Enhancing Teaching and Learning with Understanding in Mathematics Using ICT: Professional Development Programmes for ASEAN Mathematics Teachers

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SEAMEO

SOUTHEAST ASIAN MINISTERS OF EDUCATION ORGANISATION

RECSAM

REGIONAL CENTER FOR EDUCATION IN SCIENCE AND MATHEMATICS
PENANG, MALAYSIA

SEAMEO RECSAM

VISION

Leading centre for quality science and mathematics education

MISSION

To promote and enhance Science and Mathematics Education among SEAMEO member countries.

MEMBER COUNTRIES

RECSAM's **Strategic Goals**

- Conduct relevant R&D activities to inform pedagogy and policy;
- **Design and implement effective professional development programmes;**
- Ensure strong and active networking among experts and institutions;
- Increase engagement in consultancy services;
- Convene conferences, seminars and workshops to pool expertise;
- Serve as an effective clearing house for information
- Enhance continuous professional staff development
- Strengthen quality assurance in provision of services and management resources;

Integrating ICT in Teaching and Learning Mathematics

UNESCO Project

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SEAMEO

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SEAMEO RECSAM Programmes (Mathematics)

- **Support UNESCO's and SEAMEO Region's Programmes**

RECSAM'S PROGRAM IN TRAINING TEACHERS AND EDUCATORS IN USING ICT IN TEACHING AND LEARNING MATHEMATICS

THE 8TH FIVE YEAR PLAN F.Y. 2005-2010

Regular and Customised Courses: Integrating ICT

THEME	*THE SUB-THEME*
Integrating ICT in Teaching and Learning Mathematics	(1) Hand-Held Technology; (2) Courseware and software Applications; (3) Internet-Based Learning; (4) Multimedia (8th Five Year Plan, 2003)

REGULAR COURSES :

COURSE TITLES

Classroom Activities

Training Program:
- **4 weeks duration**
- **Under Scholarship by MOE Malaysia**
- **3 batches a year**

PM – 3222
Using ICT In Teaching and Learning for Understanding in Primary Mathematics

PM – 2233
Enhancing Online Teaching and Learning for Primary Mathematics Teachers

PM – 3262
Using ICT In Teaching Primary Mathematics through Cooperative Learning Models

PM – 3494
Interactive Multimedia for the Teaching and Learning of Primary Mathematics

REGULAR COURSES

School Try-out

Projects:
- Multiplier Effect Proposal
- Lesson Plan
- Project Work

1. **SM - 3222 Using ICT in Teaching and Learning for Understanding in Secondary Mathematics**
2. **SM – 3494 Integrating Multimedia for the Teaching and Learning of Secondary Mathematics**
3. **SM – 3164 Enhancing Students' Understanding and Active Learning in Secondary Mathematics through Selected Hand-Held Technology**
4. **AM – 9063 Design and Development of Primary and Secondary Mathematics Instructional Technologies**
5. **SM – 8130 Integrating (ICT) in the Enrichment Program for Gifted Learners in Secondary Mathematics**
6. **SM – 3050 Integrating ICT on Students' Assessment in Secondary Mathematics**

Using ICT in Teaching and Learning for Understanding Mathematics

The Teaching, Learning and Technology Principles in School Mathematics (NCTM, 2000)

The Teaching Principle

Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.

The Learning Principle

Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge

The Technology Principle

Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances student's learning

Teaching and Learning for Understanding Using ICT in Mathematics

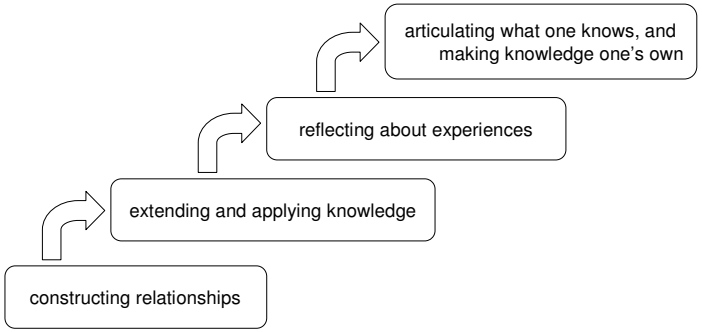
Thinking about and doing mathematics
is the central focus of learning mathematics
for the 21st century.

NCTM recommends that Mathematics instructional program should :

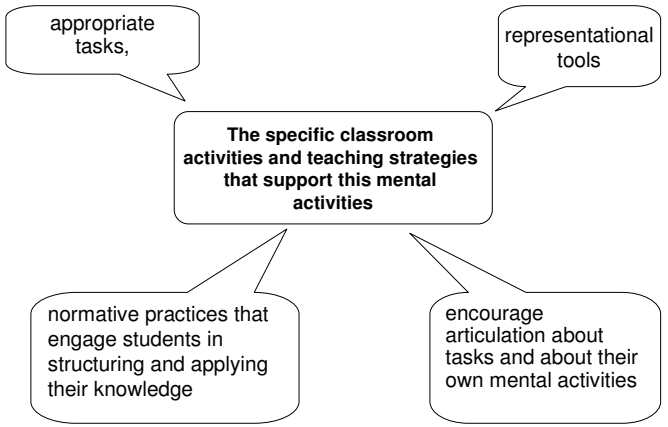
"enable all students to understand and use mathematics and to use technology to help all students understand mathematics …".

Fundamental Forms

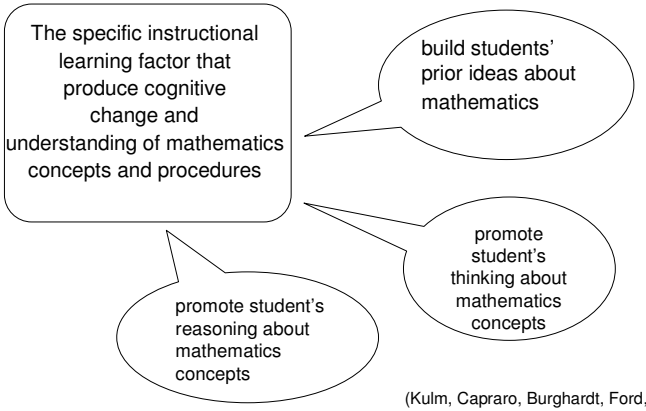
- Learning mathematics with understanding involve some fundamental forms of mental activity: (Carpenter & Lehrer, 1999).



The Specific Classroom Activities for Enhancing Understanding



Important Factors in Building Childrens' Understanding



(Kulm, Capraro, Burghardt, Ford, 2001).

REGULAR COURSE

USING ICT IN TEACHING AND LEARNING

FOR UNDERSTANDING IN MATHEMATICS

Participants

- 10 participants attend each regular course under scholarship from RECSAM .
- These participants are teachers and teacher-educators from universities, teacher training colleges, department of education office and schools.

They generally have the following profile:

- Serve in university departments of mathematics education and teacher training institutions that are involved in pre-service and in-service teacher training at primary or secondary level.
- In charge of the ICT related matters of their institutions.
- Have basic skills in ICT tools
- Have basic skills in reading, writing, and speaking English.

Duration : 4 weeks (120 hrs)

The objectives

- Show an understanding of important issues and trends in mathematics and mathematics education;
- Use various teaching strategies and approaches to support mathematics investigation, modelling and mathematical problem solving;
- Determine appropriate use of ICT in teaching and learning mathematics;
- Use ICT: Graphic Calculator, Geometer's Sketchpad, MS-EXCEL, Autograph, Thinker Plot, Kid Pix Deluxe, LOGO, Internet and WWW in teaching and learning for understanding in secondary mathematics;
- Assess student performance in learning mathematics using ICT;
- Design lessons for secondary mathematics that integrates the use of ICT.

General Components

- (1) Basic ICT,
- (2) Multiplier Effects Proposal
- (3) Action Research.

Core Components

Theory	Pedagogy	Technology
Current Trends in math Education	ICT in teaching and learning Math	Basic ICT tools
Philosophy of Math Education	New roles of teachers in the ICT environment	Software
How students learn mathematics	Teaching and learning for understanding using ICT	Hand-held technology
Constructivism in the math classroom	Pedagogical principles for integrating ICT into math classrooms	Web-Quest e-learning
Instructional design using ICT	Utilizing technology in creating problem-based curriculum	
Alternative Assessment in	Creating lesson using ICT to support differing learning characteristics	
Seminar on writing multiplier effect proposal	Individual learning, cooperative learning, inquiry-based learning Using ICT	
Classroom Action Research		

INTEGRATING ICT (CONSTRUCTIVIST PEDAGOGY)

- Structuring opportunities for trainees to reflect on the whole process
- Encouraging trainees to compare their own ideas with alternative explanation
- Presenting trainees with alternative explanations or concepts
- Encouraging trainees to generate their own solutions
- Providing trainees with opportunities to explore
- Using trainees' preconceptions of the math concepts

(Chiappetta, Koballa, & Collette, 1998).

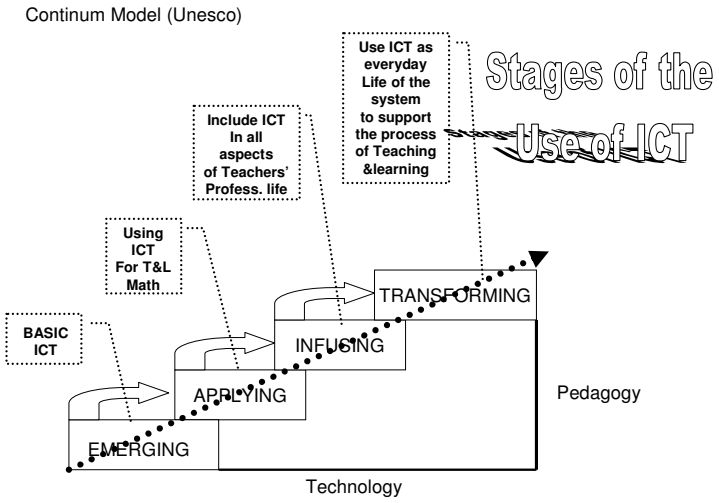
Activities Using ICT

Example:

Title: Heart Rates as a Sinusoidal Using a CBL and a heart monitor

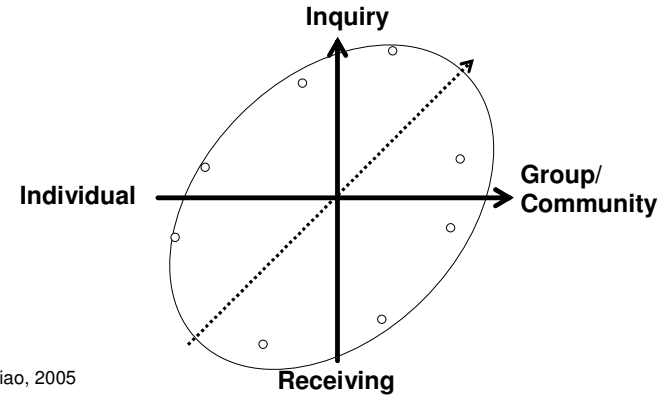
Math Problem Solving	Students will perform harmonic analysis (finding the equation, given the curve).
Exploration & Investigation	Students explore mathematical concepts through the activities with other students
Math Communication and Reasoning	Students discuss mathematical concepts with other students and make predictions.
Math Connection	Students will observe connections between trigonometry (sinusoidal curves) and biology (heartbeats).
Math Representation	Students see different representation of the data
Math Modeling	Students build a mathematical model

Stages of the Use of ICT



ICT PEDAGOGY INTEGRATION

2-Dimension Category of Pedagogy



Miao, 2005

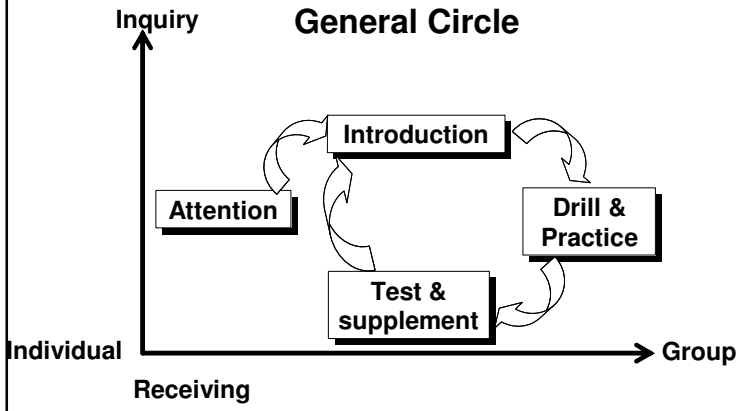
ICT-Pedagogy

How to Use ICT to Facilitate：

- Expository-based Learning
- Inquiry-based Learning
- Individual Learning
- Cooperative Learning

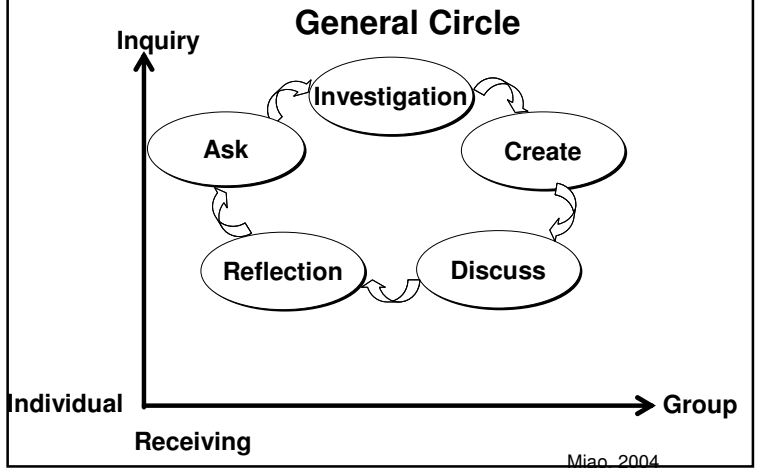
Miao, 2005

Expository-based Learning



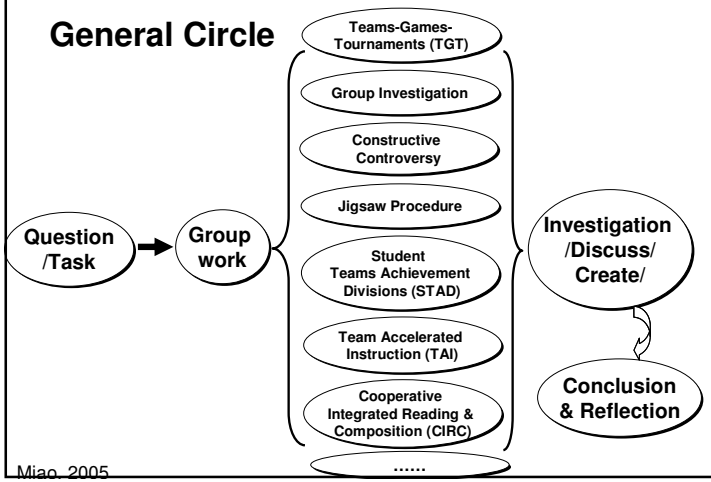
Miao, 2005

Inquiry-based Learning



Miao, 2004

Cooperative Learning



Miao, 2005

ICT-Based Individual Learning

- **Individual Learning with structured software – CAI:**
  - **Drill and Practice**
  - **Simulations**
  - **Tutorials**
  - **Instructional Games**
  - **Problem-solving Programs**
  - **Integrated Learning Systems**

Miao, 2005

Resources-Based Learning

Key features

During resource-based learning, students are motivated to learn about a topic by trying to find information on it in as many ways and places as possible (books, journals, newspapers, multi-media, Web, etc).

- Student- centered：a sense of ownership of learning, self-confidence, and reinforcement
- Learn by doing: students making meaning as individuals
- Students as information hunter & interpreter: this learning experience mimics real life to construct knowledge by problem solving with information tools.

INSTRUCTIONAL STRATEGIES

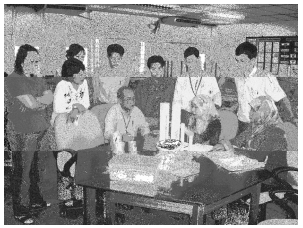
• Self directed learning

Pair Learning

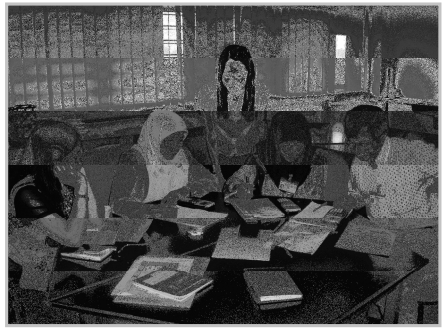
• computer-mediated communication

HANDS-ON ACTIVITIES






Classrooms Activities Using Graphic Calculator



Group work Sharing of experiences

Course Requirements

- Individual Tasks for each Topic
- Groups Tasks for each Topic
- Individual Multiplier Effect Proposal
- Final Group Project Work

Final Project Work

- Each Group Develop Lesson Plan with its activities and worksheets, evaluation sheets
- Conducting Try-out in school or Try-out in classroom
- Analyzing Try-out
- Writing Final Project Work
- Presenting the Result of the Try-out

Sample of Project Work Titles

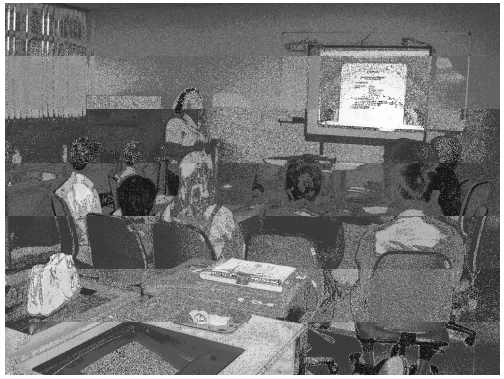
- ENHANCING LEARNING ***STATISTICS*** USING ***TINKER PLOT*** AT LOWER SECONDARY MATHEMATICS
- USING ***AUTOGRAPH*** IN TEACHING AND LEARNING ***TRANSFORMATION*** FOR LOWER SECONDARY MATHEMATICS
- USING ***GRAPHIC CALCULATOR*** IN ENHANCING STUDENTS' UNDERSTANDING THROUGH MATHEMATICAL EXPLORATION OF TRIGONOMETRIC FUNCTION
- FRACTION IN ACTION USING ***MANIPULATIVE AND VIRTUAL MANIPULATIVE*** FOR PRIMARY STUDENTS

School Try-Out

There were two modes of trying out the lesson:

1. Conduct Action Research
   Try-out in the school for the conduct of action research developed together with teachers
2. Conduct lesson study
   Participants conduct lesson study to try-out and improve lesson plan

Group Project Presentation



Multiplier effects

- After training, the trainee teachers are expected to conduct similar activities to train their colleagues or other teachers in their respective countries, resulting in multiplier effect.

Evaluation

- Course Evaluation
- Pretest and Posttest of participants' perception toward the course are given before and after the course.
- Participants performance also evaluated at the end of the course

Program Evaluation

- At the end of each week of training and at the end of each course, a session is held to get feedback from the trainees.
- Participants evaluate the course programs through a structured questionnaire. The program is then modified according to the feedback received.

Teachers' Perception Toward ICT

- Teachers' perception toward ICT was given to participant before and after the course

Challenges

Prior

- English Proficiency
- Basic ICT Skills
- Background of Subject / Field
- Different Ability

After (Impact Study)

- ❑ No Financial Support
- ❑ No ICT Tool in School
- ❑ School Curriculum