

INITIATING A PROJECT ON TI-92/DERIVE SUPPORTED CALCULUS TEACHING IN TURKEY

Yaşar Ersoy

*Middle East Technical University,
06531 Ankara, Turkey*

Halil Ardahan

*Selçuk University
Konya, Turkey*

Abstract: Our experiences in the in-service education of mathematics teachers and in staff development programs for teacher educators in Turkey are summarized and discussed. We have designed a series of seminars, workshop and in-service courses on the use of graphic calculators in teaching of various topics in school mathematics, eg algebra, pre-calculus and calculus. We will exhibit the sample of designed activities on TI-92/Derive supported calculus teaching materials as well as the response and thought of mathematics teachers and teacher educators.

Key Words: In-service education, Mathematics teaching, G/CAS calculator, Teachers' perceptions

1. INTRODUCTION

Information and communication technology (ICT) has tremendous potential to enhance the teaching and learning environment, but requires new knowledge and skills. Among others, advanced calculators, namely graphic calculators and/or computer algebra system (G/CAS) calculators provide an enhanced learning/teaching environment, and affect the criteria for assessment and professional development of teachers. During the last decades it has been perceived that ICT is indeed an instructional and learning technology that has assisted in current mathematics education reform and had various impacts on teaching and learning of mathematics (For example, Howson & Kahane, 1986; Kutzler, 1994; Ruthven, 1995; Waits and Demana, 1997).

Although the philosophy is more or less the same, the use of computers and calculators (C/C) in the process of learning and teaching of mathematics may vary and face with different obstacles in developing countries. Moreover, the introduction and implementation of either ICT or personal computing technology (PCT) into the education system of developing countries needs new resources and different strategies, although foresaid tools and accumulated experiences do exist in industrialized countries for a relatively long time, ie at least for ten years. Among others, such an innovation in school mathematics requires teacher educators and policy makers to spend more efforts for persuading the teachers and others, and set up an appropriate environment for teaching/learning mathematics (Ersoy, 1992).

In the present study, we will discuss our experiences in the in-service education and training (INSET) of a group of mathematics teachers and propose a staff development programs for teacher educators in Turkey.

2. BACKGROUND INFORMATION

Acquiring expertise in using a PCT, for example calculator, and teaching a lesson unit involving mathematics requires a sustained program of professional development. Here we will present an overview of needs for INSET that integrates school curriculum and calculator very briefly and the main structure of an education program for in-service mathematics teachers.

2.1. Issues and Needs for INSET for Professional Development

In 1998-99 school year, more than 30 thousand of the manpower in secondary education is mathematics teachers working in the public schools and about one thousand in private schools. Thus the number of all teachers in elementary and secondary schools is about a half million in Turkey. The number and consequently the percentage will increase very soon if the growth of population and the standards of developed countries are taken into account. Although this is the responsibility of teacher education institutions, most of research findings have not been used by the policy makers in Turkey, in general; authorities in the Turkish Education System (TES), in particular.

Besides the other problems and issues, there is a shortage of qualified staff and/or competent teachers to train the others in Turkey. There are not enough competent and experienced teachers of mathematics who can be tutors and leaders for the novice and inexperienced teachers in secondary schools. Therefore we should design various staff development programs for mathematics teachers and teacher educators. Attempts to introduce new subject matter and/or techniques in mathematics instruction and to make concrete suggestions for implementation in the classrooms are often ambiguous about the teacher's role and importance in this process.

2.2. Module and Sample of Materials for Professional Development of Teachers

The module itself and activities therein are at different levels of difficulty, and making it easier to identify activities and worksheets for the particular needs of any group of students. Some activities cover mathematical concepts and techniques, and many relate to applicable mathematics or modelling context. In some cases, suggested extensions to activities provide ample material for an extended practice and/or project.

The activities have a mathematical focus and have been chosen because of various reasons. They are ideally suited to working with CAS; they would be difficult, inconvenient and in some cases virtually impossible without the use of a CAS.

Module A: Algebra and Pre-Calculus: Visualising Function and Mathematical Modelling

A series of activities is designed to help students/mathematics teachers visualise the shape of the graphs of polynomial functions, especially linear and quadratic functions. Some real world problem were chosen to build up mathematical models and solve them with the use of an appropriate PCT, e.g. graphic calculators.

Module B: Pre-Calculus and Calculus 1: Differentiation and Application

The aim of this module is to introduce the concept of differentiation by exploring the gradient function of various polynomials, exponential and logarithmic function.

Module C: Pre-Calculus and Calculus 2: Integration and Application

It is important to emphasise from the start that integration is a way of regarding an area, volume, mass, etc. as a sum of small elements of area, volume, mass, etc., each of which can be approximated sufficiently accurately.

3. SCHOOL MATHEMATICS TEACHERS' PERCEPTIONS AND OPINIONS

There are many claims made about the positive effects of CIT on students' motivation. There may be few research studies on teachers' perceptions on using PCT, namely calculators in teaching/learning of mathematics. Therefore, we decided to investigate into teachers' perceptions and find out what they think of the utilisation of calculators in teaching school mathematics. In this section, we will reflect the result of a pilot study on the mathematics teachers' perceptions of using calculators in teaching school mathematics.

3.1. General Aim and Subject of Study

The general aim of the pilot project was to collect information about the calculator experiences and opinions of a group of mathematics teachers in several schools in Turkey. In this context, the specific project objectives in the present study were to find out:

- what the teachers' levels of calculator use and experiences were;
- whether teachers perceived that calculator use made mathematics more interesting and helped the development of specific mathematics skills.

The subject of this study was a group of secondary school mathematics teachers working in various public and private schools in Izmir in 1998-99 school year and participated in one-day seminar and workshop which was held in İzmir Özel Türk Lisesi. The number of teachers teaching the senior high school mathematics was 44, and any of them had not got any experience with the use of calculators in teaching/learning of mathematics.

3.2. Instruments

Based on teachers' needs assessment, which was administrated at various schools in the beginning of the project, we had planned the activities and designed two new questionnaires. One of these questionnaires was about the teachers' perceptions and opinions about the utilisation of calculators in teaching/learning of mathematics (TeQu-1) while the other (TeQu-2) was about the benefits of the organised seminar and workshop¹. The items in TeQu-1 were regrouped and displayed in Table 1 and Table 2.

¹ Here we will give the results of data gathered by means of TeQu-1.

Table 1. Mathematics Teachers' Perceptions on Using Calculator/ Computers

	Items on Calculator and Computer
CC ₀₁	Use of calculators in own daily work and classroom activities
CC ₀₂	Use of computers in teaching/learning mathematics
CC ₀₃	Feel confident using calculators in the classroom
CC ₀₄	Feel confident using computer in math classroom
CC ₀₅	Read essays and articles on calculators and computers
CC ₀₆	Want to participate in INSET on uses of the learning technology

Table 2a. Teachers' Perceptions on Using Calculators in Teaching/ Learning Maths

	Items on Using Calculators in Teaching/Learning Mathematics
CM ₀₁	Using a calculator is enjoyable and motivating for learning math
CM ₀₄ *	Calculator work does not fit into my general math work
CM ₀₆	Using calculator develops a logical thinking
CM ₀₇	Using calculator encourages discussion about math
CM ₀₈ *	It is too difficult to learn about using calculator for teaching math
CM ₁₀	Calculators encourage discovery and investigation work

* This item is in the form of negative statement.

Table 2b. Teachers' Perceptions on Using Calculators in Teaching/ Learning Maths

	Items on Using Calculator in Teaching/Learning Mathematics
CM ₀₂ *	The students are too young to make good use of calculators in math
CM ₀₃	A calculator gives students more control over their learning in math
CM ₀₄ *	Calculator work does not fit into my general math work
CM ₀₅	What students have done cannot be checked if they use a calculator
CM ₀₉ *	Parents do not like children using calculators in schools
CM ₁₁	There may be harmful effects if students use calculator too much
CM ₁₂ *	There is no relevance in the use of calculators by students
CM ₁₃	Calculators should be freely available to all students in schools

* This item is in the form of negative statement.

Table 2c. Teachers' perceptions on utilisation of calculators

	Positive/Negative Statements on Use of Calculators
CM ₁₄	Using a calculator is enjoyable and motivating
CM ₁₅ *	Calculator encourage mental laziness
CM ₁₆	Calculators facilitate the learning of basic facts
CM ₁₇	Calculators develop an ability to estimate and approximate
CM ₁₈	Using a calculator helps to develop specific mathematical skills
CM ₁₉ *	Calculators in school are a bad idea. They are stolen or break, or their batteries run out
CM ₂₀	Students should use calculators unless they have mastered the number work with pencil and paper methods

* This item is in the form of negative statement.

Both TeQu-1 and TeQu-2 were administered at the end of the one-day seminar/ workshop, and the teachers were free to respond the items. The data provided on the returned two type questionnaires, and the analysis of TeQu-1 gave information about a group of mathematics teacher' experiences on using calculators and their perceptions on the utilisation.

4. ANALYSIS AND RESULTS

The gathered data by means of TeQu-1 were analysed under certain sub-topics, and the results are then displayed as bar charts in this section. Since the bar charts are self-exploratory, not all but some figures will be interpreted very briefly.

4.1. Availability and Use of Calculator/Computers by Mathematics Teachers

The background of teachers who participated in the one-day seminar and workshop is important for the design of program, and to decide on the strategy of professional development. Fig 1 shows the percentage of mathematics teachers reporting their access, experience in using calculator and/or computer in classroom and teaching mathematics, etc. The meaning of the abbreviated code CC1, ...,CC6 on the horizontal axis is the same shown in Table 1.

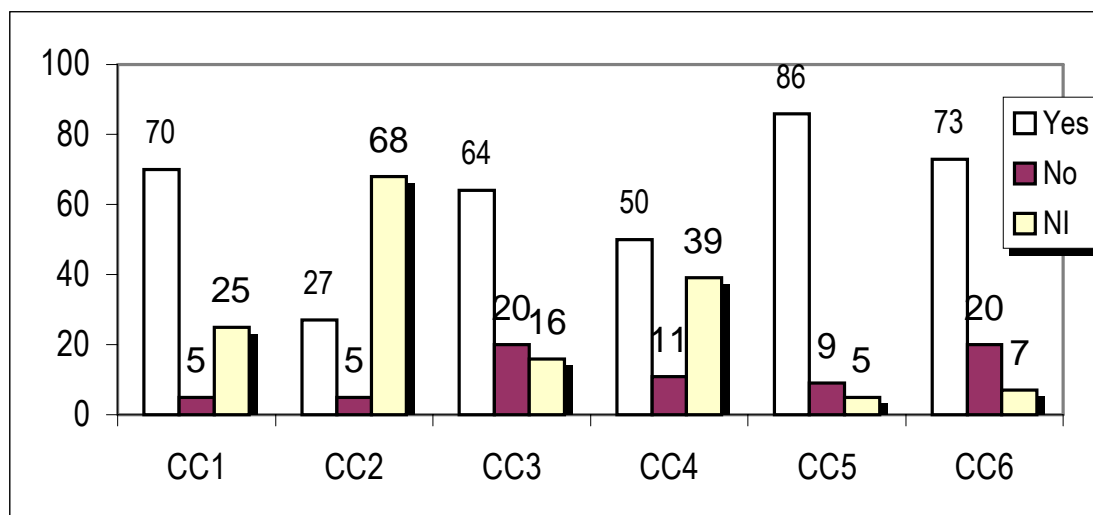


Fig 1. Percentage of teachers who access and use calculators/computers (CC)

As seen in Fig 1, most teachers (%70) use calculators in their daily work and/or classroom (CC1) but the majority (%68) has no idea about the use of calculators in teaching/learning school mathematics (CC2). Most teachers (%73) responded that they want to participate in an INSET about the use of calculators while some (%20) do not (CC6). Majority of maths teachers (86%) said that they read essays and articles on calculators and computers (CC5) while 9% said no. Although we understand teachers' needs and their sincere wishes, but they do not have necessary and enough resources for reading and professional development. More precisely, there is not any published journal and magazine on the use of CC in teaching mathematics and science in Turkey.

4.2. Teachers' Perceptions on Utilisation of Calculators in Teaching/Learning Mathematics

The items in TeQu-1 were grouped under three headings, and each of them is displayed in Fig 2a, Fig 2b and Fig 2c respectively.

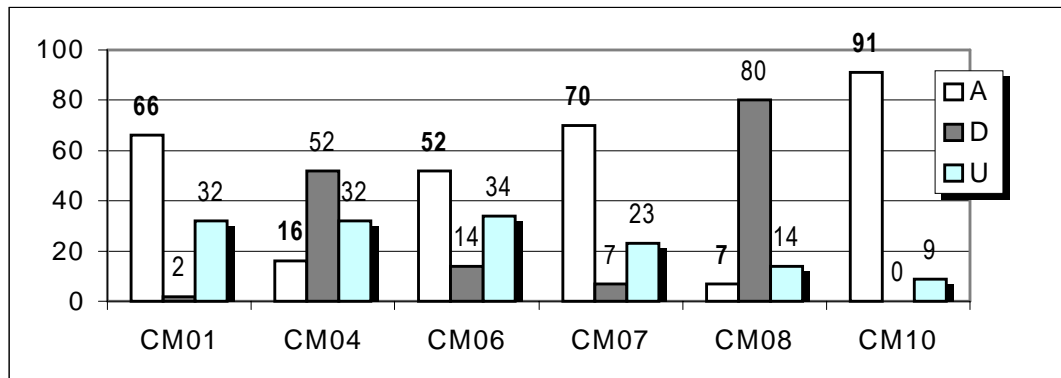


Fig 2a. Teachers' Perceptions on Utilisation of Calculators for Teaching Mathematics

As seen in Fig 2a, more than half of the teachers (66%) think that „CM01: Using a calculator is enjoyable and motivating for learning maths“ while almost all of them (91%) agree with the view that „CM10: Calculators encourage discovery and investigation work“. Most of the teachers (80%) are disagree with the view that „CM08: It is too difficult to learn about using the calculator for teaching maths“ while some (14%) have no idea about it. Moreover, almost all teachers (91%) participated in the seminar think that „CM10: Calculators encourage discovery and investigation work“ while 70% of them share the view that „CM07: Using a calculator encourages discussion about maths“. Thus the teachers' perceptions on utilisation of calculators for teaching mathematics seem to be very positive, and encourage us to work on the detail of professional development programs.

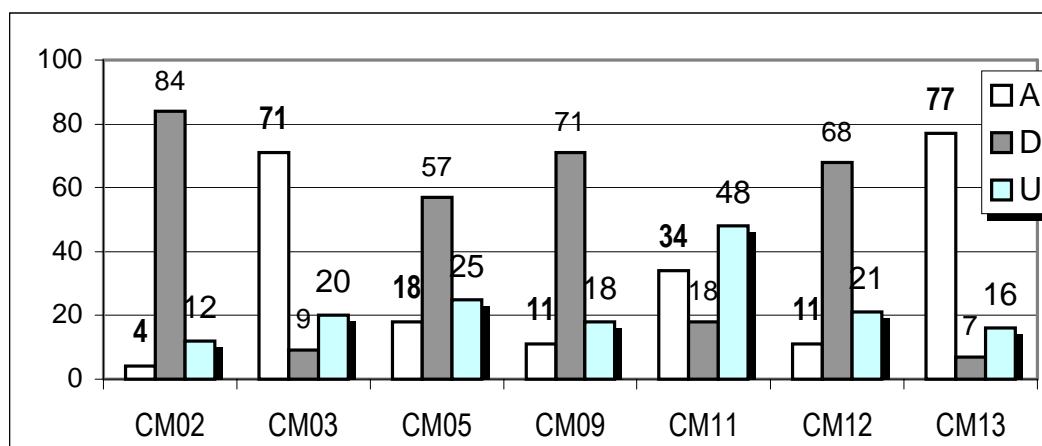


Fig 2b. Teachers' Perceptions on Utilisation of Calculators by Students for Learning Mathematics

Most of the teachers (84%) are disagree with the view that „CM02: The students in my class are too young to make good use of calculator in maths“ while 71 % of them think that „CM03: A calculator gives students more control over their learning in mathematics“. Most of the teachers share the view

that „CM13: Calculators should be freely available at all times to all pupils“ while 7 % of them say no. Moreover, among the teachers, 34% them have a view that there may be harmful effects if students use calculator too much in the classroom while about half of them (48%) have no idea (CM11). Moreover, most of the mathematics teachers (71%) are disagree with the view that „CM09*: Parents do not like children using calculators in schools* while 68 % of them do not share the view „CM12*: Since tried and tested methods work, pupils do not need to use calculators*. Thus, majority of the teachers at the end of the one-day seminar and workshop have gave positive responses to the questions related to calculators and students' learning of mathematics.

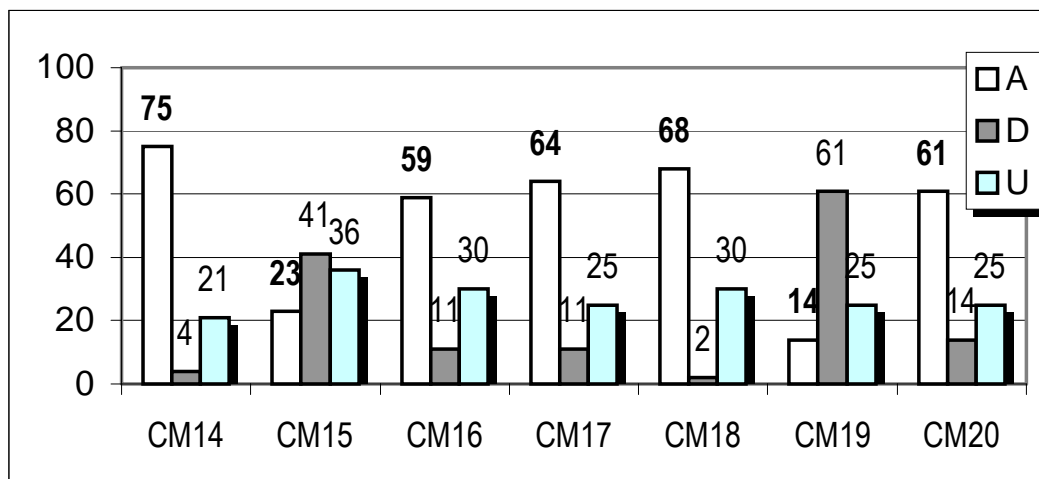


Fig 3c. Teachers' Perceptions and Opinions about Calculators and Mathematics Skills

Most of the teachers (75%) think that „CM14: Using a calculator is enjoyable and motivating“ while 21 % them have not decided yet about the same statement. Majority of the mathematics teacher (68%) are agree on the statement that „CM18: Using a calculator helps to develop specific mathematical skills“ while 64 of them share the view that „ CM17: Calculators develop an ability to estimate and approximate“. The percentage of the teachers who are disagree on the same statements is 2 and 11 respectively. More than half of the mathematics teachers (61%) have the view that „ CM20: Students should use calculators unless they have mastered the number work with pencil and paper methods“ while the same percentage of them do not think that „CM19*: Calculators in school are a bad idea. They are stolen or break, or their batteries run out“. Among these teachers, 25% of them have not decided yet about these items. Finally, 41% of the teachers are disagree on the statement „CM15*: Calculator encourage mental laziness“ while 36% have not decided yet about the same statement.

The results in the present exploratory study summarized above encourage us to design various teacher development program on the introduction, implementation and integration of ICT into teaching/learning of mathematics.

5. CONCLUSION AND RECOMMENDATIONS

Advanced calculators, both G and G/CAS, have some potential to enhance the teaching and learning environment, but requires new knowledge and skills when educators and teachers decide to use in the classroom. Therefore both classroom teachers in primary school and mathematics teachers in secondary school should be retrained in a series of short courses and supported continuously. In this study, we found that most of the teachers, who own four function or simple calculators, are not familiar with use of technology in teaching of mathematics in Turkey. However, most of them are willing to know how such technologies can be used to improve the current situation of learning/teaching mathematics and remove students' misconception. Among them, the young generation of mathematics teachers and teachers working private schools show more enthusiasm for the professional development. This may be an advantage for the popularisation of the use of PCT, namely calculators, and find out the obstacles in the period of implementation.

Furthermore, both primary school classroom teachers and secondary school mathematics teachers in Turkey regard calculator as one part of ICT, but besides calculation, they are unaware with its powerful function of graphing, programming and symbolic manipulations. In connection with the implementation and integration of PCT, we have several questions to answer, and some issues to discuss in detail. For example, if we know little a kind of technology, how can we make full and effective use of it? Moreover, most of the mathematics teachers would like to do more on technologies, but the equipment, fund and time is insufficient. It is worthwhile to stress that teachers who participated in one-day seminar and workshop gave us an impression that they are ready to make full practice of using calculators in teaching mathematics.

Finally, the findings in the present exploratory study suggest that teachers knowledge on the use of advanced calculators may influence teachers' perceptions and opinions. Several conclusions and recommendations emanated from this finding. One is that teacher educators should spend various efforts to plan and organise more effective and flexible seminars and workshop for the teachers. However, we still do not understand the complex process of teaching/learning of mathematics with the use of technology. Therefore, we should study and understand teacher thinking, teacher behaviour and outcomes of the use of PCT in teaching of mathematics. It seems to us that teacher perceptions and behaviour change as they make the transition from novice to expert; and the use calculators become more fruitful, flexible and manageable.

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