Mathematics Teacher's Perception On The Use Of Graphing Calculator (TI-83): Southeast Asian Perspective

Asst.Prof. Krongthong Khairiree
SEAMEO RECSAM
Penang, Malaysia

Abstract

The purpose of this paper is to summarize mathematics teachers' perception on the use of graphing calculator (TI-83) in mathematics education in Southeast Asian Countries. The graphing calculator is a relatively new form of technology, one which was specifically developed as an aid in teaching and learning mathematics. SEAMEO RECSAM (Southeast Asian Ministers of Education Organization, Regional Centre For Science And Mathematics) is in line with its commitment in helping educators through the use of innovative technologies in teaching and learning in science and mathematics in the Southeast Asian Region. From 1998 until present, experimental research and action research carried out through SEAMEO RECSAM has shown that if it is appropriately employed, graphing calculator can be used as a teaching tool in enhancing students to learn mathematics effectively.

Graphing Calculators

The graphing calculator is specifically developed as a tool to assist the teaching and learning mathematics. Graphing calculators can empower students to use their ability to visualise, as well as their developing mathematical skills and concepts, to "do" mathematics. By using graphing calculators students can, for example, access, or even create, graphing representations which will enable them to give geometric interpretations to algebraic concepts. Students can use the calculators to see reasons for some algebraic procedures, to confirm algebraic solutions, to check algebraic manipulations, to develop deeper understanding about the content of algebra, and to build understanding about many topics in connection with algebra (Dunham & Dick, 1994).

Because of the increased access to important mathematical ideas and representations provided by graphing calculators, even students who would ordinarily be frustrated or bored by the tedious manipulations can make progress. The students get immediate feedback and they learn through exploring and discovering, they can develop a higher level of mathematical understanding. By using graphing calculators, teachers can be freed to spend more times on developing deeper conceptual understanding and problem-solving skills (Demana & Waits, 1989).

The author gratefully acknowledge the support provided by SEAMEO RECSAM in supporting this research and Texas Instrument in loaning the graphing calculator TI-83/82 for three years duration of the research project. I wish to extend my gratitude to Dr.Tran Vui, Mrs. Francilyn A. O'Brien and Mr. Norjoharuddeen B. Mohd. Nor for having conducted the research and gave their full report of Vietnam, Philippines, and Malaysia. My gratitude is also to teachers and students in the mention countries for their contribution to this research.

However, research had shown that teachers had to achieve a sensible balance in their students' used of traditional paper-and-pencil techniques and operations through using graphing calculators. Teachers who have gained experience in the use of graphing calculators have discovered ways by which paper-and-pencil techniques and graphing calculators can complement each other in the mathematics classroom. According to Waits and Demana (1998), one method teachers can use to achieve a good balance is to have students employ the following strategies:

- Solve problems using paper-and-pencil and *support* the result using a graphing calculator;
- Solve problems using a graphing calculator, and then *confirm* the result using paper-and-pencil algebraic manipulation method;
- Use manipulative and paper-and-pencil techniques during initial concept development, and then use graphing calculators in the extension and generalising phases; and
- Use graphing calculators to investigate and explore the various connections among different representations of a problem situation.

SEAMEO RECSAM And Graphing Calculator

In Southeast Asia, the graphing calculator is still being introduced, there are not many schools, which have explored the use of this handheld technology. As technology is now a major player in visualization and in the exploration of challenging concepts in mathematics, RECSAM aims to spearhead in using these new technologies as tools in teaching and learning mathematics in the Asian Region. From 1998 until the present, the secondary mathematics teachers from 10 countries in Southeast Asia were exposed to the knowledge on the use of graphing calculator in their mathematics classes. SEAMEO RECSAM play an important role in conducting courses, organizing workshops and exhibitions as well as conducting research on graphing calculator.

RECSAM offered 6-week course on *Exploring Secondary Mathematics with Handheld Technology: the Graphing Calculator* for mathematics teachers from ten (10) SEAMEO Members Countries. They are Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. The mathematics teachers who attended this course were selected from the said ten countries, they received full scholarships from SEAMEO RECSAM. RECSAM had conducted the course on *Exploring Secondary Mathematics with Handheld Technology: the Graphing Calculator* from 2 October to 11 November 2000 in SEAMEO RECSAM Penang, Malaysia. The graphing calculator used in this course were TI-83 $^{+}$. This course will be conducted again as planned in the SEAMEO RECSAM Programmes and Activities for The 7th five-year plan: July2000-June 2005.

In addition with the six-week courses and others courses conducted on Graphing calculator in RECSAM Penang Malaysia, RECSAM had conducted workshops and exhibition in other SEAMEO Member Countries such as Brunei Darussalam, Philippines, Thailand and Vietnam. Moreover, RECSAM conducted quantitative research and qualitative research on the use of graphing calculator as a tool in secondary mathematics.

Southeast Asian Mathematics Teacher's perception on the use of graphing calculator

In 1998, RECSAM conducted the research study on the use of graphing calculator as a tool in four SEAMEO Member Countries namely: Malaysia, Philippines, Thailand and Vietnam. This research study employed qualitative and quantitative method: the quasi-experimental, pretest-posttest, non-equivalent control group design. The researchers in this research conducted a series of training workshops on how to use graphing calculator (TI-83) as a tool in secondary mathematics. From the first workshop, the researchers selected mathematics teachers who volunteered to participate throughout this research.

The sample in each country consisted of four secondary schools. Each school randomly assigned two intact classes to be the experimental group and another two intact classes to be the control group. The experimental group learned mathematics by using the graphing calculators (TI-83) for one semester, where as the control group learned mathematics by using the traditional whole-class instruction. There were approximately 2,560 students' boys and girls in secondary year 3 or 4 levels from Malaysia, Philippines, Thailand and Vietnam involved in the research study. This research study is in the process of report writing.

Teacher's perception toward the graphing calculator is one of the purposes of this research study. The questionnaire on teacher's perception on the use of graphing calculator in their mathematics class was given to a group of mathematics teachers who taught in the experimental classes. The following are excerpt from the summary of teacher's perception on the use of graphing calculator in Malaysia, Philippines, Thailand and Vietnam.

Malaysia: Mathematics Teacher's Perception Toward the Use of the Graphing Calculator

After having used the graphing calculator in the mathematics classroom, the teachers reported that most students are more interested in learning mathematics, have better understanding of the mathematics topics and have encouraged the students to be more involved in the classroom discourse. The teachers perceived that graphing calculators would be more effective to the students if they are used to learn mathematics that in an innovative environment. The malaysian teachers perception are summarized in Table 1.

Philippines: Mathematics Teacher's Perception Toward the Use of the Graphing Calculator

The responses of the teachers who used the graphing calculator in their mathematics classes revealed very positive declarations regarding the use of this hand-held technology in their classes. They have stated that the graphing calculator was a very useful tool in making the lessons more meaningful and interesting to students. That it made graphing of difficult functions easier and faster, which were time consuming, laborious and inaccurate when done manually.

Likewise, the teachers felt that it helped them build more confidence in teaching the topic because of the many explorations, investigations and problems solving that they can cover regarding a specific topic. According to them, the effect was that

they were able to organize and plan for a variety of activities which have become more appealing to the students. They have unanimously agreed that such activities with the use graphing calculator were a clear departure from the usual drill and practice type of exercises in their traditional mathematics classes.

Consequently, they felt they have become more empowered to teach difficult concepts. It also made them feel free from the role of sole provider of information and problem solution to becoming a facilitator of learning. They felt that they have made the students do a lot thinking compared to the traditional classes. Not just waiting for them to show how to do a solution to a problem or a single strategy to solve it.

The teachers have stated their very positive attitude toward the use of this technology and have recommended it to be used in the secondary schools. According to them they had a very enriching and fulfilling experience in using the technology and only wished they can have the calculators permanently in their schools. The following are some responses which are worth mentioning:

"Pinag-iisip ako ng husto." (The materials made me really think.)

"Ang mga materyales ay nagbibigay sa mga estudyante sa pagkakataon na makapag-iisip at makapag-explore sa mga ibinibigay na proplema. (The materials give the students chance to think and explore a problem).

"Ang mga estudyante na ngayon ang nag-iisip kung papano lulutasin ang problema. Hindi na sila naghihintay sa guro na gagawa at magpapaliwanag para sa kanila. (Students now do the thinking on how to go about doing something or how to solve a problem. Students no longer wait for the teacher to do or explain to them.)

"Nakaka-challenge." (They are challenging).

"Masaya ako at meron nang ganitong activities sa Matematiks." (I'm happy that there are already activities like these in Mathematics.)

Thailand: Mathematics Teacher's Perception Toward Using Graphing Calculator

The mathematics teachers who were involved in RECSAM research study revealed that using graphing calculator (TI-83) in their mathematics classroom had a positive effect toward the teaching and learning. It brought mathematics into their technology world. In line with this, graphing calculator also create an opportunity for students to communicate and cooperate by providing a means by which students can produce, compare and reproduce mathematical results of sufficient complexity. The graphing calculator enables this happen individually, quickly and reliably. Graphing calculator could be used as a confirmatory tool, it is good for slower students they can check their work, give immediate and individual confidence.

However, some teachers found that the complexity of the graphing calculator had a negative motivational effect on the students until they gained sufficient usage skills. It could be a source of frustration in graphing use – especially with the small screen and in some statistical graphs, and range setting process for some other graphs. The summary of Thai: Mathematics teachers' perceptions on the use of graphing calculator are following:

- The effective teaching and learning in mathematics classes using graphing calculator is dependent upon the teachers. The teachers must have the

knowledge not only how to use graphing calculator, but also how to correct all trouble shooting. Teachers must know when and how to teach mathematics using graphing calculator. The teachers need to be trained and know how to use graphing calculator fluently and efficiently.

- If you learn how to use graphing calculator, it is not hard and I think it helped me to do much better in mathematics than I could have before.
- The teachers need support to encourage them to take risks and to experiment with graphing calculator in their classroom. The support include:
  - *Mutual support* from peers, resource persons, as well as the directors of schools
  - *A number of graphing calculator* enough for the students to use in pairs or small groups in a long term period.
  - *A storage, a safety place/cabinet with the key lock*. There was an immediate and obvious need of storage of 20-30 units of graphing calculators after classes, because of the fear of losing or damaging expensive equipment. Security was initially regarded as an important issue by all teachers who are involved in this project
  - *Time.* Time spending in mathematics classes using graphing calculator were more than actual class, since teachers need time to introduce how to use graphing calculator to students and time for the familiarity. Teachers also need time to become familiar with the teaching possibilities of the graphing calculator too.
  - *Textbooks,* worksheets or work cards, suitable with mathematics curriculum and graphing calculator for classroom activity base.

- The questions and problems in the worksheets and quiz and tests must suitably designed to use with graphing calculator. The design should emphasize on communication, discovering and investigating rather than just a simple computing skills.
- Assessment and evaluation. Teachers felt that there is a need for a review of assessment and evaluation.

Vietnam: Mathematics Teacher's Perception Toward Using Graphing Calculator

The mathematics teachers who were involved in RECSAM research study revealed that using graphing calculator (TI-83) in their mathematics classroom had a positive effect toward the teaching and learning. The following teachers' perception are excerpted from the research report:

- The opportunity to use the graphing calculators has been great. The way I teach some topics has been reversed, though I still have reservations about ensuring I meet the curriculum requirements without being sidetracked with the graphing calculator.
- I have enjoyed my one term with my students using the graphing calculator.
- Graphing calculators are totally dedicated to mathematics features.
- Graphing calculators allow us to introduce mathematical ideas and techniques that have been beyond the reach of traditional non-tech curricula.

- I think we can use TI-82 or 83 in teaching and learning mathematics. There are two main things in mathematics: Logic and Algorithm. With the help of teacher, graphing calculators and computer students are able to solve the problems in algorithm and logic.
- Effective use of graphing calculators is dependent upon the teacher' understanding the changes in mathematics and in teaching which are possible. Our experience is that his understanding takes a considerable time to develop.
- At the beginning I felt threatened in the classroom by my lack of familiarity with the graphing calculator. My lack of user knowledge precipitated a positive change in teaching and learning styles in the classroom.
- Teachers need support to encourage them to take risks and to experiment with graphing calculators in their classroom. They need to be able to share their experiences and ideas about technology.

The summary of Southeast Asian mathematics teachers' perception toward the use of graphing calculator are shown in the Table 1 below:

Table 1: Southeast Asian Mathematics Teachers' Perception Toward The Use Of Graphing Calculator

Country	**Teacher's perception toward the use of graphing calculator-TI-83**
Malaysia	• Students are more interested in learning mathematics • Students are more involved in classroom discourse • Students have a better understanding of the concepts and procedures taught by the teacher. • Students are more confident in discovering and learning concepts by themselves • Students are more adapt at using the calculators than the teachers • Teachers found that it was easier to play the role of classroom facilitator when graphing calculator is used the classroom
Philippines	• The use of graphing calculator has very positive effects on students' performance/achievement and attitude in secondary mathematics; • Teachers have very positive attitudes toward the use of graphing calculator as a tool in teaching and learning mathematics; • Lesson more enjoyable, interesting and meaningful; • Discover and exploration which were impossible without using graphing calculator; • Friendly use and useful tool in teaching/learning mathematics; • With graphing calculator, we were able to teach the characteristics of the graphs of more complicated equations and more confidence in teaching; • The graphing calculator TI-83 is friendly used, it is easy to implement in the mathematics class.

Thailand	• The efficiency of graphing calculator is suitable with the content in secondary mathematics in Thailand; • graphing calculator is a good tool in drawing graph of function especially the graphs that are tedious and difficult to do manually; • Graphing calculator enhancing imaginary, exploring, discovering and problem solving skills and changing the classroom environment; • The graphing calculator TI-83 is friendly used, it is easy to implement in the mathematics class. • Graphing calculator can be negative effect if teacher do not plan to use properly and teacher having usage difficulties; • The TI-view screen should be used with TI-83 in every session; • The worksheet to be used with graphing calculator must well design and challenge in order to enable students construct the concept in mathematics.
Vietnam	• Strongly suggest to the Ministry of Education and training should have instruction and plan on using graphing calculator in schools. • We should organize more workshops, seminars on using graphing calculators to help teachers change their perception to information technology in teaching mathematics. It should be changed from the Ministry of Education and Training to the schools, so the changes will be more united and effective. • To prepare mathematics activities or tasks when the students and teachers are proficient in using graphing calculators is much easier. And the student confidence and persistence in mathematics increase constantly • It helped me because it makes things easier; I didn't have to draw up a table of values to plot the graphs. Once you knew the method it was really easy, you could zoom into a graph and you could draws lots of graphs. • The graphing calculator took time to get used to. A graphing calculator is very complicated. But once you get to know what to do, it can help you in statistics, algebra, calculus and trigonometry. • I fell my basic skills have fallen back because the calculator can do much more. • The use of IT in teaching and learning in upper secondary mathematics is surely effective. • The graphing calculator gives the students more confidence. Students seem to be more prepared to try things out and risk making mistakes. • It is easier on paper; you don't have a lot of complicated buttons your supposed to press. I find it difficult knowing how to key something in, there are too many steps. • Good but there are too many complicated buttons to use. You have to go through a lot of stages to work out just one thing.

The summary of Southeast Asian Mathematics Teachers' perception toward the use of graphing calculator (TI-83) in others issues are display in Table 2 below:

Table 2: Southeast Asian Mathematics Teachers' Perception Toward The Use Of Graphing Calculator (TI-83) In Others Issues

Issue	Malaysia	Philippines	Thailand	Vietnam
Graphing Calculator(GC) : TI-83 machine	• Portable • Easy to learn how to use by the students but not by teachers.	• Small size easy to handle; • Friendly use;	• Small size, it easy to carry along but the screen of GC is not large enough. This cause the graph is not as clear as it should be. • The line of the graph is not smooth and only one colour • GC is a good tool, it can be used almost all contents in secondary mathematics.	• Some teachers found that the complexity of the graphing calculator had a negative motivational effect on the students until they gained sufficient skills. • Graphing calculator could be used as a confirmatory tool, and able to give immediate and individual confidence. • Graphing calculator is only more efficient if you fully understand how to use it. And it takes me a great deal longer than when I do calculations by hand or with a normal calculator.
Time	• Teachers need more time to prepare instructional materials • Save time in graphing, so students can see more graphs in one period of classroom	• Students need more time to practice the use of GC and teacher need more time to prepare the worksheet to be used with TI-83 and mathematics	• Students could use GC only in mathematics class they needed more time to practice GC. • Using GC teacher could save time in drawing graph, teacher could teach more in-depth content.	• The length of time it took before teachers became comfortable with the idea of this graphing calculator was longer than expected.

Instructional materials: Textbooks, worksheets/ work cards	No instructional material and textbook published by the Ministry. Most of materials are translated from foreign books by the teachers.	The instructional materials uses in the classes were developed in the workshops, which conducted before the research study.	There is no textbook which incorporate the use of GC and mathematics contents. All instructional materials use in the classes were developed in the workshops conducted before the research study.	The instructional materials to be used in the mathematics classes were developed in the workshops which conducted before the research study.
Assessment, Evaluation and Examination	Students are not allow to use graphing in the exam.	Students are not allow to use graphing in the exam.	Students are not allow to use graphing in the exam.	The students are absolutely not allowed to use graphing calculators in any exam.
Attitude	The students have very positive attitudes toward the use of the graphing calculator in the teaching and learning of secondary mathematics	The teachers and students have very positive attitudes toward the use of the graphing calculator in the teaching and learning of secondary mathematics.	The teachers and students have very positive attitudes toward the use of the graphing calculator in the teaching and learning of secondary mathematics	The students and teachers have very positive attitudes toward the use of the graphing calculator in the teaching and learning of secondary mathematics
Professional development	About 400 teachers have been trained to use graphing calculators in classroom in 7 weeks courses conducted in RECSAM	About 100 teachers have been trained to use graphing calculators in secondary mathematics from RECSAM.	About 300 teachers have been trained to use graphing calculators in secondary mathematics from RECSAM.	About 100 teachers have been trained to use graphing calculators in secondary mathematics from RECSAM.

Conclusion

In conclusion, overall the Southeast Asian mathematics teachers' perception on the use of graphing calculator are positive, however some implication issues mentioned above have to be looked into seriously at Ministry of Education level. If mathematics educators are to help their students think mathematically there is a need to find ways to improve the students' understanding of connections between various mathematics facts and procedures. There are now grounds to believe that the use of handheld graphing calculators can help students who previously could not cope with algebra, to learn algebra. It also appears to be likely, that all students, even the very

capable ones, will benefit by using graphing calculators in secondary mathematics. SEAMEO RECSAM will continue to be the leader and spearhead in using these new technologies as tools in teaching and learning mathematics in Southeast Asian. SEAMEO RECSAM shall play an important role in providing the knowledge through courses, organizing workshops and exhibitions on Handheld technology: Graphing calculator in the next SEAMEO RECSAM 8th Five-Year Plan of Programmes and Activities from July 2005-June 2010.

References

Blythe, T. (1998). *Teaching for understanding guide.* San Francisco, CA: Jossey-Boss Inc.

Burrill, G. (1992). The graphing calculator: A tool for change. *NCTM 1992 Yearbook (pp.14-22).* Reston,VA: National Council of Teachers of Mathematics.

Demana, F., & Waits, B. (1990). Enhancing mathematics teaching and learning through technology. *NCTM 1990 Yearbook* (pp. 145–154). Reston, VA: National Council of Teachers of Mathematics.

Demana, F., & Waits, B. (1990). The role of technology in teaching mathematics. *The Mathematics Teacher, 82*(1), 345–350.

Demana, F., & Waits, B. (1989). Around the sun in a graphing calculator. *Mathematics Teacher, 82*(7).

Dunham, P. H., & Dick, T. P. (1994). Research on graphing calculators. *Mathematics Teacher,* 87, 440–445.

Khairiree, K. (2000). The use of graphic calculator as a tool in enhancing teaching and active learning in secondary mathematics in some Southeast Asian countries: Research report. In Ow Yong Kean Guan (Ed.) *Proceedings of The International Conference and Exhibition Education Super Highway 1999,* at SEAMEO RECSAM, 30 November – 4 December 1999.

SEAMEO RECSAM, (1999). *Programmes and Activities for the 7th five-year plan: July 2000-June 2005.* Penang: SEAMEO RECSAM.

Waits, B., & Demana,F., (1998).The role of graphing calculators in mathematics reform. In Edward D. Laughbaum (Ed.). *Hand-Held* Te*chnology in Mathematics and Science Education: A Collection of Papers*, pp. 72-75. Ohio: The Ohio State University