筑波大学
University of Tsukuba

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MINISTRY OF EDUCATION, CULTURE, SPORTS, SCIENCE AND TECHNOLOGY-JAPAN

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Developing Human Character through STEM Planning and Design Learning (PaDL) Framework

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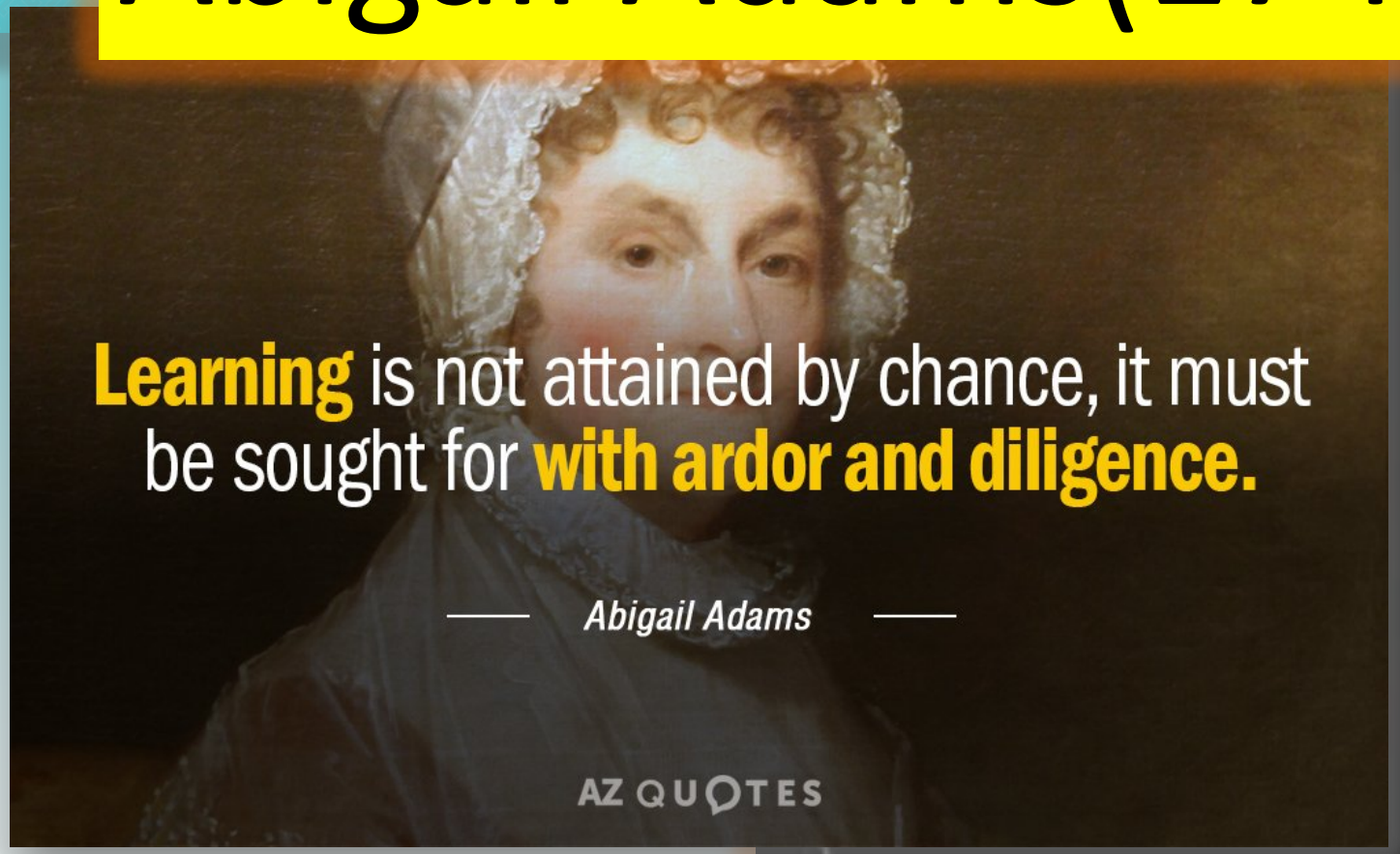


Great learning and superior abilities...will be of little value and small estimation unless virtue, honor, truth, and integrity are added to them.

AZ QUOTES

What does character mean?

- generally a distinctive mark by which one thing is distinguished from others . . .
- the assemblage of qualities that distinguish one individual from another (Homiak, 2007)
- People of good character are individuals who know the good, love the good and do the good (K.Ryan and K. Bohlin, 1999).

What does character mean . . .

- **Know the good** – can understand good and evil; develop the ability to sum up a situation, deliberate, choose the right thing to do and then do it
- **Love the good** – develop a full range of moral feelings and emotions (love for good and a contempt for evil, capacity to **empathise** with others
- **Do the good** – the will to act after thoughtful consideration if all the circumstances and relevant facts

Why the Need for Character education. . .

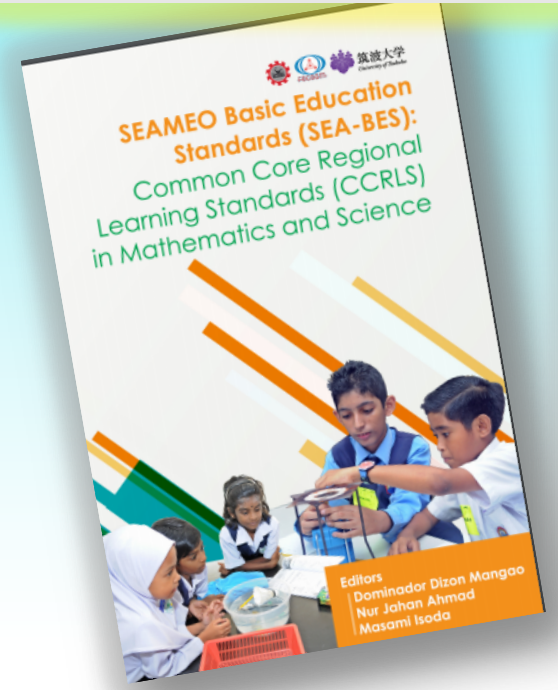
is to help students develop good character, which includes **knowing**, **caring** about and **acting** upon **core ethical values** such as respect, responsibility, honesty, fairness and compassion

SEAMEO Education Agenda (2015-2035)

SEA-BES project is re-aligned into Priority Area #7 "Adopting a 21st Century Curriculum " . . .

*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."*

AIM: “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**.”



Human Character as an important component of the framework for CCRLS in Mathematics and CCRLS in Science are reflected as **“Mathematical values, attitudes and habits for human character” and “Values, and attitudes**

Aims of Mathematics in CCRLS are to:

- develop mathematical values, attitudes and habits of mind for human character;
- develop mathematical thinking and enable to produce appropriate process; and
- acquire proficiency in mathematics content and apply mathematics in appropriate situations.

Eventually, the aims would lead to the development of basic human characters, creative human capital, and well qualified citizens in Southeast Asia for a harmonious society through mathematics (Mangao, D.D., Ahmad, N.J. & Isoda, M. , 2017)

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
- Generalize 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 and Processes

Mathematical Ideas:
Set, Unit, Comparison, Operation, Algorithm,
Fundamental principles, Permanence of form, various representations and Translations.

Mathematical Thinking:
Generalisation and specialization
Extension and integration
Inductive, analogical and deductive reasoning
Abstracting, concretizing and embodiment
Objectifying by representation and symbolising
Relational and functional thinking
Thinking forward and backward

Mathematical Activities:

- Problem solving
- Exploration and inquiry
- Mathematical modeling
- Conjecturing, justifying and proving
- Conceptualisation and proceduralisation
- Representation and sharing

Contents

Key Stage 1

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

Key Stage 2

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

Key Stage 3

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

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Empathy as an important human character. . .

- "Empathy is seeing with the eyes of another, listening with the ears of another and feeling with the heart of another." – Alfred Adler
- empathy means " … the ability to share someone else's feelings or experiences by imagining what it would be like to be in that person's situation"(Cambridge Dictionary, 2020)
- "understanding and sharing the feelings of another"(New Oxford American Dictionary Online 2011)
- By understanding others' feelings, one can respond aptly to the situation. This **human character** value is important in determining the decisions made based on many aspects of life situations.

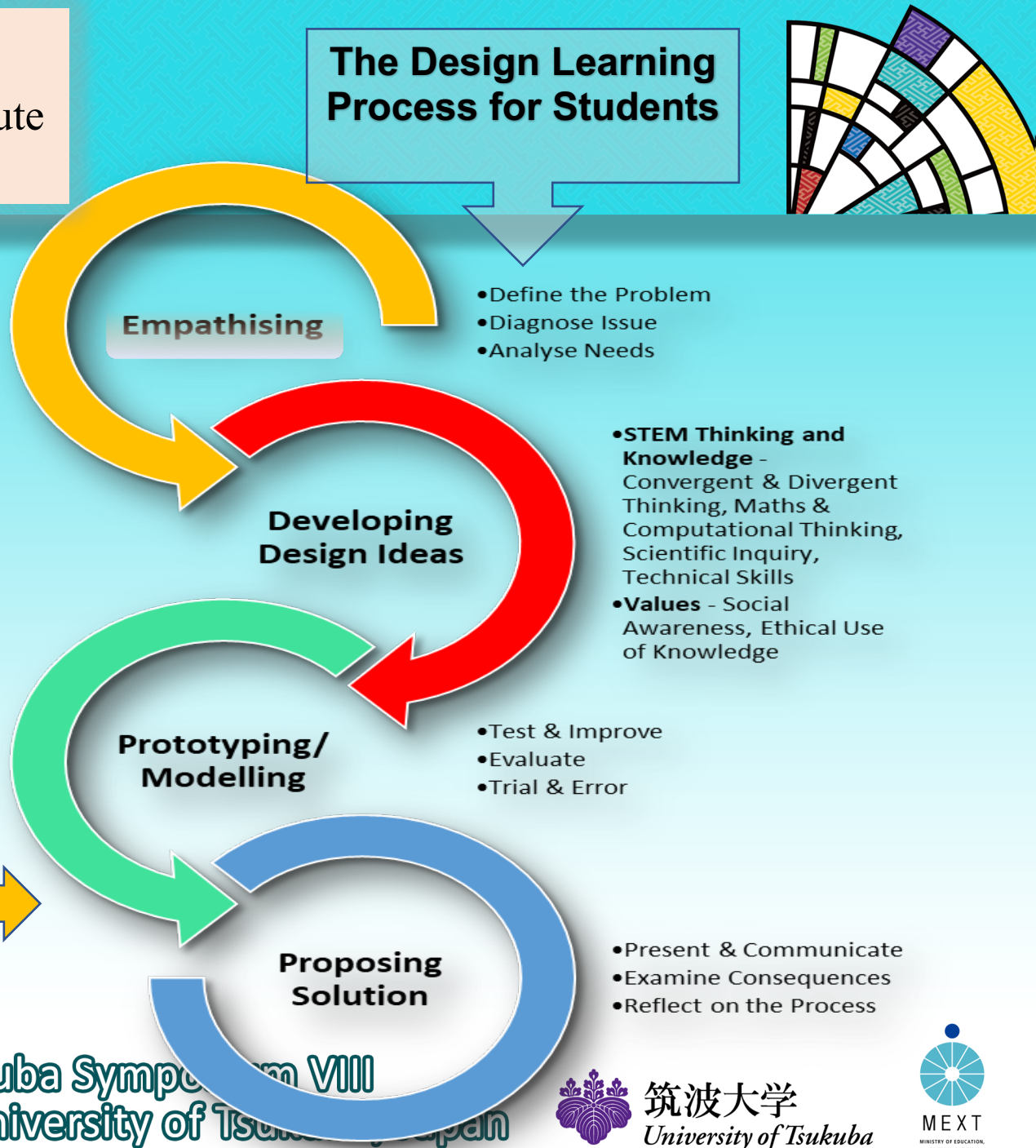
Why is empathy important for STEM education?

- Engaging students in empathy can make STEM learning more meaningful because students can see the impact of STEM in their lives and the lives of others.
- By making STEM content relevant, students will be able to see themselves as potential contributing members of the STEM community.
- Taking a more interpersonal and **empathy**-based approach to STEM learning can also broaden our visions of what it means to be a "STEM person."

Empathy is the first of the five phases in **Design Thinking model** proposed by Hasso-Plattner Institute of Design at Stanford, which is also known as d.school.

By engaging empathy, students will learn the process of solving issues through observing and listening.

Planning and Design Learning (PaDL)" Framework



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RECSAM's Planning and Design Learning (PaDL) Framework

- The **Planning model for teachers** is comprised of the following steps or cycle:

(a) creating enthusiasm, a real-world problem or issue for students, connection to the curriculum,

(b) plannning the sequence of learning activities, scaffolding, resources, and assessment.

(c) Reflection

- Through the **Design learning process** (**empathising**, …, proposing solution). Get students to consider issues like ethical use of knowledge, implications and consequences of solutions, how to work cooperatively in groups, how to conduct inquiry and develop other 21st Century Skills.

Developing empathy

- The empathy stage puts other people at the start and heart of any planning activity or research project.
- This human-centred approach ensures that the design and proposed solution is anchored in the real-world.
- It will help the students make the right decisions and avoid design failure when solving problems. Do not guess what other people need without first listening to them. A lack of empathy will contribute to design failure. Without empathy, there is no solution.

Developing empathy

- Humans and communities have various degrees of willingness to adopt particular solutions to problems, which can act as potential design constraints.
- Engaging in empathy encourages students to examine these constraints from multiple perspectives and to ask questions to refine ideas and solutions to better address these constraints.
- Insights gained from engaging in empathy can also support students to better identify and define a problem statement that addresses the needs of particular communities.

THANK
YOU