**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
- 1st nationwide project: JUST DO MATH Project (2014–2017)  
  - for enhancing students’ mathematics learning attitudes  
  - for mathematics teacher professional development

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

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Grades</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th (Int. Avg.)</td>
<td>27%</td>
<td>38%</td>
<td>--</td>
<td>--</td>
<td>29%</td>
<td>32%</td>
</tr>
<tr>
<td>8th (Int. Avg.)</td>
<td>46%</td>
<td>67%</td>
<td>16%</td>
<td>46%</td>
<td>45%</td>
<td>53%</td>
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</table>

**How we Tackle the Problem...**

**Mathematics-Grounding Activity (MGA)**

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

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**Structure of the JDM Project (nationwide project)**

**Mathematics-Grounding Activity (MGA)**

- Mathematics Spreader Teacher
- MGA Designer
- Lecturer of Mathematics Spreader Teacher
- Workshop
- Quality Control
- Math Camp
- Terminal Report
- Workshop
- Workshop
- Workshop
Structure of the JDM Project (nationwide project)

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

<table>
<thead>
<tr>
<th>Points of the Denoted Number</th>
<th>List of the Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 point (no set of width and length)</td>
<td>e.g. 1, 2, 3, 5, ...</td>
</tr>
<tr>
<td>1 point (1 set of width and length)</td>
<td>e.g. 4, 6, 8, 9, ...</td>
</tr>
<tr>
<td>2 points (2 sets of width and length)</td>
<td>e.g. 12, 16, ...</td>
</tr>
<tr>
<td>3 points (3 sets of width and length)</td>
<td>e.g. 24, 30, ...</td>
</tr>
<tr>
<td>4 points (4 sets of width and length)</td>
<td>e.g. 36, 48</td>
</tr>
</tbody>
</table>

- 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. Representation: 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)

<table>
<thead>
<tr>
<th>Building</th>
<th>Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience</td>
<td>Mode 1 Experiment</td>
</tr>
<tr>
<td>Communication</td>
<td>Mode 2 Discussion</td>
</tr>
<tr>
<td>Creativity</td>
<td>Mode 3 Internal Consistency</td>
</tr>
</tbody>
</table>

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 Understanding (Pirie & Kieren, 1989)
  - ‘don’t need’ boundaries
  - ‘folding back’
  - The complementaries of ‘acting’ and ‘experiencing’ that occur at each level of understanding