ShiDa Institute for Mathematics Education (SDiME)

JUST DO MATH Project

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An Overlook of SDiME

- Shi-Da Institute for Mathematics Education (SDiME), since 2016.08
  (former: **Mathematics Education Center** (MEC) since 2014.08–2016.07)
- Dean of the institute: Prof. Fou-Lai Lin
- http://mec.math.ntnu.edu.tw/
- 1st nationwide project: **JUST DO MATH** Project (2014–2017)
  - for enhancing students' mathematics ***learning attitudes***
  - for ***mathematics teacher professional development***

TW Students' Affective Problems in Learning Math: e.g. TIMSS 2007 & 2011

Attitude / Grades	Not confident in mathematics		Do not value mathematics		Do not like learning mathematics	
	2007	2011	2007	2011	2007	2011
4th (Int. Avg.)	27% (11%)	38% (21%)	--	--	29% (14%)	32% (16%)
8th (Int. Avg.)	46% (20%)	67% (41%)	16% (5%)	46% (15%)	45% (26%)	53% (31%)

How we Tackle the Problem…

JUST DO MATH (JDM) Project

Mathematics-Grounding Activity

- Meaningful learning (***concrete experiences*** before abstract learning)
- Raising math learning ***motivation***

Structure of the JDM Project (nationwide project)

Mathematics-Grounding Activity (MGA)

Expected Role of Teacher: Mathematics Spreader Teacher | MGA Designer | Lecturer of Mathematics Spreader Teacher

(PD & Practice) Context: Workshop, Math Camp, Terminal Report — Quality Control | Workshop — Quality Control | Workshop — Quality Control

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Classroom

Teaching Mathematical Concepts with One MGA

An example of **GAME** as the Approach

- The promoter of **game-based learning**, **Keith Devlin**, contends that "***games are the best way to teach math***" (Shapiro, 2014).

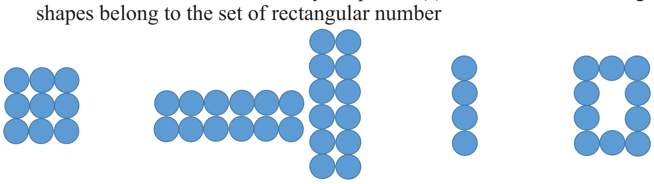
Example of RECTANGULAR NUMBERS

- Three sub-activities
- Exploring with the prerequisite of ***multiplication*** to develop students' further concepts of
  - *prime number*,
  - *composite number*, and
  - *factorization*

  through exploring the areas of rectangles

Sub-Activity 1

- Explore various kinds of rectangular number (e.g. one rectangle with 12 coins) with the coins
- Communicate and discuss with your partner(s), whether the following shapes belong to the set of rectangular number



Sub-Activity 2

- Practice with teachers' assistance
- Construct as many **rectangular numbers** as possible with **50 coins**, following the rules made in sub-activity 1.

Sub-Activity 3

- Competition game:
- A group of 2-3 people: take turns to pose any rectangular number within 50 and the opponent has to decode the width and length of the rectangles as much as possible, and make a record of those numbers
- Scoring with the following table

Points of the Denoted Number	List of the Numbers
0 point (no set of width and length)	e.g. 1, 2, 3, 5, …
1 point (1 set of width and length)	e.g. 4, 6, 8, 9, …
2 points (2 sets of width and length)	e.g. 12, 16, …
3 points (3 sets of width and length)	e.g. 24, 30, …
4 points (4 sets of width and length)	e.g. 36, 48

- Categorizing and Naming the numbers

Networking Theories (1)

- **Three Cognitive Representations of Learning** (Bruner, 1966)
  1. Enactive representation: forming the rectangular number(s)
  2. Iconic representation: e.g. sets of width and length
  3. Symbolic representation: e.g. categorizing & naming

Networking Theories (2)

- **The Progressive Functions of Mathematics Games** (e.g., Dienes, 1970)
  1. **Free Play**: Noticing the mathematics attributes embedded in
  2. **Rule of the Game**: Exploration of the rules by students themselves
  3. **Searching for Commonality**: Searching the mathematical structure from the activity
  4. **Representations**: Constructing ways of representation for the preparation of further abstract communication with peers (e.g. no-scored number)
  5. **Symbolization**: Building symbols as the language to examine and describe the representation
  6. **Formalization**: Proving the rules of the mathematical game, incl. the description of axioms, deductive reasoning of a theorem, proof from an axiom to a theory, etc.

Networking Theories (3)

- **Three Modes of Schema Construction (Skemp, 1986)**

Building		**Testing**
Experience from our own encounters with the physical world	**Mode 1**	***Experiment*** against expectations of events in the physical world
Communication from the schema of others	**Mode 2**	***Discussion*** comparison with the schemas of others
Creativity from within by formation of higher-order concepts (by extrapolation, imagination, intuition)	**Mode 3**	***Internal Consistency*** comparison with one's own existing knowledge and beliefs

Mode 1: the importance of *structured practical activities*
Mode 2: the value of *co-operative learning*
Mode 3: *creativity* in the learning of mathematics

Networking Theories (4)

- **Model of Mathematics Understand** (Pirie & Kieren, 1989)
- 'don't need' boundaries
- 'folding back'
- The complementaries of 'acting and 'experiencing' that occur at each level of understanding