CHAPTER 14

LATIN AMERICAN CALCULATORS IN MATHEMATICS EDUCATION PROJECT: PLACEM

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The Latin American Calculators in Mathematics Education Project (PLACEM) is experimenting with the use of calculators in mathematics teaching in seven Latin American countries: Argentina, Brazil, Chile, Colombia, Dominican Republic, Mexico and Venezuela. PLACEM has received calculators and some financial support from Texas Instruments. There has been only minor resistance to calculator use, and initial results from the projects indicate changes in teacher perceptions on the nature of mathematics. Materials are being developed, teacher workshops held, and research projects initiated. Most countries experienced difficulty with importing the donated calculators, and there is an emerging demand for calculators.

ANTECEDENTS

UNESCO conducted in Asia a pilot project on teaching mathematics using calculators. Australia, Japan, New Zealand and Pakistan co–operated in examining their mathematics curricula to see how learning could be improved by using calculators. They prepared curriculum materials which specifically required the use of calculators. When the project concluded, Australia had mandated, in agreement with the Australian Mathematics Teachers Association, calculator use at all levels. New Zealand had developed curriculum materials which used calculators, which were subsequently incorporated in the new national textbooks. Japan has included calculator use in their new national objectives of mathematics teaching. And Pakistan's education department decided to not recommend the use of calculators at the primary school level.

In 1992, Ed Jacobsen at UNESCO initiated a similar project for Latin America, but lack of funds prevented its implementation. The Inter–American Committee for Mathematics Education (IACME) agreed to sanction the project, and funding has been given by Texas Instruments beginning in 1994. Joining Ed Jacobsen in the Coordination of the Project were Rick Scott from the University of New Mexico (Vice President of IACME) and Eduardo Luna from Barry University (President of IACME). The funding from Texas Instruments has included calculators, some money for the printing of materials, and travel money so that country coordinators could meet

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with the project coordinators. On their behalf, the countries have invested matching funds, mainly in terms of personnel and field work.

OBJECTIVES

The main objectives of PLACEM are:

- Identify math education categories of instruction and testing that are applicable to the use of calculator technology in grades K–12 and teacher training universities
- Develop, select and/or adapt curriculum materials and testing methodologies that incorporate calculator functionality for teaching mathematics and assessing learning.
- Critique the applicability of TI instructional calculators functionality to school K–12 grade curriculum and teacher training institutions.
- Conduct preliminary experiments using developed materials to assess pedagogical applicability, student comprehension and attitudes, and teacher attitudes.

PARTICIPATING COUNTRIES

Argentina

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Calculators used: TI–108, Math Explorer, TI–82, TI–85

Teacher strikes, political changes, and importation difficulties have led to a situation in which the calculators for PLACEM have not yet been imported into Argentina. Teacher in–service sessions have been carried out to prepare groups of teachers to use the calculators when they arrive.

Brazil

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Calculators used: Math Explorer, TI–30, TI–82

PLACEM–Brazil is divided into three sub–projects:

- Teacher development
- Using calculators in middle school and high school
- Materials development.

Teachers attending the development courses have expressed interest in having their schools acquire calculators. On the basis of the initial application of materials they are being revised and will be reapplied in the following school year with a corresponding study of student achievement. Meanwhile an article on mathematical modelling with the TI–82 has been published (Salett and Hein, 1995) and a Portuguese translation of the Math Explorer manual has been prepared.

Chile

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Calculators used: Math Explorer, TI–30, TI–82

PLACEM–Chile has used a three pronged approach. On an initial level they explored possible resistance on the part of teachers to the introduction of calculators into their classrooms. Through meetings related to a program of technical assistance to schools offered by the Universidad de Santiago called *Assistance Network Project* they found some beliefs that calculator use would lead to a loss of computational proficiency and to students not thinking (“calculators atrophy the mind”). There was also some fear expressed that they would not know how to use all the features of more complicated calculators and would lose authority in relation to their students. An important conclusion reached is that the introduction of calculators should be accompanied by a curriculum change strategy that could deal with any detected resistance.

They have also initiated an exploration of effective ways of teaching and learning mathematics with the use of calculators with projects in middle school, high school and university. Advanced undergraduate and graduate students have worked with three university professors in preparing instructional materials to use with the calculators. Those materials are going through a careful development and revision process.

At a third level they have begun to study patterns of student answers and errors in using the developed materials. They are also developing ways to study the relationship between basic cognitive abilities and calculator use.

Finally, PLACEM–Chile has been involved with a proposal accepted by the Ministry of Education to purchase graphing calculators as part of a national curriculum renovation and teacher professionalization project. They have also participated in identifying the characteristics that should be included in a pedagogical manual on the use of graphing calculators, which is a basic requirement for their inclusion in the educational system.

Colombia

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Calculators used: TI–85

PLACEM–Colombia became part of an on–going research and development project on precalculus mathematics in a mathematics education research institute known as *una empresa docente* at the Universidad de los Andes in Bogotá. Among the research they have published on calculator use is an article by Mesa (1996). She identifies "the good, the bad, and the ugly" of calculator use in a precalculus class. Among "the good" she cited her own confrontation with the elements of precalculus, her students view of the calculator as another possessor of "truth" in the classroom, a new view of the importance of errors in learning mathematics, and a sense in which the calculators served as a subject of conversation that led to more collegial collaboration. "The bad" had mostly to do with the cost in Colombia of the TI–85, and the difficulties occasioned by having students showing up with five or six different cheaper models. "The ugly" mainly had to do with confronting her own initially limited view of just what is mathematics and the role of evaluation in learning mathematics. Another outcome of the work with calculators in precalculus at *una empresa docente* has been the publication by Grupo Editorial Iberoamérica of a book on problem situations in precalculus (Gómez, et. al., 1996).

Dominican Republic

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Calculators used: Math Explorer

In the Dominican Republic, PLACEM has been able to tie into significant work already on going in improving middle school mathematics teaching and learning. Initial teacher professional development activities on calculator use have been carried out. Most of the time has been dedicated to that activity because there was not a tradition of calculator use. However, an interesting extension of the middle school work has been a renewed interest in calculator use at the University. That interest has been further fueled by a donation of TI–85s from Barry University in Miami.

Mexico

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Calculators used: Math Explorer

The greatest number of individual projects have been initiated by PLACEM–Mexico: pre–primary, primary, middle school, high school, and university in both public and private institutions. The sub–projects have involved professors and students from several universities, including the National Autonomous University, the National Polytechnic Institute, and the National Pedagogical University, as well as from the Secretariat of Education. The pre–primary project seeks to find what sorts of calculator activities can be used to help young children develop number sense. The primary level project is working with *niños de la calle* (street children). Middle school projects are stressing using the Math Explorers to help understand concepts and solve problems. Workshops have been done with several groups of middle school teachers. One of the high school projects is video taping students working on calculator based projects in cooperative groups. The Coordinator and two of the sub–project leaders of PLACEM–Mexico participated in T^3 training at Ohio State University.

Venezuela

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Calculators used: TI–82

Most of the work of PLACEM–Venezuela has been with workshops for high school teachers. Activity lessons have been prepared concerning functions, inverse functions, trigonometric functions, matrices, and tangents to a curve. A pilot study is being conducted with high school students and the concept of tangent to a curve. Classroom implementation has been impeded by teacher strikes.

CONCLUSIONS

PLACEM is being developed, although there does exist variability in the processes and results in the various countries. In some they already have results that have been published or presented at international events (e.g. Brazil, Chile, Colombia, Mexico), others are at an advanced stage in their development, and others are just beginning (e.g. Argentina).

In almost all of the countries there have been difficulties importing the donated calculators. In some cases there was a complicated series of documents to fill out in order to import them without paying taxes. In other cases there was complicated paper work and still the necessity to pay importation taxes. In most countries distribution systems are being developed so that teachers and students will be able to purchase Texas Instruments calculators.

Some countries have experienced extended teachers strikes that have affected public schools in general and the calculator projects in particular.

As strikes lessened the number of days of instruction, the planned activities with the calculators occasionally had to be abandoned.

Although PLACEM has encountered some expressed resistance to calculator use, in general, student, teacher, administrator, and parent resistance to calculator use has not been a problem. In fact, in almost all cases there has been strong support for calculator use.

The fact that the symbols on the calculator keys are based on English does not seem to have been a serious negative factor in their use with Spanish or Portuguese speaking students. Some problems have arisen in using overhead projector models because overhead projectors are not as ubiquitous in Latin America as in the United States. The large posters of the calculators are much more widely applicable.

Currently the countries are preparing research reports and information articles on options and results of planned use of calculators. They are also in the process of developing, validating and optimizing educational materials that will permit an illustration of the possibilities and benefits in cognitive, affective and social learning of students. Teachers are being prepared in ways that will make it possible to introduce the use of calculators into Latin American efforts to improve educational quality and equity.

Finally, there is concern in various countries that do not want to create a demand for calculators that cannot be satisfied. That is, the activities of PLACEM are having an impact in an emerging demand that in some countries requires the development of mechanisms and procedures for its timely satisfaction.

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