ENHANCING TEACHING AND LEARNING FOR UNDERSTANDING IN MATHEMATICS USING ICT: PROFESSIONAL DEVELOPMENT PROGRAMMES FOR MATHEMATICS TEACHERS IN SEAMEO COUNTRIES

Ida Karnasih
Senior Lecturer UNIMED, MEDAN
SEAMEO RECSAM, MALAYSIA
ikarnasih2001@yahoo.com

Wahyudi
SEAMEO RECSAM, MALAYSIA
wahyudiw@yahoo.com

ABSTRACT

This paper describes professional development programmes, which is designed to prepare teachers in integrating ICT in enhancing teaching and learning for understanding mathematics. One of the aims of this programme is to fulfil teachers with experiences in integrating ICT in mathematics classroom in order to support Indonesian MOE programmes in mathematics classroom. This paper describes the philosophy, the programmes and the implementation, the challenges in implementing ICT in Mathematics classrooms. This paper also describes professional development programs in training mathematics teachers using ICT. Strategy/approaches, assessment, It also gives some examples of participant's project work in fulfilling the goals of programmes. Some recommendation and suggestions for future professional development for mathematics teachers in integrating ICT in mathematics classroom are also described in this paper.

Key Word: ***Mathematics Education, Learning with Understanding, Integrating ICT, Professional Development***

Introduction

Mathematics education reform has emphasized a need for increased experience with technology and critical thinking skills in order to better prepare students for a modern society that is dependent on access to and use of information. However, the complexity and diversity of these skills leave some uncertainty about their succesful implementation in mathematics classroom. The integration of Information and Communication Technologies (ICT) into professional practice place great demands on teachers to provide students with the oppurtunity to develop the skills required to engage in progressive societies and to become life-long learners (CEO Forum, 2001) as well as to enhance learning. To exploit the potential of ICT, there is a need for teachers or educators to fully incorporate those new technologies into their teaching practice.

Increasingly, efforts are being made to integrate ICT in mathematics classroms in South-East Asian countries, including Indonesia, but its use in mathematics classroom practices in some countries is still limited. The recent TIMSS-2003 studies show that technology integration is extremely rare in school Mathematics and Science, even when national curricula make reference to the use of computers, equipment is available for classroom use, and teachers have received recent training in technology integration in their subject (Ruthven, 2007).

Singapore, as a developed country, has started to integrate ICT in teaching and learning of mathematics since 1997. Malaysia with its programs at developing SMART SCHOOL has integrated ICT in mathematics classrooms using computer courseware. For secondary school level they hace started to use Scientific and Graphic Calculator, and GSP (The Geometer's SketchPad) and mathematics courseware.

For future programmes in integrating ICT in education, UNESCO (2006) under The Next Gen Project has involved ten countries from he Asia-Pacific region, namely Cambodia, India, Indonesia, Lao PDR, Malaysia, People's Republic of China, Philippines, Sri Lanka, Thailand and Viet Nam. The Next Gen Project was launched in Bangkok, Thailand, from 16 to 18 May 2006. The aims is to improve the integration of ICT into education in Asia-Pacific region and to encourage more learner-centred methods of instruction in school in the region. The project aims also to enable the next generation of post-primary teachers in the Asia-Pacific region to harness the benefits of information and communication technologies (ICT) to enhance teacing and learning.

To date, the use of ICT in mathematics classrooms in most South-East Asian countries has not been fully and successfully realized, and places an imperative challenge on educators to acquire relevant skills and to adopt teaching practices that may challenge their current practices. This is crucial as the positive impact of ICT depends on how teachers use iCT in their teaching and learning programs (Kozma, 2003). Roschelle (2000) stated "teacher who succeed in using technology often make substantial changes in their teaching styles and in the curriculum they use" (P. 91). This indicates a need for mathematics teacher in Indonesia to integrate technology in enhancing mathematical concepts and procedures and to extend student' mathematical thinking and problem solving skills. The intensive and quality training have to be done in improving the quality of mathematics teachers for future mathematics education in the region.

New Vision in Integrating ICT

UNESCO (2002) has stated new visions for the integration of ICT in teaching and learning in order to develop teachers competencies.

Vision 1: Technology, in general, and ICT, in particular, is an aid to teaching and a tool in the facilitation of learning; it is supplementary to the fundamental process of teaching and learning.

Vision 2: Teachers have changing roles in technology-facilitated learning environments and remain fundamental and central to the learning process.

Vision 3: Learning is the responsibility of the learner and the teacher has the fundamental task of guiding the learner and facilitating learning through good pedagogy and appropriate technology.

Vision 4: Pedagogy, as a key professional attribute and major element of professionalism in teachers, can be supported by technology for an improved teaching-learning process.

Vision 5: ICT can strengthen attributes of the formal school as a one-stop learning community that is essential for good pedagogy, and provide a remedy for improved leraning in alternative settings outside the institution.

Vision 6: ICT offers new and innovative modes of learners centred learning culture at all levels of education. It can bring classroom without walls and has profound impact on learning environments.

Vision 7: ICT integration becomes a necessary, natural, automatic and integral part of teaching and learning rather than an add-on teaching aid.

The Teaching, The Learning and The Technology Principles in Mathematics

The main idea of this articles is based on the six principles of mathematics education written by The National Council of Teachers of Mathematics (NCTM, 2000) which should underlie mathematics in curriculum, instruction, and assessment. The three principles discuss in this article are in light with focus of this paper:

1. *The Teaching Principle: Effective mathematics teaching requires understanding what student know and need to learn and then challenge and support them to learn it.*
2. *The Learning Principle: Student must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*
3. *The Technology Principle: Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances student's learning.*

A few observations that relate to those principles in implementing the standard in in-service programs include: (1) The teaching principle is supportive of higher-order knowledge and skills learning for understanding, rather than rote learning; (2) The learning principle is strongly supportive of constructivism; and (3) The technology principle is supportive of a careful examination of rules of ICT in all aspects of mathematics curriculum, instruction, and assessment. In implementing these principles some question arise:

- In integrating technology into teaching mathematics, what kind of approaches, strategies, and activities should be given to student so that student's understanding can be enhanced?
- When students use technology in learning mathematics, should we drop paper and pencil activities, using manipulative or hands-on activities because of calculators and computers? When to use or not to use technology? And what kind of technology fit to the certain mathematics topic?
- Contructivism is an important learning theory. But, there are other learning theories that might also be important to mathematis education and should be taking into considering in integrating ICT into mathematics classrooms.

More over, NCTM (1991) describes that techers need to be more proficient in "using, and helping students use, technology and ***other tools*** to persue mathematical investigation". This means that other tools also should be considered to reach the goal of developing student mathematical power. For example: teachers can use manipulative before using virtual manipulative (e-learning) in learning fraction. More importantly teachers should be proficient in "guiding individual, small group, and whole class work" (p.1).

Teaching and Learning for Understanding Using ICT in Mathematics

The integration of Information and Communication Technologies (ICT) into educationis recognized as: providing oppurtunities for developing skills for the 12st century, having the potential to transform pedagogical practices, and playing a role in reforming curricula. ICT offers powerful opportunities for pupils to explore mathematical ideas, to conjecture, to generalize, explain results and analize situations, and to receive fast and reliable, and non-judgemental, feedback. Their use needs

careful planning-not just of the organization of hardware and appropriate software, but also of activities that allow students to develop their mathematical thinking as well as on computer exploration. Additionally, it is considered an essential tool for developing understanding about mathematical concepts. The challenge for techers is how to use and integrate ICT in ways that promote mathematical thinking and concept development.

The American National Council of Teachers of Mathematics (NCTM) concerned with principles and standards for mathematics classrooms which are viewed are places where thinking about and doing mathematics is the central focus the 21st century. Among its guiding principles, 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 and prepare them to use mathematics in an increasingly technology world". Classrooms that promote learning mathematics with understanding for all students involve a necessarily complex set of interactions and engagement of teacher and students with richly-situated mathematical content (McClain & Cob, 2001). It involves some fundamental forms of mental activity: (1) constructing relationship, (2) extending and applying knowledge, (3) reflecting about experiences, (4) articulating waht one knows, and making knowledge one's own (Carpenter & Lehrer, 1999).

Furthermore, the specific classrooms activities and teaching strategies that support this mental activities include appropriate tasks, representational tools, and normative practices that engage students in structuring and applying their knowledge and in reflection and encourage articulation about tasks and about their own mental activities. One of the goals of teaching mathematics is to produce student's cognitive change of mathematics concept and procedures. The specific instructional learning factor that produce cognitive change and understanding of mathematics concepts and procedures in particular, activities that (1) build students' prior ideas about mathematics and (2) promote student thinking and reasoning about mathematics concepts that are important factors in building understanding (Kulm, Capraro, Burghart, Ford, 2001). Ausubel (1968) noted that "the most important single factor influencing learning is waht the learner already knows". There are many implications of this finding in mathematics teaching and learning. Schoenfeld (1992) explain that difficulties in mathematical problem solving are often caused by student's inefective use of what they already know. Research on these variables has provided evidence of their importance in mathematics teaching and learning that is designed to lead to conceptual change.

Preparing Mathematics Teachers Teach with Technology

In the 21st century, the change of information and communication has impact in the shift to incorporate computer-based, electronic technologies integrating learning with these technologies within the context of the academic subject areas.

However, how teachers learned their subject matter is not necessarily the way their students will need to be taught in the 21st century. Learning subject matter with technology is different from learning to teach that subject matter with technology.

In some SEA countries, few teachers have been taught to teach their subject matter with technology. Teachers need to be trained school teachers feel comfortable using technology in their teaching. Right now, the concern about the preparation of teachers is for a changing curriculum that integrates technology. Mathematics Standards (National Council of Teachers of Mathematics (NCTM, 2000) point toward a mathematically rich

curriculum where technology is an essential component of the learning environment, not only in the curriculum but also in the instruction.

Professional Development of Mathematics Teachers/Educators

RECSAM as a centre of excellence in science and mathematics education supports UNESCO's programs which aims to empower teachers, teachers educators to effectively use ICT for expanding learning opportunities and ensuring educational for quality and relevance. SEAMEO RECSAM as a centre of excellence in education for science and mathematics has mission "to promote and enhance Science and Mathematics Education among SEAMEO member countries". Its vision is as a "leading centre for quality science and mathematics education". Among its strategic goals are "to design and implement effective professional development programmes and to enhance continous proffesional staff development for ASEAN Mathematics and Science teachers". RECSAM's programs in training mathematics and science

teachers are directed toward helping teachers in South-East Asian countries to support the implementation of mathematics curriculum in the member countries in an effective way. On eof the themes of the courses offered in RECSAM is Integrating ICT in Teaching and Learning mathematics and science. The course aims to improve the capabilities of in-service mathematics teachers and educators to utilize ICT as pedagogical tools and educational resources. The training and Professional Development of Teachers for Effective Use ICT in Improving Teaching and Learning Mathematics involves training teachers to create lesson plans utilizing ICT and to use educational software. Some of the expected results include, a set of prototype course materials on integrating technology with pedagogy produced; the multiplier effect proposal for training teachers or colleagues in their own countries; training of teacher or teacher-trainers or master teachers.

RECSAM realizes the importance of ICT for the survival of the education in SEAMEO member coutries and it has implemented the EightFive-Year Plan to transform the program into an excellent center to enhance the countries' competitiveness and to enhance the quality of life for the people through the exploitation of information technology. RECSAM's Programs also supportUNESCO's recommendation for future education in intergrating ICT in classroom in all countries. The UNESCO ICT in Education Unit has recognized this need in its broader vision to harness ICT for achieving the Education for All goals. The Next Gen Project has been guided by the vision of the Director of the UNESCO Asia and Pacific Regional Bureau for Education in Bangkok, Mr Sheldon Shaeffer, who expressed the goal as follows:

> *"By 2008, all regional Member States will be in a position to offer eachers an education on how and when to best use technologies for teaching and learning, through training which is integrated an all national pre-service teacher training institutions in the Asia-Pacific regions. Learners will directly benefit from this new generation of well educated teachers, who will be empowered to use technologies and to facilitate the learners' active participation in learning, and in the knowledge socities and economics."*

To achieve these goals, it is RECSAM's responsibility to provide South-East Asian teachers with ICT skillsl and in harnessing the potential advantages of ICT in improving teaching and learning by offering some courses on in ICT integration. The training program aims to improve the capabilities of in-service teachers and facilitators

to utilize ICT as pedagogical tools and educational resources for effective use of ICT in improving teaching and learning of mathematics and to enhance the reach and quality of mathematics education.

The technology a new round curriculum reforms in Southeast Asian countries are taking place, which brings fresh challenges for mathematics teachers who are required to integrate ICT into their teaching. Technology-pedagogy integration now is becoming a critical component of their proffesional competencies. ICT has then become a crucial element for teacher training. In RECSAM's, Integrating Information and Communication Technology (ICT) in Teaching and Learning Mathematics has been a theme of the Regular or Costumized Course. The sub-themes include (1) Hand-Held Technology; (2) Courseware and softwareApplications; (3) Internet-Based Learning; and (4) Multimedia (8^{th} Five Year Plan, 2003). For many years, RECSAM has made considerable efforts in training teachers in Southeast Asian countries in integrating ICT. Among the topics are: Enhancing Teaching and Learning for understanding mathematics (Ida Karnasih, 2005, 2006), Enhancing On-Line teaching and learning (Simon, 2006), Using ICT through cooperative learning (Khrongthong, 2003), Integrating ICT in the enrichment programs for gifted learners (Khrongthong, 2002), Integrating ICT on student assessment, Design and the development of Mathematics instructional technologies, Enhancing students' understanding and active learning through selected hand-held technology (Ui Hock, 2005), and interactive multimedia for teaching and learning mathematics (Anamalai, 2005). Some courses are offered for both primary and secondary teachers.

A Model of ICT Application for Teachers' Professional Development

Studies of ICT development in both developed and developing countries identify at least four broad approaches through which educational systems and individual institutions typically proceed in their adoption and use ICT. Sometimes, the number of stages identified varies. However, there is a general consensus that the introduction and use of ICT in education proceeds in broad stages that may be conceived as a continuum or series of steps Emerging, Applying, Infusing, and Transforming (UNESCO, 2003).

The continuum model above indicates that the skills of mathematics teacher trainees flows from the emerging to the applying into the infusing and then culminates in the transforming processes of the educative which takes place in schools mathematics.

1. ***The Emerging Approach*** is the first stages of ICTs skills development in teachers. The focus is on appreciation of technical functions, components and general usese of ICTs, especially for education and training. This approach tends to be theoretical and practical components involves the personal use of ICT such as the use of word processing to prepare worksheets, locating information on CD-ROMs or on the internet, or communicating with friends and family via e-mail. The emphasis here is on training of teachers in a rang of tools and applications, and increasing teachers' awareness of the opportunities for applying ICT to their teaching in the future. The course topic called "Basic ICT" which is offered as one of the general topics.
2. ***The Applying Approach*** emphasizes the application of ICTs to mathematics subjects areas. In the applying approach, teachers use ICT for professional purposes,

focusing on improving mathematics teaching in order to enrich how they teach mathematics with a range of ICT applications. This approachoften involves teachers in integrating ICT to teach mathematics skills and knowledge; beginning to change their methodology in the classroom; and using ICT to support their training and professional development.

3. ***The Infusing Approach*** involves the inclusion of ICT in all aspects of teacher's professional lives such ways as to improve student learningand the management of learning processes in mathematics classrooms. The approach support active and creative teachers who are able to stimulate and manage the learning of students, integrating a range of preferred learning styles and uses of ICT in achieving their goals in the teaching and learning of mathematics. The infusing approach often involves teavher easily integrating different knowledge and skills from other subjects into projects based curricula.
4. ***The Transforming Approach*** involves teachers and other support staff in the schools system regarding ICT as a natural part of everyday life of the system that they begin to look at the processes of teaching and learning mathemtics in new ways. The emphasis changes from a teacher-centered to learned-centered system where the teacher is helping students as the facilitator of their learning experiences to construct new learning paradigms out of the various offerings tha the school makes available to them.

This shift in emphasis in learners needs also calls for new training needs on the part of the teachers, where they would be imbued with such components of knowledge that prepares them to annex the potentials of ICTs in sourcing and disseminating information to their students.

Contructivist Approach in Training Teachers in Using ICT

Research shows that contructivist teaching has only been widely accpeted in mathematics and science since the early 1980's (Steffe & Gale, 1995). The contructivist approach to teaching and learning is gradually being implemented by facilitators. "teaching, from a contructivist perspective, is not viewed as telling or transmitting fixed truths to trainess but rathe as providing trainess with relevant experiences and subsequent for dialogue so meaning can evolve and be constructed" (Arends, 1998, p.5).

RECSAM as a centre of excellence in training science and mathematics teachers has been implemented contructivist approach in training teachers which emphasizes on thinking, understanding, reasoning and applying knowledge. RECSAM's attempts to introduce the trainees to contructivist learning are to engage them in activities that required them to learn a strategy of using IT for contructivist learning. So, the trainers' roles in the training is no longer as the transmitter of knowledge but as the facilitator of learning (Chaille and Britain (1991), and the instruction will vary depending on the participants' proir knowledge, current interest, and level of involvement (Chaille & britain, 1991). In the training the facilitator has to understand the participants' existing knowledge, which may be incomplete or wrong, and guide the participants' perceptions and initiate understandings of the of the concepts being lerned (Tobin & Dawson, 1992). In implementing the training on integrating ICT, the contructivist teaching is guided by five basic element: (1) Activating prior knowledge; (2) Acquiring knowledge; (3) Understanding knowledge; (4) Using knowledge; (5) Reflecting on knowledge (Tolman & Hardy, 1995).

The effectiveness of ICT in teaching and learning of mathematics should be maximized, and their potentials realized by integrating such technologies into teaching practices that are consistent with a contructivist pedagogy, in which trainees are actively engaged in their own learning. Even through a variety of approaches have been presented under the general rubric of "contructivism", the greater major of these approaches share a core of basic elements (Chiapetta, Koballa, & Colette, 1998). These elements include: (a) using trainees' perconceptions of the math concepts as a departure point for planning and conducting instruction, (b) providing trainees with opportunities to explore the target phenomenas and concepts through varied and rich experiences with these pheneomena and concepts, (c) encouraging trainees to generate their own solutions for a problem, or ideas to explain a set of observations or data (which the students could collect themselves or could be furnished with) and test those solutions and ideas through a variety of methods, (d) presenting trainees (where needed) with alternative explanations or concepts that are more consistent with canonical scientific and mathematical conceptions, (e) encouraging trainees to compare their own ideas with alternative explanation or ideas by reference to criteria, such as evidence, and explanatory and predictive power, (f) structuring opportunities for trainees toreflect on the whole process for the purpose of deriving "lessons" about the target concepts and processes.

Assessing Student's Understanding Using ICT

In assessing student's understanding, grades should reflect each student's level of mathematical understanding rather than reflecting their comparative performance. They should be based on evidence that accurately reflects the progress of each student toward the attainment of mathematical power and should indicate understanding of important mathematical content derived from learning situations in which students are actively engaged. The NCTM *Assesment Standards for School Mathematics* describes a comprehensive performance assessment system the signed to document student achievement by using checklist, portfolios, and summary reports. The cheklist provides information about student progress in mastering specific content and is completed based on variety of assessment tasks, including observation. The portfolio is compiled by the student to demonstrate their understanding. The summary report provides informations to parents and others outside the classroom; in it, the teacher summarizes student achievement by providing ratings for the checklist, portfolio, and progress enhanced environment (NCTM, 2000).

PROFESSIONAL PROGRAMS IN TRAINING TEACHERS ON ICT

The course represents an international effort that through training to enhance school teachers' competence for using ICT in mathematics classrooms. The goal of the curriculum is to train classroom teacher how to promote individual, cooperative, and inquiry-based learning and effectively integrate the use of computers and other learning and achievement. As part of RECSAM's programs in Integrating ICT in training, RECSAM offers a course entitled "Using Information and Communication Technology (ICT) in Teaching and Learning for Understanding in Primary/Secondary Mathematics" (Ida Karnasih 2005, Ida Karnasih 2006) as Regular Courses. This course aims to provide techers with the knowledge and proficiency in using ICT in teaching and learning secondary mathematics.

The Objectives

The main objective of this course is to equip teachers with the knowledge and skills in using ICT effectively in teaching and learning mathematics at the secondary school level. At the end of the course the participants should be able to:

- show an understanding of 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 as Handled-Technology: Graphic Calculator, Geometer's Sketchpad, MS-EXCEL, Autograph, Thinker Plot, Internet and WWW in teaching and learningfor understanding in secondary mathematics;
- show an understanding of classroom-based action research in mathematics using ICT;
- assess student performance in learning mathematics using ICT;
- design lessons for secondary mathematics that integrates the use of ICT.

The Course Contents

The focus of the paper is in helping students enhance understanding mathematics using ICT. In the syllabus, we attempt to make a convergence between theories, technologies and pedagogical practice, with a focuson pedagogical practice. The syllabus consist of three parts: practical activities, theoretical lectures, and using technology tools to support teaching and learning.

Practical activities: This part involve a variety of hands-on and minds-on involving activities using ICT. To some extent, these activities embody essential elements of innovative instructional processes, including action reseach-based learning, problem/project-based learning, collaborative/cooperative learning, and performance-oriented evaluation.

Theoretical lectures: This part includes lectures adresses innovative learning models with support of new technologies, or discusses methodological points critical to the design of creative learning systems using technology.

Technology (Tools): This part collects a set of tools for teaching and learning using ICT such as: different kinds of software, hand-held technology, basic ICT tools.

The support materials: Materials are designed to support different parctical activities given including lesson templates, exemplar of lessons plan, project-work samples, and evaluation rubrics, etc. (Figure 1).

Theory (lectures)	**Pedagogy (activities)**	**Technology (tools)**
• Current Trends in math Education • How students learn mathematics: conception and misconception in mathematics learning • Constructivism in the math classroom • Instructional design using ICT • Classroom action research • Alternative Assessment in	**Introduction to ICT and its application in mathematics education** • Role of ICT in teaching methodology renovation (ICT and pedagogy) • New roles of teachers in ICT environment • Selecting strategies/technologies **ICT and Pedagogy** • Pedagogical principles for integraing ICT into math clssrooms • Utilizing technology in creating	**Teaching with educational software and other applications** • Basic ICT tools; Word; EXCEL; PowerPoint; IE Explorer; Search Engine; E-mail; Chat Room • Software: a. The GSP, LOGO, KidPix Deluxe, Virtual manipulative b. The GSP. Tinker Plot,

evaluating students' ICT environment • Seminar on writing multiplier effect proposal	probelm-based curriculum • Buliding critical thinking skills in the classroom using ICT • Creating lesson using ICT to support differing learning characteristics • Individual learning, cooperative learning, inquiry-based learning Using ICT	Autograph • Hand-held technology: a. Simple calculator, manipulative (primary math) b. Graphic calculator, Classpad 300, CBL/CBR • Teaching with WebQuest e-learning

Figure 1. A tri-part structure of instructional technology curriculum

The training programmes is targetted for 120 hours in 3 categories which include 9% for general components, 85% for core components, and 6 % for enrichment components.

Instructional Strategies and Methodologies

The training programme employs various instructional strategies and methodologies such as: individual, peer, and collaborative/cooperative group learning and roundtable tasks; ICT integration demonstrations; Sharing of Experiences. Hands-on practice; Interactive theme presentations. In the efforts of providing a holistic environment for our trainee teachers at SEAMEO RECSAM, the trainees are encouraged to 'learn by experiencing and doing' about using technology in the training. The deliberate attempt is to move away from lecturing and teaching of discrete ICT skills to model various strategies that are built upon established learning theories and pedagogies. These instructional strategies include: contructivist approach to learning, direct instruction, self-directed learning, group work and computer-mediated communication. Through these processes, our trainees also are given experience in the use of ICT in teaching and learning mathematics as a tool for administration, presentation, and cfonitive processing. It includes several activities which are designed to achieve the goals.

Participants

Ten participants attend each regular course under scholarship from RECSAM. These participants are teachers and teachers-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 tarining institutions tthat are involved in pre-serviceand in-service teacher tariningat primary or secondary level.
- In change of the ICT related matters of their institutions.
- Have basic skills in ICT tools such as word processors, data bases, presentation software, e-mail and do internet browsing.

Multiplier Effects

The overall training stategy follow the cascade model where the core resource team will train group of national level master trainers and teacher educators in the SEAMEO countries at the national or sub-regional training programmes. The tarinee teachers trained are expected to conduct similiar activities to train rest of the teachers in their respective countries, resulting in multiplier effect.

Lesson Plan and Project Work

At the end course the trainees were required to plan and conduct an ICT-based lesson (ICT-BL) for their project work. Our emphasis on their reflections helped the trainees to understand our philosophy, that is, learning is an internal process and "those methods and techniques which involve the individual most deeply in self-directed inquiry will produce the greatest learning" (knowles, 1980, p.56). such an experience also helped the trainees to engage in reflective practice, an essential component for bringing understanding to the complex nature of classrooms (Zeichner & Liston, 1996). The Lesson Plan project is a group-project on the development of the lesson implemented as Action Reseach project practiced in school in Penang. The projects were small units of student-centered learning activite with specific learning objectives. One of the main features is ttha it relies on teachers as developers of learning units, who are most familiar with the problems encountered by students in their class working together with classroom teacher where they try-out the lesson. In completing the Lesson Plan project, the trainees had to work together in group to engage in collaborative learning. Working in group, the trainees brainstormed ideas of their Lesson Plan. They, then, posted ideas (objevtives, context of instruction, activities and tools) on the discussion board. Try-out was conducted in RECSAM or in RECSAM's partner school for getting feedback from students and teachers about the *Lesson Plan*. The course supervisor focused the comments on: (1) whether the learning objectives were appropriate and whether they promoted learning with understanding and higher order thinking; (2) whethet the tasks (learning activities) were appropriate; (3) whether the problem context (scenario) was clear, motivating and authentic and (4) whether the resource the support was appropriate and sufficient. Through such an exercise, the trainees negotiated the strategies and shared ideas in designing instructional activities. The trainees submitted their group Lessons Plans together with a self-reflection at the first meeting of the module. In the reflection, the trainees described their experiences of conducting ICT-based lessons and analyzed the causes of success or failure. They were also encouraged to make suggestions on how the lesson could be more effective. Such sel-diagnosis helped the trainees to analyze.

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 progra, is then modified according to the feedback received.

Participants Performance

Individual Pre-Test and Post-Test Score

A study of participants' perception of the course contents was conducted using questionnaires. The questionners were the participants's perceptions on the knowledge and skills in each topic of the course content. The questionners were administrated before the course started and a posttest was given att the end of the course to all participants Regular Course. The outcome of the participants'perception in each

topic of the course input in general from the pretest and posttest are shown in Table 1 below.

From the results of the survey study, it was found that in the average there were improvements in mean score of all categories of the topics offered (Table 1).

Table 1. Gain Scores in Several Categories

No	Categories	Pretest	Posttest	Gain
1	For general prerequisite topis/skills	2.14	3.45	1.31
2	Students Learning Skills in Math and Math Ed	2.90	3.47	0.57
3	Teaching Strategies/Approaches Using ICT	2.71	3.51	0.80
4	ICT Pedagogy Integration	1.97	3.48	1.51*
5	Using Selected ICT/IT in Teaching and Learning Mathematics	1.00	3.34	2.34*
6	Assessment Techniques Using ICT	1.14	3.14	2.00*
7	Classroom Based Action Research	0.71	3.43	2.72*

The results show very high gains in three most important aspects of Integrating ICT : (1) Using selected ICT/IT; (2) Assesment Techniques Using ICT; and ICT Pedagogy Integration. Classroom Based Action Research was the highest gain achieved.

Table 2. PRETEST AND POSTTEST SCORES

No.	Topics/Skills	Level of Perception of Pretest	
1	**GENERAL PREREQUISTES OR COMPONENTS**		
	1. New Trends, Issues and Practice in secondary Mathematics Education (SEAMEO and GLOBAL)	1.86	3.29
	2. Familiarization with Word Processor and Graphic Presentation	2.57	3.57
	3. Multiplier Effects (ME) Initiating and Implementign changes	2.00	3.29
2.	**SPECIALIZATION MATHEMATICS AND MATHEMATICS EDUCATION**		
2.1	• How Student Learn Secondary Mathematics	3.00	3.71
	• Learning Theories in Teaching and learning Math	2.71	3.29
	• Learning Difficulties In Secondary mathematics;	2.86	3.29
	• Conceptions & Misconceptions In Secondary Mathematics	3.28	3.43
	• Believe and Attitudes toward using ICT in Teaching and Learning Mathematics	2.71	3.71
	• Teaching Mathematics for understanding	2.85	3.43
2.2	**Secondary Mathematics Teaching Strategies/Approaches Using ICT**		
	• Mathematical Problem Solving: Skills & Strategies	2.71	3.71
	• Mathematical Investigation and Exploration	2.71	3.29

	• Mathematical modelling	2.71	3.57
2.3	**Using Information and Communication Technology (ICT) in Teaching and Learning Mathematics** • ICT-Pedagogy Integration in Mathetics Instruction • Using ICT in Mathematics: What? When? Why? And How? • Using ICT with Indivodual and Group Learning	 1.57 1.86 2.29	 3.43 3.29 3.71
2.4	**Selected ICT/IT in Teaching and Learning maths for Understanding**		
	The use of Handled-Technology in Teaching Algebra, Statisttics, Trigonometry, and Calculus:		
	• Graphic Calculator (TI'84)	0.71	3.00
	• Class Pad 300's	0.43	3.00
	• Tinker Plot	0.43	3.71
	Using geometer's Sketchpad	1.00	3.86
	Using MS-EXCEL in Teaching and Learning Mathematics	2.86	3.14
	Using Autograph in Teaching and Learning Secondary Mathematics	0.57	3.24
2.5	**Learning Mathematics Through Internet and WWW**	1.43	3.29
2.6	**The Assessment Techniques for Learning Maths Using ICT**	1.14	3.14
2.7	**Classroom Based Action Research in Secondary Mathematics**	0.71	3.43

Conclusion and Recommendation

SEAMEO RECSAM as a Center of Excellence has continously commited to integrate ICT in training teachers/educators. The programs have been settled until 2010 under the 8th Five Year Plan (2003). A number of course have been conducted through regular courses, costumized courses, and workshops with different titles and different purposes, but it reached only small number of teachers in using ICT need to focus around issues pertaining to the effective integration of arrange of technologies acrooss all ASEAN region to support teachers through e-learning and School-Net. E-learning creates engaging learning oppotunities and, when effectively implemented, act as catalyst for authentic, meaningful learning experiences for teachers who cannot attend courses directly in RECSAM. School-Net gives opportunities to the well-developed countries on ICT to share their resources and expertise to needy countries in ASEAN region. Recognizing the importance of ICT in teaching and learning, a major countries in the world have provided ICT training in a variety of forms and degree. Teachers can be trained to learn how to use ICT or teachers can use VIA ICT. Jung suggests teacher training approach to follow four categories: (1) ICT used as main content focus of teacher training; (2) ICT used as part of teaching metods; (3) ICT used as core technology for delivering teacher training; (4) ICT used to facilitate professional development and networking. Morever, Jung suggested to give more attention to specific roles ICT in offering multimedia simulations of good teaching practices, delivering individualized training courses, helping overcome teachers' isolation, connecting individual teachers to a large teaching coommunity on a continous basis, and promoting teacher-on teacher collaboration.

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