Education

TECHNICAL NOTE

NOVEMBER 2009

Emma Näslund-Hadley,
Marcelo Cabrol, and
Pablo Ibarrarán

BEYOND CHALK AND TALK: EXPERIMENTAL MATH AND SCIENCE EDUCATION IN ARGENTINA

Summary: Primary-school students in Argentina score low in international assessments of learning, particularly in math and science. To help remedy this situation, the Inter-American Development Bank is supporting a pilot study to identify pedagogical models that will enhance learning.

Three approaches based on so-called guided inquiry are being studied in two Argentine provinces during the 2009 academic year. In this paper we describe the pilot initiative and evaluation design, while also summarizing some of the baseline data and background information. Already the initiative has found that teachers lack content knowledge and interest in math and science, students lack interest in math, and parents appear to lack interest in their children's education. The three pedagogical models being piloted could help address these problems.

CONTENTS

Edited by Steven B. Kennedy
Design and layout by Laura C. Johnson

Inter-American Development Bank
1300 New York Avenue, N.W.
Washington, DC 20577
USA

Low Rankings in International Assessments

Controlling for per capita GDP, students from Latin America and the Caribbean consistently perform below students in East Asia and in the industrialized countries that make up the Organisation for Economic Co-operation and Development in international assessments of educational achievement. In 2006, the Latin American countries participating in the OECD Programme for International Student Assessment (PISA), which focuses on secondary education, were all among the bottom performers. The situation is particularly challenging in mathematics and natural science, areas that are critical for raising worker productivity over the long term. To address this pervasive problem, governments are seeking new pedagogical models to help improve student learning.

While Argentina has made significant progress in widening access to education and in expanding coverage of the school-age population, its results on the 2006 PISA test were unflattering. Argentina ranked 53 in mathematics and 51 in science out of 57 participating countries. Even more troubling, Argentina's results represented a decline in those two areas with respect to its 2000 PISA results and in relation to other countries in the region. In fact, among the 15 countries that participated in both the 2000 and 2006 PISA tests, Argentina had the sharpest decline.

In primary education, the Second Regional Comparative and Explanatory Study (SERCE; like PISA, conducted in 2006) placed Argentina's students well below the regional average in science. More than 40 percent of the country's third-grade students scored no higher than the first level, compared with just 11 percent of Cuban students. The situation in mathematics was less troubling, with Argentina ranking near the average for both third and sixth grade. However, Argentina's average is below levels commensurate with the country's per capita income.

A rural sixth-grade student in Argentina is more than twice as likely as an urban student to score at the lowest level in mathematics on the SERCE test. Argentina's national grade-level assessment test, ONE, confirmed the rural–urban gap: students in rural schools are at a disadvantage in both science and mathematics when compared with students in urban schools.

In response to low achievement in science and mathematics, Argentina's Ministry of Education and the Inter-American Development Bank (IDB) are implementing a pilot project to identify better approaches to the teaching of math and natural science in primary schools. The government has made these two areas a priority for educational policy, and the pilot forms part of a larger initiative of the Ministry of Education and the Ministry of Science, Technology, and Productive Innovation. That initiative includes several activities to improve teaching and learning in these subject areas.

The purpose of this monograph is to describe the pilot initiative and its evaluation design, as well as teacher and student content knowledge and perceptions about math and natural science. We hope to sensitize policymakers, institutional leaders, and stakeholders in primary education to the importance of identifying what works, why, and under what circumstances in mathematics and natural science education in the region.

"Today our children learn science to explain things in their everyday lives."
Gabriela Sultana, principal, province of Buenos Aires

Inquiry-Based Learning

Some information is available about the importance of mathematics and natural science skills for economic competitiveness, but little is known about which pedagogical models are most successful in improving math and science scores in basic education. A handful of rigorous evaluations has been conducted in the United States and Europe, but experiences in Latin America are rarely documented.

Against this background, the IDB-supported pilot in Argentina seeks to identify pedagogical models that will improve learning among students from the lowest socioeconomic strata. Before joining the initiative, participating schools used a highly structured learning approach in which all students followed each lesson together in a pre-set sequence. By contrast, the pilot has been designed to test three *inquiry-based* models—two aimed at improving natural science education and a play-based mathematics approach—in two Argentine provinces during the 2009 academic year.

The term *inquiry* is popularly used to describe a spectrum of pedagogical approaches that imply some degree of student involvement and questioning that leads to understanding. In the Argentina pilot, all three approaches may be classified as *guided* inquiry-based approaches because the teacher facilitates the learning process, ensuring the focus on relevant outcomes and encouraging divergent thinking. All three approaches are also characterized by scientific reasoning, experimentation, group work, and dialogue. They constitute a sharp departure from teacher-led demonstrations and simple transmission of concepts.

"I like doing experiments because we can learn things we don't know."
Lazareno, fourth-grade student, province of Buenos Aires

Two Inquiry-Based Models for Teaching Natural Science

The two pilot science-education models are known as Science and Technology through Creativity (CTC) and the Scientific Literacy Program (PAC).

CTC was developed by Sangari Brazil for implementation under the less-than-optimal circumstances that often characterize education in developing countries, where teachers often have scanty pedagogical training and limited knowledge of the subjects they teach. The model offers the teacher an integrated package, including materials for experiments, teacher and student guides for each subject area, and step-by-step guidance for teachers. Teachers do not plan their own lessons; instead, tutorial instructions show them how to carry out each set of lessons. In Brazil, CTC has been used in the education of about a million school children. While the results seem very promising—including anecdotal evidence of increased student interest in and understanding of natural science—no rigorous evaluation has yet been done.

PAC is inspired by the French program, *La Main à la Pâte*. Like CTC, PAC aims to construct knowledge through guided experiments, but it gives the

teacher a more prominent role. PAC is not a set of pre-determined lessons, but rather a framework that attempts to show how essential skills—scientific reasoning and sense-making—can be integrated into primary-level education in natural science. Great emphasis is placed on the role of language in knowledge construction.

While the PAC model offers numerous examples of how reasoning and sense-making may be used in the classroom, it does not require the teacher to follow a step-by-step guide for each lesson. Instead, the teacher has the freedom to plan lessons. Nor is the model limited to a single textbook. Instead, the teacher researches and identifies appropriate texts—from newspapers to academic literature—that can be integrated into the lessons. The simple kits that accompany PAC are complemented by props from the everyday lives of teachers and students—everything from strings and sticks to chicken bones and vinegar. PAC's emphasis on the teacher has the potential to produce engaged educators and students, but realizing that potential requires solid pedagogical foundation skills and hence more rigorous initial teacher training.

Mathematics for All

Mathematics for All is a play-based pedagogical approach that aims to give meaning to mathematics.

Rather than teaching students to carry out complex procedures, Mathematics for All focuses on what they can do with their knowledge. The model builds on children's natural proclivity to play, tying educational content to the rules of games, such as lotteries, bingo, card games, addition and multiplication grids, and money counting. Students are encouraged to develop their own problem-solving strategies, justify their ideas, and accept suggestions and criticism from their peers. In one pilot classroom, students were asked how many tables with four plates on each could be set from a stack of 36 plates. Three students solved the problem using very different strategies, as shown in figure 1. After solving problems individually students are encouraged to explain their own reasoning, detect fallacies, and critique others' thinking.

All three models involve traditional teacher training as well as tutoring inside and outside the classroom. The number of training hours is similar for all models: around 80, divided equally between seminars and tutoring. In all three models, teachers are encouraged to reflect on their practices and to share experiences and thoughts with other participating teachers. The pilots involve the whole school in the mathematics or natural science strategy, with school principals and staff members participating in some training sessions and engaging in monitoring and planning meetings.

"Children who before did not participate, now achieve results because of the desire to win the game."

Carina, mathematics teacher, province of Buenos Aires

All three models are relatively low in cost and have the potential to be scaled up. The exact cost of doing so in Argentina has not yet been determined, but in Brazil, where the CTC model has been scaled up, the monthly cost per student is US$10.

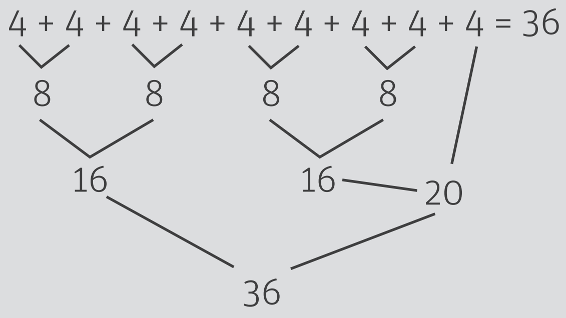
Pilot Evaluation Design

The three pedagogical models described above are being tested through an experimental evaluation consisting of three treatment groups (PAC, CTC, and Mathematics for All) and a fourth control group that receives the standard program in natural science and mathematics. The aim of the evaluation is to investigate the effects of the three models on primary students' mathematical and scientific reasoning and content knowledge.

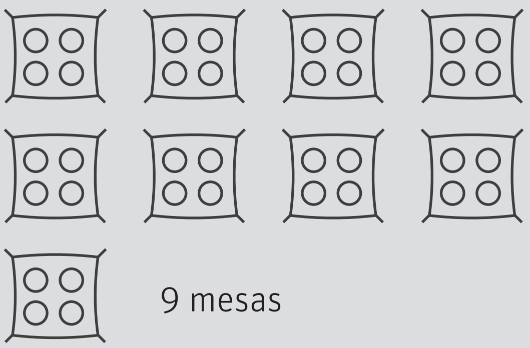
The pilot is being implemented in the capital area and the departments of Tafí Viejo, Yerba Buena, and Cruz Alta in the province of Tucumán; and in the southern part of the outlying area of Buenos Aires (the "Conurbano") in the province of Buenos Aires. The two areas were selected based on socioeconomic characteristics and educational results. Both contain a high proportion of vulnerable schools and a high proportion of households with unmet basic needs. Both also have high proportions of students who scored poorly in science and mathematics on the ONE test. In each province at least 300 schools were randomly selected and randomly assigned to one of the four groups (PAC, CTC, Mathematics for All, or control group). A total of 675 schools and more than 18,100 fourth-grade students are participating in the pilot (table 1).

Figure 1
Three ways to solve the same mathematics problem

¿Para cuantos mesas le alcanzan?
Le alcanzan para 9 mesas.



4 x 9 = 36   36÷4 = 9



Taken into account in the school selection and assignment process were total enrollment in previous years, the schools' vulnerability index, the unsatisfied basic needs index of the area in which the schools are located, and ONE 2000 test scores in math and science (table 2). Even though the test score data were a few years old, the groups are very similar.

The evaluation is being carried out by a team of external evaluators from the Catholic University of Uruguay (UCUDAL) and the International Institute for Educational Planning (IIPE). With both quantitative and qualitative components, the evaluation considers a wide range of parameters—among them (i) the effectiveness of teaching models in improving achievement; (ii) the teaching environment, including classroom dynamics and gender relationships among student groups; (iii) the teachers' subjective assessments of the students' learning capacity; (iv) the teachers' subject-area and pedagogical knowledge; and (v) the models' sustainability in terms of the cost of expanding them to the national level and the durability of pedagogical inputs.

Table 1
Pilot schools and fourth-grade students by province and pedagogical model

	PAC		CTC		Mathematics		Control group		Total	
	Schools	Students	Schools	Students	Schools	Students	Schools	Students	Schools	Students
Buenos Aires	77	1,913	84	2,175	77	1,990	80	2,100	318	8,178
Tucumán	98	2,758	93	2,518	84	2.285	82	2,371	357	9,932
Total	175	4,671	177	4,693	161	4,275	162	4,471	675	18,110

Source: IIPE-UCUDAL 2009.

The quantitative evaluation consists of a standardized test administered at the beginning of the school year in March 2009, before the initiation of the pilot, and repeated again at the end of the pilot in December 2009. As the pre-pilot test could not be administered to the entire pilot population, an evaluation sample was formed from 56 randomly selected schools. The total number of fourth-grade students in the sampled schools was 5,892. The sample groups were compared along many dimensions, including the repetition rate of the schools in the group, their student-teacher ratio, the seniority of their teachers, the condition and characteristics of their infrastructure, and the availability of teaching materials, equipment, and support staff. On average the groups are fairly similar, but for individual indicators a small but statistically significant difference was detected in favor of the control group in the mathematics category. Following the second test application, these initial differences will be controlled for statistically.

The test, designed to measure math and science learning in the fourth grade, includes both multiple-choice and open-ended questions. The coverage of students taking the test is reasonably high: 85 percent in natural science and 80 percent in mathematics and in the control group.[1] The test was administrated by external investigators, 13.8 percent of whom were randomly selected for supervision.[2] The test results were calibrated using the Rasch model, the same method used for the PISA test.

Table 2
Values of variables used for selection of participating schools by group

	PAC	CTC	Mathematics	Control group	Total
Students per school	465	458	408	439	443
Vulnerability index	55.3	50.5	57.7	54.3	58.7
Mathematics test score	53.8	51.6	53.0	51.7	52.5
Science test score	58.4	56.7	57.7	57.0	57.4

Source: IIPE-UCUDAL, 2009

The quantitative evaluation is complemented by a qualitative evaluation consisting of systematic observation of teaching practices and changes in pedagogy. Extensive information concerning the characteristics of the schools, students, teachers, families, and community contexts are being collected through surveys and interviews of teachers, principals, and students surveys, and through classroom observation.

1. This is in line with international standards. PISA and SERCE require coverage of 85 percent and 80 percent, respectively. For individual schools, PISA requires only 50 percent coverage.
2. By way of comparison, 10 percent of PISA and SERCE test administrators are supervised.

Baseline Findings

Beside providing the values against which the effect of the pedagogical models will be measured, the baseline data offer important information about the study population. The following dimensions stand out as particularly noteworthy: characteristics of the pilot schools, content knowledge and attitudes of teachers and students, and parental involvement.

> **"We learn better in groups. You learn what the others know."**
> *Lara, fourth-grade student, province of Buenos Aires*

Pilot School Characteristics

The pedagogical models are being tested on students from socioeconomically disadvantaged backgrounds who lack foundation skills in many subjects. The pedagogical coordinators involved in the implementation of the pilot have reported that about a fifth of the students cannot read or write. In some schools, the proportion is as high as one-third. The pilot schools are located in poor communities, and a majority of their principals characterized the environment surrounding the school as problematic or very problematic—with high levels of drug use, child labor, homelessness, violence, and vandalism. Some 40 percent of the students reported that one of their peers had been robbed, and half declared that fights were constant in the school. At the same time, more than 60 percent of students indicated that their teachers almost always were in a good mood, and 45 percent said that they would be sad or very sad to change schools. In general the availability of teaching materials and equipment is limited, with four students per book, 162 students per computer, and 379 students per television. Only 5.4 percent of schools have science laboratories.

Student Characteristics, Test Scores, and Attitudes

Information about students was collected in four areas: sociocultural data, school trajectory, perceptions about the school environment, and attitudes towards mathematics and natural science.

In both subject areas, the knowledge tests were difficult for the students. This was to be expected, given that the tests covered topics to be taught during the school year. On average, students answered 6.3 out of 24 items correctly on the natural science test and 4.4 out of 24 items on the mathematics test. It is noteworthy that in natural science a few students managed to respond to 23 items correctly. In mathematics, the maximum number of correct responses observed was 17.

The widespread perception among the students about scientists is that they are intelligent, wear lab coats, help people, and discover things. This positive image is reflected also in the students' views of

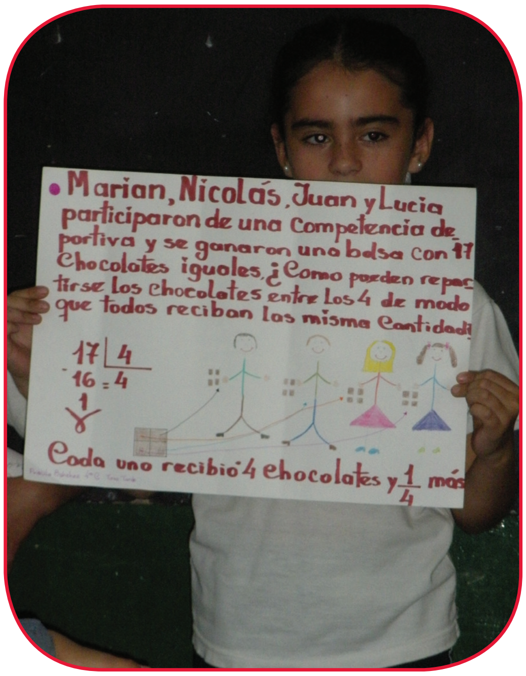


Table 3
Teacher perceptions about students (percent)

	Mathematics			Natural science		
Perception	**Positive opinion**	**Negative opinion**	**No response**	**Positive opinion**	**Negative opinion**	**No response**
Conduct	67.7	27.8	4.5	67.4	28.7	3.9
Interest in learning	63.9	29.3	6.8	71.0	25.8	3.2
Interest in learning subject (math or science)	15.0	72.9	12.0	76.3	18.6	5.0
Attendance	60.2	32.3	7.5	79.2	16.8	3.9
Focus on task	12.8	79.7	7.5	38.7	57.7	3.6
Oral and written expression	42.9	51.1	6.0	41.9	54.1	3.9
Group work skills	39.1	53.4	7.5	48.4	47.3	4.3
Parental involvement	53.4	38.3	8.3	33.7	63.1	3.2
Academic achievement	53.4	39.1	7.5	72.4	22.2	5.4
Capacity to learn varied contents	55.6	38.3	6.0	63.1	33.0	3.9
Communication skills	56.4	34.6	9.0	46.6	50.5	2.9
Independent thinking skills	45.1	48.1	6.8	39.4	56.6	3.9
Analytical skills	47.4	45.0	6.8	19.7	74.6	5.7

Source: IIPE-UCUDAL, 2009

mathematicians, whom they perceive to be intelligent, helpful, and dedicated to discovering important things. While half the students considered mathematics to be an important subject, only 30 percent believed that natural science was important.

Students' perception of their own academic achievement is not aligned with teachers' perceptions. Seventy percent of the students believed that they were good or very good students. Yet, in mathematics, close to 80 percent of teachers indicated that their students had trouble focusing on tasks, and 73 percent had negative perceptions of their students' interest in the subject (table 3).

The teachers' perceptions of their students was assessed along a wide spectrum of dimensions, including student behavior in the discipline, oral and written expression, ability to engage in group activities, interest in the subject area, class attendance, capacity to learn, and achievement. The teachers had mixed perceptions of their students. While they valued positively the students' attendance, interest in learning,

"She is much more motivated to go to school with this program. The first thing she does in the morning is to look for her science book."
Mother of fourth-grade student, province of Tucumán

and conduct, they were more negative in other areas. In natural science, three-quarters of the teachers perceived that their students lacked analytical skills, and close to 57 percent thought that their students lacked independent thinking skills. In mathematics, fewer than 13 percent of teachers thought that students were able to focus on tasks.

The teachers' lack of confidence in their students is particularly troublesome in light of research showing that teachers' perceptions of their students affect how teachers teach and how much students learn.[3]

Although the results from the interviews with parents are not yet available, it is striking that both directors and teachers indicate a lack of involvement of parents in the education of their children. This finding is particularly important given the fairly wide acceptance of the idea that parental involvement affects student achievement in school.[4]

Teachers' Knowledge of Their Subject Matter

Teachers' subject-matter knowledge was evaluated along two dimensions. First, teachers were asked to name three basic concepts that students should learn in four areas of mathematics (multiplication of natural numbers, fractions, geometric figures, and decimal numbers) and three areas of natural science (electricity and magnetism, the human body, and properties of matter). Second, in the same content areas, the teachers were asked to express basic concepts that they teach their students. In both disciplines, the selected content areas are covered by the national core learning priorities that fourth graders are supposed to be taught and by the fourth-grade curriculum of the two provinces. As they applied the instrument, the team of investigators observed that many teachers had difficulty in responding, a perception reflected in the results (table 4).

Less than half the teachers were able to define three basic mathematics concepts that fourth-grade students should learn in the four selected content areas. Some 30 percent of the teachers were able to identify one or two basic math concepts. A fifth of the teachers did not respond to the question, which could be interpreted to mean that they were unable to define basic concepts. On average, fewer than 2 percent of the teachers were able to express basic concepts about what they teach their students in one of the selected math content areas. Over half the mathematics teachers either were unable to identify concepts of relevance to the students' everyday lives or elected not to answer the question.

Table 4
Content knowledge of teachers (percent)

	Mathematics	Natural science
Able to name one pertinent concept	6.9	8.6
Able to name two pertinent concepts	19.7	15.8
Able to name three pertinent concepts	43.6	39.5
Names nonpertinent concept	1.0	1.3
Expresses one pertinent idea	1.7	1.1
Expresses two pertinent ideas	1.7	0.9
Expresses three pertinent ideas	0.9	2.9
Expresses nonpertinent ideas	2.9	4.7
No response	21.7	25.2

Source: IIPE-UCUDAL, 2009

3. See for example Sweet (1994), who identified a relationship between teachers' perceptions of students' motivation to read and students' reading achievement; and Drame (2002), who concluded that teachers' perceptions, particularly of learning disabilities and academic performances, affected their instructional patterns and treatment of students.
4. See for example, Greenwood and Hickman (1991), Seefeldt (1985), and Gutman and McLoyd (2000), who found that parents of high achievers were more involved in their children's education.

The situation is even more troublesome in natural science, where fewer than 40 percent of teachers were able to name three concepts that fourth-grade students should learn in the selected content areas. Fewer than 3 percent of the teachers were able to express basic concepts about what they teach their students in the selected natural science content areas. Teachers commonly confused concepts. For example, many teachers had problems differentiating between concepts such as "environment" and "eco-system," relating the latter to environmentalists and preservationists.

"This new way of working is as if you give the children the possibility to look for information, open their minds; it's a chance for them to use scientific methods, exploring, investigating, asking." *Beatiz, natural science teacher, province of Tucumán*

Teachers' Self-Perceptions and Attitudes toward Natural Science and Mathematics

The teachers' perceptions about mathematics and natural science were evaluated along a range of dimensions that included their attitudes toward the subject, their perceptions of students and learning, and their professional self-image. The teachers also were asked to highlight three conceptual contents in their respective disciplines that are useful to the students' everyday lives.

As a group, the teachers appear to be unaware of or do not want to admit their own limitations in mathematical knowledge and teaching practices. In spite of the obvious problems in answering content-related questions, nearly three-quarters of the teachers have confidence in their own professional knowledge (table 5). Only in geometry did fewer teachers (55 percent) claim to have the knowledge needed to teach their subject. In natural science, teachers' confidence in their own knowledge was substantially lower (40 percent), and fewer than 38 percent had confidence in their ability to carry out experiments in

Table 5
Professional self-image of teachers (percent)

	Mathematics				Natural science			
	Positive	No opinion	Negative	No response	Positive	No opinion	Negative	No response
Time management	63.2	22.3	4.5	9.0	50.2	31.5	16.1	2.2
Confidence in professional knowledge	73.7	19.5	3.8	3.0	40.5	35.5	21.1	2.9
Interest in teaching subject	42.9	33.1	19.5	4.5	36.9	45.9	12.5	4.7
Confidence in capacity to incorporate science experiments into lessons	n.a.	n.a.	n.a.	n.a.	37.6	35.5	24.0	2.9
Confidence in geometry content knowledge	54.9	27.8	13.5	3.8	n.a.	n.a.	n.a.	n.a.

Source: IIPE-UCUDAL, 2009
n.a. = not applicable.

the classroom. In both domains, less than half the teachers said that they were interested in teaching their respective subjects.

Teachers' attitudes toward the subject areas were assessed along several dimensions, including the presence of prejudice and stereotypes related to the subject area and knowledge of methodologies in the discipline. Based on their answers, the teachers' perceptions were classified as current, undefined or outdated. Only some 36 percent were current. More than 27 percent of teachers had an outdated perception of mathematical knowledge, believing it to be an exact science that does not evolve and that it is a discipline to which only highly intelligent, rigorous, and rational people should dedicate themselves. In natural science as many as 58 percent of teachers had an outdated perception of what constitutes scientific knowledge and what scientists do, stating that natural science is a body of accepted truths that explain mainly natural phenomena. Three-quarters of the teachers had stereotyped conceptions of scientific methods and thinking.

Conclusion

The need to improve mathematics and natural science education in the Latin American region is undeniable. International standardized tests place the students of the region among the world's poorest performers. In today's knowledge-based societies, understanding basic mathematical and scientific concepts and theories and being able to frame and solve scientific questions are more critical then ever. Skills that in the past were required only by a few are now a prerequisite for employment in today's global economy. Poor skills in mathematics and natural science skills are a serious disadvantage for every individual who wishes to function effectively in modern society. On the national level, they constitute a major economic cost in terms of lost productivity and reduced international competitiveness.

While the pilot sample is representative of a small population only, the results from the baseline evaluation have begun to paint a picture of problems with math and science education at the primary level. Perhaps most important is that teachers lack content knowledge and interest in teaching both subjects. In mathematics, students are perceived by the investigators to lack interest and to have problems focusing on tasks. In natural science, students are described as interested but unable to focus. Parents are perceived to lack interest in their children's education.

It is premature to speculate about the advantage of one model over another. Yet, the lack of preparation and interest among teachers would appear to favor a pedagogical model such as CTC that requires relatively little of the teacher in terms of content knowledge and lesson preparation. CTC is slightly more expensive per student than PAC, and it will be interesting to see how the cost-effectiveness rates of the models compare. In mathematics, classroom observation tentatively indicates that the pilot pedagogical model addresses the issue of low student interest in the subject. The second application of the knowledge test will tell us if greater interest transforms into improved learning.

References

Drame, E. 2002. "Sociocultural context effects on teachers' readiness to refer for learning disabilities." *Exceptional Children* 69 (1): 41–53.

Greenwood, Gordon E., and Catherine W. Hickman. 1991. "Research and practice in parent involvement: Implications for teacher education." *Elementary School Journal* 91 (3): 279–288.

Gutman, Lesley Morrison, and Vonnie C. McLoyd. 2000. "Parents' management of their children's education within the home, at school, and in the community: An examination of African American families living in poverty." *Urban Review* 32: 1–24.

IIPE-UCUDAL. 2009. "Programa de mejora de la enseñanza de las ciencias naturales y la matemática: Componente de evaluación línea de base." Unpublished IDB consultancy report.

Ministry of Education. 2009. "Mejora de la calidad de la enseñanza área matemática: Avances marzo-julio." Unpublished presentation. Buenos Aires, Argentina.

OECD, PISA 2006 database.

OREALC, SERCE 2000 and 2006 databases.

Pena, D.C. (2000). Parent involvement: Influencing factors and implications. *The Journal of Educational Research* 94 (1).

Seefeldt, Carol. 1985. "Parent involvement: Support or stress?" *Childhood Education* 62 (2): 98–102.

Sweet, Anne P., and John T. Guthrie. 1994. "Teacher perceptions of students' motivation to read." Reading Research Report 29, National Reading Research Center, College Park, Maryland.

About the Authors

Emma Näslund-Hadley is sector specialist in the Education Division of the IDB.
Marcelo Cabrol is chief of the Education Division of the IDB.
Pablo Ibarrarán is a senior sector specialist in the Office of Strategic Planning and Development Effectiveness of the IDB.

Cataloging-in-Publication data provided by the Inter-American Development Bank
Felipe Herrera Library

Näslund-Hadley, Emma.

Beyond chalk and talk: experimental math and science education in Argentina / Emma Näslund-Hadley, Marcelo Cabrol, and Pablo Ibarrarán.

p. cm.

Includes bibliographical references.

1. Mathematics—Study and teaching—Argentina. 2. Science—Study and teaching—Argentina. 3. Teaching—Argentina—Research. I. Cabrol, Marcelo. II. Ibarrarán, Pablo. III. Inter-American Development Bank. Education Division. IV. Title.

Q181.B4 N37 2009

507.1 N241—dc22