5.2% จิตรกร	Industrial designe 1.0% นักออกแบบผลิตภัณฑ์
Ordinary officer 99.7% เจ้าหน้าที่/พนักงานทั่วไป	Delivery courier 98.6 % การส่งพัสดุหรือเอกสาร (ไปรษณี)	Securities agent 69.6% ตัวแทนหลักประกัน	Mathematician 4.4% นักคณิตศาสตร์	Announcer 0.7% ผู้ประกาศข่าว
Bank teller 99.4% พนักงานธนาคาร	Security guard 97.8% พนักงานรักษาความปลอดภัย	Translator 67.1% ล่าม	Novelist 2.4% นักประพันธ์/นักเขียนนวนิยาย	Internist 0.6% อายุรแพทย์
Warehouse worker 99.4% พนักงานคลังสินค้า	Machine assembly 91.6% ช่างกล	Real estate salesperson 52.7% พนักงานขายอสังหาริมทรัพย์	Nurse 1.2% พยาบาล	SME diagnosticia 0.2% นักวิเคราะห์ธุรกิจขนาดย่อม

High Qualification

Big Company

Artistic

What shall we do? (NHK)

Hotel room clerk 98.7%

↑ 2:40

Alternate the job to the tasks for AI, and then find the new services which can be provided by human.

Establishment of Human Relationship is the key!

What shall we do?
Let's alternate the job which can be done by AI! (NHK)

Hotel room clerk 98.7%

- Alternate the job to the tasks for AI, and then find the new services which can be provided by human.
- Establishment of Human Relationship is the key!

Glasses technical salesperson 51.7%

Real Estate Salesperson 52.7%

- Find the essential human job under searching the needs of customers.
- We should re-find the significance of ourselves through the new creation based on the human necessity.

- Salary up if Salesperson is the influencer.
- Not necessary sales talk
- Connectivity using SNS is the human competency

What is necessary as for human competency. In Education: Stereo Type Arguments? (NHK)

Develop Humanity

- Creativity
- Hospitality
- Management

Develop Digital Competency

- Knowing what AI can and cannot

Develop Humanity Without computer

Develop Digital Competency with AI

Computational Thinking: Think likely Computer

A way of thinking: Not necessary to use computer.

Components to Develop Computational Thinking: Isoda, Araya 2018

I. Competency for Programing

Analyze the problem situation into the components and recognize the sequence of tasks for programing, find algorism or recognize existed algorism there, and integrate it as a system

II. Competency for Modeling

By using existed model of mathematical science, develop the system (software) for generally applicable. Find the structure on the problem situation which can apply it. Adept the existed algorism to the situation.

III. Competency for Utilizing Big Data with Using AI Machine Learning

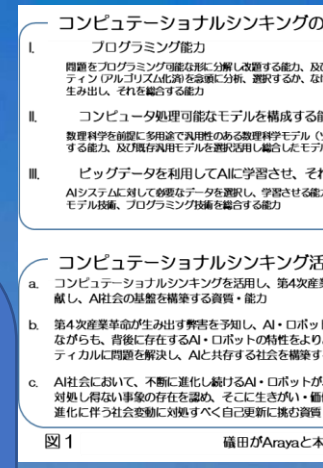
To develop appropriate AI system by using appropriate/selected exemplar/data for the specific objective, or just use AI system not selected data through the connecting the database. Utilize these AI systems with Programing and Modeling.)

Humanistic-Social Competency by Using Computational Thinking: Isoda, 2018

a. **Competency to lead** through creating the new value on the infrastructural bases for Society 5.0, beyond Industrial Revolution IV.

b. **Competency to work** through predicting the future society with negative and positive aspects under Indu Revolution IV and SDGs, and utilize AI and Robots judiciously and critically to develop well functioning society

c. **Competency to live** find the own value for humanistic oriented activity on Digital Society and realize. AI a Robots are progressive technology and tentatively functioning their limitation even we don't recognize it as a p our life. It cleats the new progressive roles for us.


コンピュテーショナルシンキングの

I. プログラミング能力

問題をプログラミング可能な形に分解し改善する能力、及
ティン（アルゴリズム化）を念頭に分析、選択するか、な
生み出し、それを組合する能力

II. コンピュータ処理可能なモデルを構成する能

数理科学を前提に多用途で汎用性のある数理科学モデル（
する能力、及び既存汎用モデルを選択活用し組合したモデ

III. ビッグデータを利用してAIに学習させ、それ

AIシステムに対して必要なデータを選択し、学習させる能力
モデル技術、プログラミング技術を組合する能力

コンピュテーショナルシンキング活

a. コンピュテーショナルシンキングを活用し、第4次産
献し、AI社会の基盤を構築する資質・能力

b. 第4次産業革命が生み出す弊害を予知し、AI・ロボッ
ながらも、背後に存在するAI・ロボットの特性をより
ティカルに問題を解決し、AIと共存する社会を構築す

c. AI社会において、不断に進化し続けるAI・ロボット
対処し得ない事象の存在を認め、そこに生きがい・
進化に伴う社会変動に対処すべく自己更新に携む資質

図1　磯田がArayaと本

Beyond the limitation of MBA (Yamaguchi, 2018)

MBA program enhanced business sciences with computational thinking: Analysis, Logic, and Reasonableness with data for Management and produced the limitations for sustainability of business

Commodity: Produce the similar solution, then not innovative and creative.

Time: Even though speedy is necessary for innovation, slow and delay to challenge the risk for opportunity

Innovation: It goes faster than the establishments of business rules/law

Financial Times, Nov. 13, 2016: **The art school MBA that promotes creative innovation!** Why?

- All markets in the world directed to expense for "Self-realization"
  I. Survive
  II. Safety
  III. Belonging
  IV. Appraised
  V. Self-realization
- It is wrong to suppose that if you cannot measure it, you can't manage it – a costly myth. (Deming)
- Arts (Plan), Craft (Do) and Science (Check)
- Leaders need the design sense to extract essential points and others cut off

a. Competency to lead: Arts, Craft and Science divined by Awareness of Beautifulness

- **Beautifulness on Vision, Moral, Management Strategy, and Re-presentation**

From STEM to STEAM

John Maeda led the vison

“Art and design are poised to transform our economy in the 21st century like science and technology did in the last century."

- Master on Software Engineering at MIT.
- Master of Arts at The University of Tsukuba, Japan
- **Challenged to integrate the engineering and art, and Computer and Craft, and invented Interactive Motion Graphics technology, and enable us computer-technology as the representation tools.**
- His Arts are in New York Museum of Modern Art and so on.
- Professor, the MIT Media Lab for 12 years
- **President, the Rhode Island School of Design (RISD) and led RISD to be recognized by the business community as number one in the world.**
- **In 2013, he organized national cocas with paraments’ members on “From STEM to STEAM” and shepherding the national STEAM movement**

“Art produce question for our life and design produce solution”

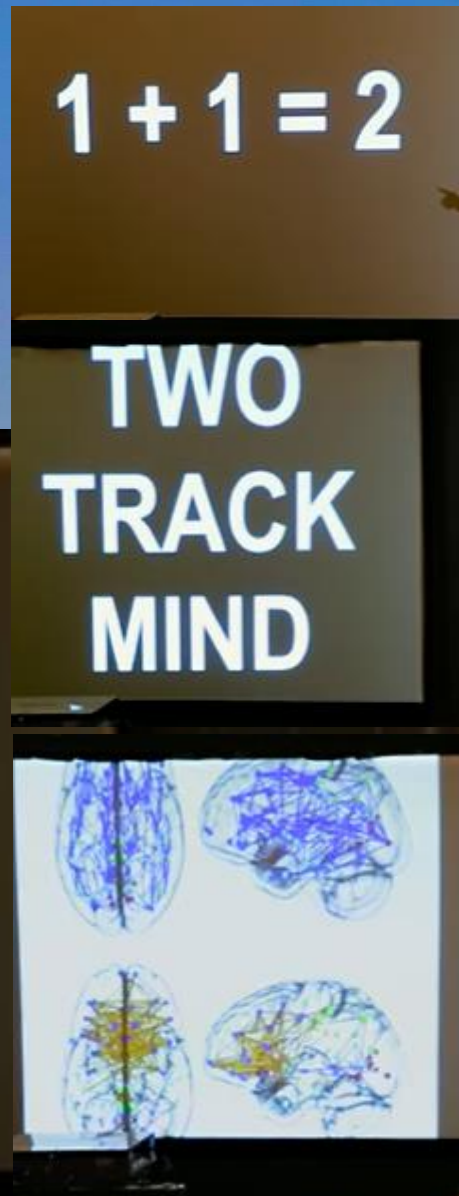
“Art and design produce the business for human welfare”

STEAM: Other actors

Ge Wang inventing the ChucK audio programming language

Yoky Matsuoka: *neurobotics*

STEAM women

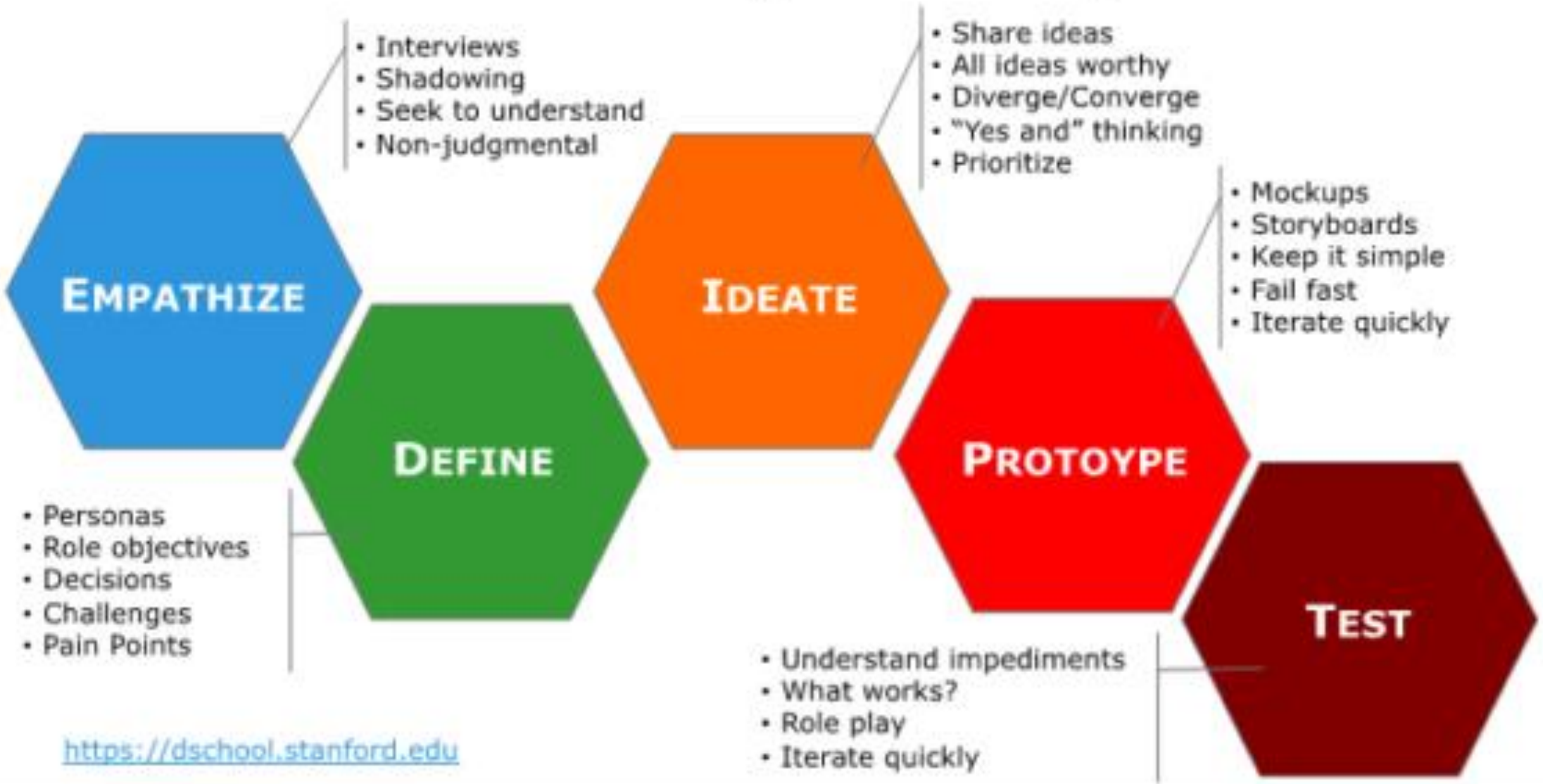


- Director, K-12 Innovation Labs
  Institution
  The Nueva School
- **Bio**
  Kim Saxe, MS, long-time educator and former engineer and research and development director, has been the director of the K–12 Innovation Labs at The Nueva School since 2008 and a lecturer at Stanford University since 2007. She has taught for more than 25 years, mostly at Nueva. Kim is a pioneer in the field of design thinking, design engineering, and entrepreneurship in education. She has invented and taught many constructivist, project-based curricula across all subject areas. She is able to translate the mindsets and methodologies of design thinking, taught to master's degree students at Stanford, into compelling and broadening experiences for younger students. Kim directs the design thinking, design engineering, and entrepreneurship programs at Nueva. She continually reinvents Nueva's inspiring and ever-changing 4,000-sq.-ft. Innovation Lab, which was designed in partnership with Stanford's Institute of Design (d.school). She also oversees the school's award-winning, competitive robotics and Tech Challenge teams. Kim has created and piloted a student-engineering curriculum that is now taught to all Nueva students in grades 4–6. Kim helps teams of teachers, administrators, and professionals from all over the world implement design thinking programs in their own countries and schools. She believes design thinking can truly transform people's lives, and thus the world.

Logical Thinking, Critical Thinking and Design Thinking

Logical Thinking	Critical Thinking	Design Thinking
Logic		Intuition
Persuasion		Huristics
Mainly right side brain		Brain and Five senses
Check the logical truth	Subjective to Objective, Various perspectives	Leaps by Idea driven, hypothetical

Stanford d.school Design Thinking Process



Standardizations of Curricula

Objectives of Mathematics Education

Objectives of Mathematics Education on CCRLS Framework for Mathematics by SEAMEO-RECSAM for ASEAN(2017: Dom, Isoda, Pedro, & Kimho et al.)

Appreciation

Mathematical Values, Attitudes and Habits for Human Character

Mathematical Values:
Generality and Expandability
Reasonableness and Harmony
Usefulness and Efficient
Simpler and Easier
Beautifulness

Mathematical Attitude attempting to:
See and think mathematically
Pose question and develop explanation such as why and when
Generalize and extend
Appreciate others' idea and change representation to conceptualize

Habits of mind for Citizen to live:
Reasonably and critically with respecting and appreciating others
Autonomously Creatively and innovatively in harmony Judiciously using tools such as ICT
Empowerly in imagining the future through lifelong learning

Reflection

Mathematical Thinking and Processes

Mathematical Ideas for:
Set, Unit, Compare, Operate, Algorithm, Fundamental principle, and Varied representation such as table, diagram, expressions, graph and translations.

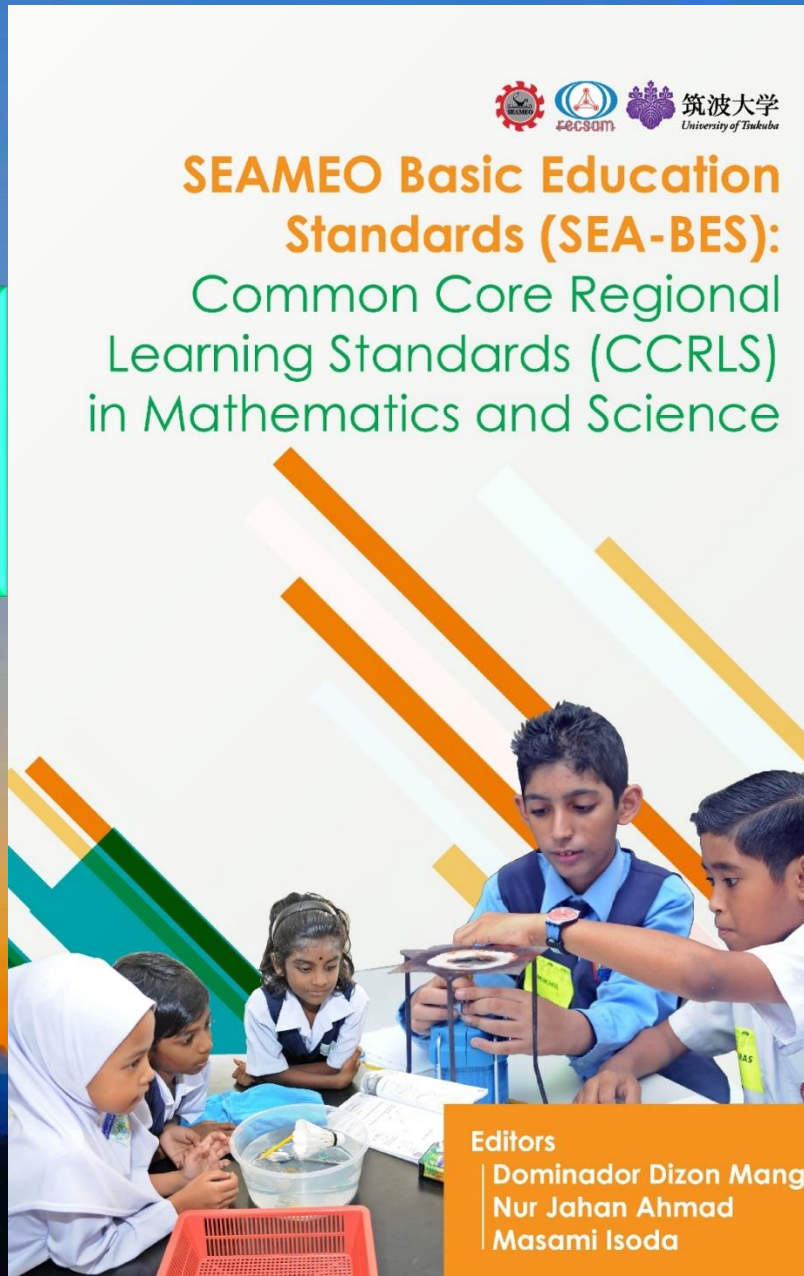
Mathematical Thinking:
Generalization and Specialization
Extension and Integration
Inductive, Analogical and Didactical reasoning
Abstracting, Concretizing and Embodiment
Objectifying by representing and symbolizing
Relational and Functional thinking
Thinking forward and backward

Mathematical Activities for:
Problem Solving
Exploration and Inquiry
Mathematical Modeling
Conjecturing, Justifying and Proving
Conceptualization and Proceduralization
Representation and Sharing

Acquisition

Content

- Numbers & Operations
- Quantity & Measurement
- Shapes, Figures and Solids
- Pattern & Data Representations
- Extension of Number and Operations
- Measurement & Relations
- Plane Figures & Space Solids
- Data Handling & Graphs
- Number & Algebra
- Space & Geometry
- Relationship & Functions
- Statistics & Probability



evelop Computational Thinking through Robot Programing

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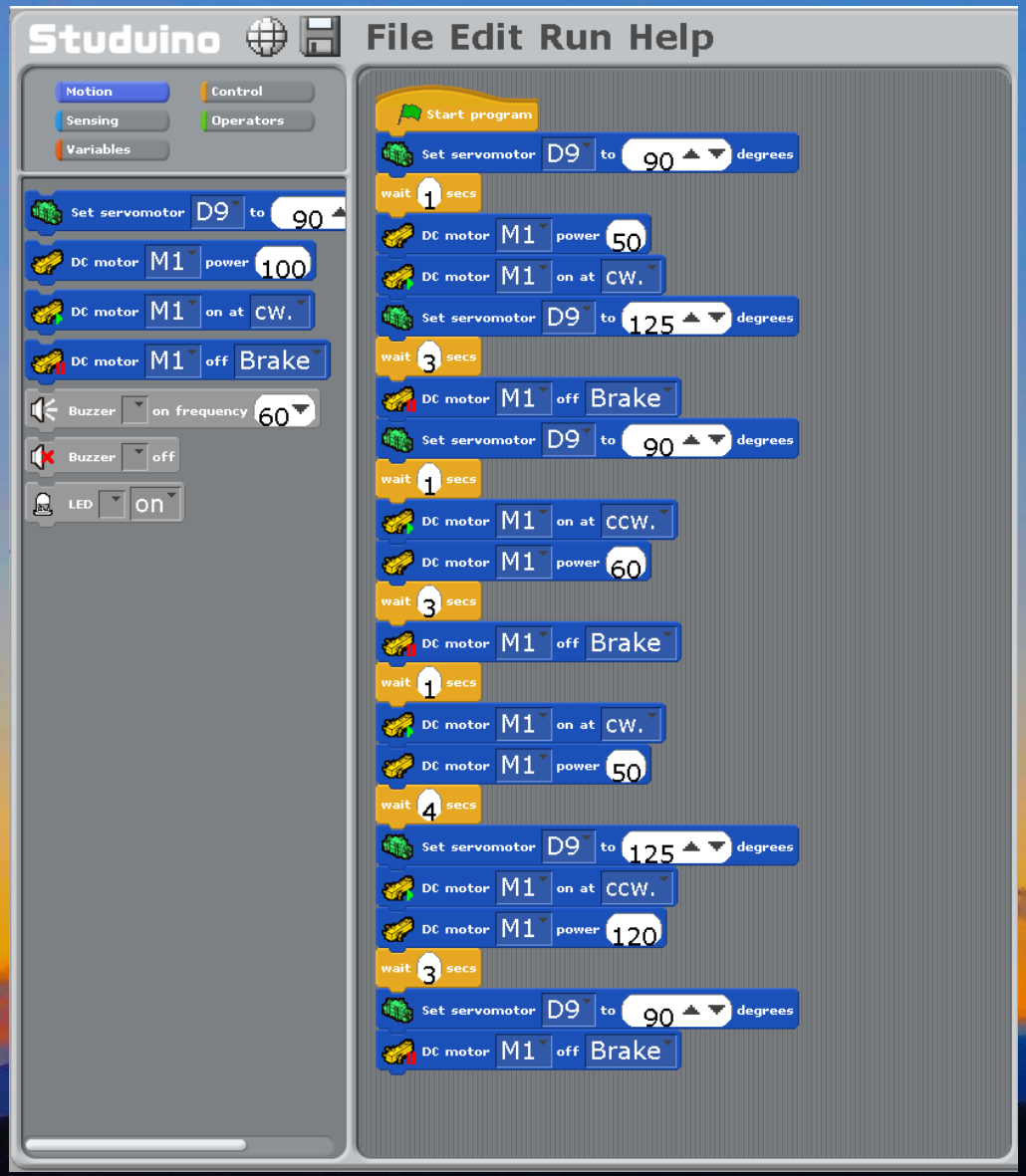

mpetency for Programing

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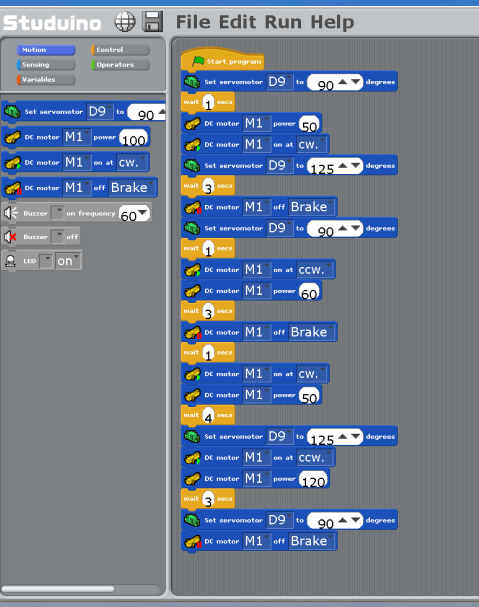
Image and Establish Design

Designing Robots by Blocks and Parts: Concrete Materials

Programing for Robots by Using Commands

Seeking the Functioning of Commands and Program on Robots



Translations and Interpretations

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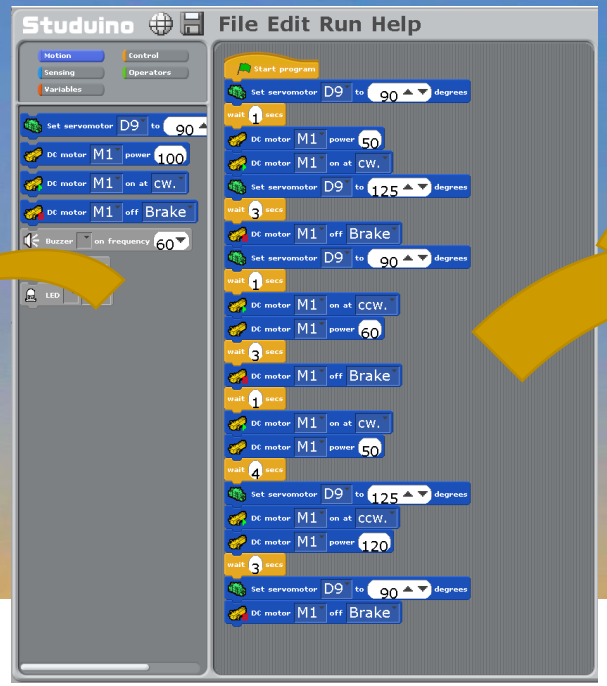
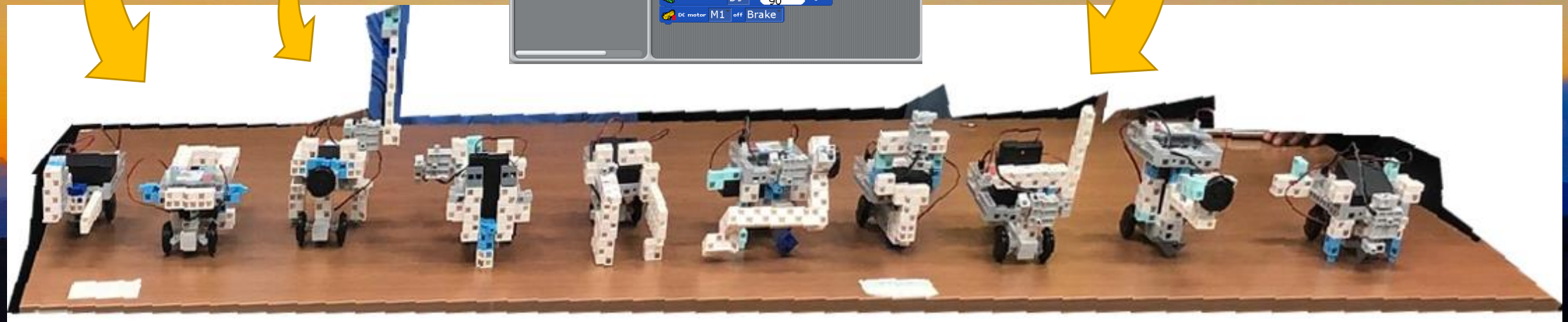


Could you imagine how does it move by this algorism?



STEAM Education: Mathematical Thinking

SEAMEO Basic Education

Usefulness and Efficient

Algorithm

- Exploration and Inquiry
- Modeling
- Conjecturing
- Representation

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Translation

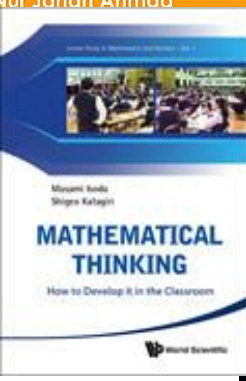
Thinking Forwards and Backwards

Appreciation

Experience

Reflection

Acquisition



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