GRAPHING CALCULATOR AS A TEACHING AND LEARNING AID FOR SECONDARY SCHOOL STUDENTS AND TEACHERS

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Abstract.
This paper discussed the possibility and suggestion of the implementation of graphing calculator in teaching and learning Mathematics in the Malaysian's upper secondary school in order to meet the challenge of today's accelerated technology. This project has been carried out on the fourth and the fifth former students and teachers at the selected schools in Malaysia. At this level of education, it is mandatory for the students as well as the teachers to be introduced to technology like graphing calculator in assisting the students and the teachers to learn and to teach Math in a more meaningful way. Therefore we hope the pilot study that we have conducted would be able to help them in making Mathematics fun to learn as well as fun to teach. A survey has been conducted on students and teachers at three secondary schools in Northern area of Malaysia. They are in Kedah, Penang and Perak. All these three schools were not been exposed to the technology of Graphing calculator before. The survey was to seek students and teachers point of views on Mathematics before and after the demonstration on how to use graphing calculator wisely in performing Mathematical tasks. Analysis was made from the survey and brought to the suggestions of a new curriculum change, teachers' attitudes and students' preparation towards the new technology.

Introduction

Mathematics is usually perceived as an uninteresting, dull and abstract subject. That is mainly because Mathematics deals with a lot of formulas, proofs, abstract concepts and requires tedious calculations. In addition, to master the knowledge of Mathematics, intensive and consistency of drill and practice are needed to ensure particular intelligence in the field of Mathematics.

Students used to come out with tears while in the process of learning Mathematics. They faced the scenario of disappointment, lost of interest and confidence in Mathematics especially when they had struggled hard to solve the problem but still did not manage to get the answer. Finally, they gave up. Consequences from that, our society has form a culture learning to pass, they must be a correct answer in Mathematics. Students tend to forget the discovery of the beauty and the truth behind Mathematics. Instead of that, subjects like arts, languages, history, geography, sciences and other social science studies are more interesting because of the nature of the subjects. They are more on story driven and can be applied with daily life. It is easier to bring the real and authentic application or existence of those subjects in real life into school.

2.0 The graphing calculator

Nowadays, Mathematics' educators face a lot of challenges to turn mathematics into an interesting and exploratory subject in schools in order to attract more students especially teenagers or young adults to like mathematics. Technology of graphing calculator is giving us an opportunity to open new doors to mathematical understanding for our students. With the aid of technology, it did bring a new hope for those students, struggle to understand the mathematics presented in ordinary lessons. 'A picture is more than a thousands words.' Representation is more than a process; it is a way of thinking and learning mathematics. Representations are powerful tools for thinking and give learners useful tools for building

understanding, communicating, information, and demonstrating reasoning. With different representations, we can examine students' understanding of certain mathematical concepts. The NCTM (National Council of Teachers of Mathematics) position statement (1996) states: Research and experience have clearly demonstrated the potential of calculators to enhance students' learning in mathematics. The cognitive gain in number sense, conceptual development, and visualization can empower and motivate students to engage the true mathematical problems solving at a level preciously denied to all but the most talented. The calculator is an essential tool to all students in mathematics.

Consequences from this statements, it is true that graphing calculator is a powerful tool that can carry out complicated mathematical tasks, showing out with visualization, thus allowing students to spend more time on the understanding of concepts. When used effectively and wisely, it becomes a tool to help students to develop actively, construct their own knowledge for better understanding in mathematics.

2.0.1 The advantage of Graphing calculator

An important part of mathematics curriculum for all students is to develop the students' ability to apply mathematics. Students need solid knowledge of basic principles, methods and results, and a clear perception of what mathematics is about. This is very important for those students not naturally gifted in Mathematics. Graphic calculators enable students to undertake mathematical modeling through experiments using classroom activities. Traditional ways of teaching method are discovered not so appropriate because most of the time is dominated actively by the teachers' participation for the whole lesson. Although changing the teaching method is hard and time constraints but there is evidence that the way of our teachers teaching performance is no longer working.

With the integration of graphic calculator, it dedicates enough time for the teachers to present a question, problem or information task. Students discuss and respond with words, sentences, formulas to enhance their real understanding. As a side benefit, students enjoyed the more creative atmosphere.

Result has shown that graphic calculators has successfully bringing the "real" mathematics to school's through information and communication technology. Today, the main emphasis for problem solving is mainly focus on calculation and its execution with paper and pencil, meanwhile it also contains more problem solving exercises turn into exercises for practicing calculation skills. Waits & Demana (1998) suggested that graphic calculator be able to equip as a balance tool in learning and teaching of mathematics. Appropriate use of graphing calculators in the teaching and learning process means the student be able to solve analytically using traditional paper and pencil algebraic methods, and then supports the results using a graphing calculator and vice versa.

Instead of that, it is also help the students to solve using a graphing calculator, and then confirms analytically the result using traditional paper and pencil methods. Graphic calculator can be used to solve mathematics questions require time spending, tedious calculations and consisted abstract thinking skill. Furthermore, the use of graphic calculators can provide more classroom time for the development of a better understanding of mathematical concepts by eliminating the time spent on "mindless paper and pencil manipulations". Whenever practical, the activities gave students the opportunity to explore and discover for themselves the conceptual understanding of the modeling calculus that is useful in accommodating diverse applications. The combinations of using a graphing calculator to employ the techniques learned, with a careful analysis of the solution is valuable for all students.

With graphic calculators, students would be able to study and classify the behavior of different classes of functions. It also can foreshadow concepts that will be encountered in later courses, to build out student's intuition. Besides that, because of the portability, low cost particularly compared to a computer, students do not need to buy additional or specific software because these calculators have specially designed built-in mathematical functions.

3.0 The survey

The survey was conducted by questionnaires and the distribution of hand outs with the combination of demonstration of the use of graphic calculator at three different secondary schools in Kedah, Perak and Penang which involved 104 Form Four and Form Five students and 15 Mathematics teachers. All students and teachers from these schools were not exposed to graphing calculator. The survey was divided into two parts. Part A and Part B. Part A consists questions which requested students understanding and general opinions of Mathematics and their interests on 5 different topics in Form Four and Form Five Mathematics subject such as Trigonometry, straight lines, Statistics, function graphs and Matrices. After completing the part A, we conducted a demonstration and a hands-on activity in classrooms on how to use graphic calculator in those mentioned topics. We also gave out hand-outs during this activity. A Form Four and Form Five questions were prepared in the hand out which include solving the questions in traditional way by using paper and pencil, and also includes the step-by-step graphic calculator operating instructions. In each school, we spent two weeks time for the demo and the hands-on session. We also have lent them a number of graphic calculators and a group of two students were given a calculator to share. This is to ensure that every one of them has the opportunity to solve the mathematical questions by using the graphic calculator and can have a clear picture of the functions and features of a graphic calculator. They seem to enjoy themselves so much to the extend that they wanted to have more problems. Meanwhile Part B questions were to seek the students' perception and interest in the five specified topics, after the demonstration of the graphic calculator.

4.0 Survey summary and analysis

The table below shown the students response to the following items before the demonstration of graphic calculator.

Percentage respondents for Part A

Item		1(%)	2(%)	3(%)
Agree		37	22.7	18.3
Disagree		63	77.3	81.7

Part A consists of thirteen questions, subjective and multiple choice (MCQ). Those MCQ questions were categories into three different types of questions. They are labeled by item 1, 2 and 3. The first type was whether or not they agree that they have great interest in the five mentioned topics. The second question was whether they agree they do not have much problem in understanding those mentioned topics. Meanwhile the third question was whether they agree that they possessed a good skill in thinking analytically, creatively and also good at problem solving technique through learning those five topics in the current classrooms.

Percentage respondents for Part B

Item		1(%)	2(%)	3(%)	4(%)
Agree		98.1	79.8	98.5	99.0
Disagree		1.9	20.2	1.5	1.0

Similarly, Part B also contained four type of questions. The first question was on their opinion, after the demonstration of the graphic calculator, whether or not they agree that graphic calculator has enhanced and broadened their knowledge and interests in those five topics and also to know their degree of enthusiasm to learn more about the underlying mathematical concepts.. The second question was whether they agree that with graphic calculator they are able to appreciate mathematics in a way the tool helps them to generate a good skill in problem solving and able to connect the concept to real life situation. The third question is to know whether they agree on the idea of integrating graphic calculator in a secondary school for Mathematics classrooms. The last type of question was whether they agree that graphic calculators should be used in examination and the idea of having 20 percent practical examination in today's SPM with the assistant of graphic calculators and 80 percent theoretical for those five mentioned topics.

From the results that we have collected from the students' responses in Part A and Part B, indicates that before the introduction of graphic calculator only 37 percent students were interested in learning Mathematics. According to the survey, students stated that Mathematics is a very boring subject, which requires strong memory to memories a lot of formulas. They addressed the problem that paper and pencil method has no application in the real world and is not fun. The purpose of the study is just to pass the examination and get good grades without having to appreciate what they have learnt.

However, after the introduction of graphic calculator, 61.1 percent of students had shown a great improvement where 98.1 percent agreed that with the use of graphic calculator has enhanced their knowledge and increased their interest in those five topics in Mathematics. Meaning to say that after the introduction of graphic calculator, students have shown amazing improvement. The percentage of interest of the five chapters shoots from 37 percent to 98.1 percent. Students were amazed by the speed of the graphic calculator. It can carry out task in such details and the work could be done easier and quicker with the aid of graphic calculator. Graphic calculator also provided them with visual representation where they can play around with parameters to plot different type of curves.

From the table, 99 percent strongly agree that with the implementation of 20 percent practical test by using the graphic calculator for the five mentioned chapters and 80 percent theory with pencil and paper.

Meanwhile, from the survey apart from what has been indicated in the tables, we have analyzed the students feedback and has discovered that 84.6 percent students think that with the aid of graphic calculator has helped them saved their time. While 77.9 percent voiced that with the graphic calculator has helped them to gain back their confident in solving the Mathematics questions during the examination. 57.7 percent agreed that they need to be exposed to the new technology with the implementation of graphic calculator at secondary schools and finally 48 percent students stated that graphic calculator can help them to reduce their nervous and fear of Mathematics and through graphic calculator, they manage to check their answer, which indirectly given them the security.

Meanwhile the survey also reveals the students concern and weaknesses of the use of graphic calculator which should been taken into account. Students have pointed out few side effects. According to the students, they addressed the following problems:

- Too much help from the graphic calculator would make them become lazy and they would build up the habit being too dependent to the graphic calculator.
- Apart from mathematics itself they also need to learn how to use the graphic calculator before being able to enjoy the graphic calculator to the fullest.
- They also worry that the calculator might lead them to misconception of basic mathematical concepts.

4.0.1 Teachers' comments and point of views

Percentage respondents for Part A

Item	1(%)	2(%)
Agree	66.7	93.3
Disagree	33.3	6.7

Teacher's survey was also divided into 2 parts, Part A and Part B. There are two questions contained in Part A. The first question was on teachers' perception with regards to the graphic calculator. From the conducted survey, results shown that 33.3 percent of the Mathematics teachers, did not know about the graphic calculator and their function. 66.7 percent have heard about the use of graphic calculator in teaching and learning mathematics but thinks that it is not necessary in their classroom.

The teachers were also been subjected to graphic calculator demonstration together with their students. After the demonstration, the teachers were again asked a few questions regarding the use of graphic calculator in teaching and learning mathematics. Now 76.2 percents of the teachers agreed that integrating graphic calculator in teaching mathematics is necessary and has given both the students and teachers the best method of teaching and learning mathematics in a classroom. They also said that teachers and students communicate much better in a classroom with graphic calculator being used as a tool to help enhanced students understanding. Meanwhile 23.8 percents of the teachers still thought that pens and papers are the best way to learn and teach mathematics. They said in this manner they will not have to bother and waste their time to know the functions and "how to use" the graphic calculator. They can concentrate on the basic concept. This group of teachers were again asked a question whether they agreed that other tools should be introduced in a classroom to help enhanced the students understanding in mathematics. It turns out that none of them has agreed to this idea. Following this question, they were further asked on why they do not agree and they have answered that a good way to learn mathematics is to experience the "hard time". By doing this the teachers and students will not miss the concept.

We also have asked the teachers opinion on whether the 100 percent scheme theory SPM examination suited today's advance Information Technology era. Only 16.7 percent teacher agreed with the scheme whereby 73.3 percent disagreed with the scheme and another 10 percent not sure. Some of the teachers believed that everything that made into theory was invented from practical work, which can produce the wanted skill in any field or profession. Thus, lab sided test students are multi skilled nowadays with a wide range of testing needed. Therefore, students must have a strong concept and theory first before they can explore the graphic calculator.

Some teachers stated that because today is a modern day, students should not be evaluated on their basic operational skills, instead, they should apply their knowledge with the aid of graphic calculator. They believed that students without having any knowledge of technology will be a disadvantage to the students.

Next question was asking about teachers' interest to learn about graphic calculator if it was introduced at secondary school. The result has shown that 76.7 percent teachers were keen to learn the technology of graphing calculator. A question on whether or not they agree on the idea of implementation of a new scheme which consist 20 percent practical by using the graphic calculator and 80 percent theoretical based on pen and paper method during SPM Mathematics examination. It turns out that 70 percent agreed with the new suggestions. Finally, the teachers were asked a question on teachers' point of views of the real implementation of the graphic calculator at secondary school. From the collected data, 80 percent teachers agreed with the suggestions.

5.0 Conclusion

As a conclusion, from the conducted survey, it is clear that there is a need to continue the investigation on the implementation of the graphing calculator at the secondary schools. The teachers' comments discovered that there is a need for our education to change the existing curriculum in Mathematics syllabus. From the survey we have seen that the graphing calculator has enhanced the learning and teaching of mathematics in classrooms. One matter that should be taken into our concern is the students should be equipped with the basic concepts prior to integration of the graphing calculator in a classroom. This is very important to ensure the quality of the learning as well as teaching processes at a school level. Also to guarantee the continuity of the learning process in particular from the school level up to the higher level such as in the matriculation and the pre-university level.

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