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## **REGIONAL**

# **COGNITIVE TUTORING SYSTEMS FOR SECONDARY EDUCATION IN LATIN AMERICA**

**RS-T1359**

## **PLAN OF OPERATIONS**

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| <p>This document was prepared by the project team consisting of: Aimee Verdisco (SCL/EDU) Project Team Leader; Claudia Cox y Amelia Cabrera (SCL/EDU); Juan Carlos Navarro (SCL/SCT); and Juan Carlos Pérez-Segnini (LEG/SGO).</p> |
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NA

## **BASIC SOCIOECONOMIC DATA**

For basic socioeconomic data, including public debt information, please refer to the following address:

[http://www.iadb.org/res/externallink\\_list.cfm?language=en&parid=1&itemlid=1&detail=Box1#b1](http://www.iadb.org/res/externallink_list.cfm?language=en&parid=1&itemlid=1&detail=Box1#b1)

**INFORMATION AVAILABLE IN THE FILES OF SCL/SCL**

**PREPARATION:**

NA

**EXECUTION:**

[Terms of Reference:](#)

## ABBREVIATIONS

|           |   |
|-----------|---|
| CSC/CCH   | Country Office of Chile                               |
| ICT       | Information and Communications Technologies           |
| KPK       | Korean Partnership Fund for Technology and Innovation |
| PISA      | Program of International Student Assessment           |
| PUC-Chile | <i>Pontificia Universidad Católica de Chile</i>       |
| TEL       | Technology Enhanced Learning                          |

## COGNITIVE TUTORING SYSTEMS FOR SECONDARY EDUCATION IN LATIN AMERICA

### RS-T1359

#### EXECUTIVE SUMMARY

|  |  |             |
|--|--|-------------|
| <b>Beneficiary:</b>                                | Secondary students and teachers in five countries (Chile, Ecuador, Mexico, Colombia, El Salvador).   |             |
| <b>Project team:</b>                               | Aimee Verdisco (SCL/EDU) Project Team Leader; Claudia Cox (SCL/EDU), Amelia Cabrera (SCL/EDU), Juan Carlos Navarro (SCL/SCT), and Juan Carlos Pérez-Segnini, (LEG/SGO).  |             |
| <b>Executing agency:</b>                           | <i>Pontificia Universidad Católica de Chile</i> (PUC-Chile)  |             |
| <b>Target beneficiaries:</b>                       | The target beneficiaries of this operation are secondary students and teachers in public schools in rural and marginal urban areas in five countries. It is estimated that at least 5,000 students and about 250 teachers will directly benefit from Component 1 and that there will be approximately 4,000 beneficiaries for Component 2.   |             |
| <b>Financing:</b>                                  | IDB (KPK):   | US\$500,000 |
|  | Local:   | US\$240,000 |
|  | Total:   | US\$740,000 |
| <b>Objectives:</b>                                 | The overall objective is to improve the quality of secondary education in mathematics in the region through the application of technology enhanced learning activities. More specifically, it will provide new mechanisms for improving efficiency in the teaching-learning process in the short-term, producing a more sustained pipeline of students interested in pursuing scientific disciplines at the university level over the medium term and, in the longer term, better placing the region to compete in an ever globalized world. |             |
| <b>Execution timetable:</b>                        | Execution period:  | 18 months   |
|  | Disbursement period:   | 24 months   |
| <b>Special contractual conditions:</b>             | None.  |             |
| <b>Exceptions to Bank policies and procedures:</b> | None.  |             |

**Environmental and social review:** The project was reviewed by the ESR Committee on January 18, 2008. No negative environmental or social effects were identified and the TC has been classified as a “C” according to the Safeguard Classification Tool (see paragraph 7.1).

**Coordination with other donors:** N/A.



## **I. BACKGROUND AND JUSTIFICATION**

- 1.1 Over the past decade, several initiatives to improve computer literacy have been introduced in Latin America with varying degrees of success. The incorporation of Information and Communications Technologies (ICTs) in the teaching-learning process is an innovative means of leapfrogging many of the obstacles currently plaguing education systems across the Region and thus of improving learning in a shorter time span than traditional approaches and doing so within traditional budgetary limits.
- 1.2 In general, the focus of ICT initiatives in education has been two-fold, providing both basic technology infrastructure and computer literacy. The specific ICT educational technology supported by this operation – cognitive tutoring – integrates technology with pedagogy to promote system-wide change. Cognitive tutoring follows a self-paced approach, allowing students to sequentially tackle progressively more difficult tasks and freeing up teacher time to work with slower students and on more difficult problems. It is a computer-based, interactive technology that tracks students in real time as they solve problems, provides feedback and hints when errors/questions are made in key points. An innovative feature of this technology thus is that it provides diagnostic data that identify obstacles to learning and possible training interventions to facilitate problem solving. It also can be tied to other multimedia educational materials such as games and simulations.
- 1.3 Cognitive tutoring has shown considerable potential, and some evidence presented to date suggests that it has proved effective in improving mathematics education. Specific math tutors have been used in large school systems (secondary level) in the United States, including Los Angeles and Chicago, as well as in rural schools; more than 300,000 secondary school students have benefited from such interventions. A critical lesson learned from these experiences is that cognitive tutoring requires extensive and constant support from the teaching staff and/or parents, absent which the technology may not produce the desired results within the expected timeframe.
- 1.4 Building from these experiences and incorporating the lessons they present, this operation seeks an important innovation: the application of cognitive tutors, fully supported by training and supervision in schools, at secondary schools throughout Latin America. The method offers considerable potential to improve learning in mathematics at the secondary level, long deemed to be among the weakest areas of the curricula throughout the Region.
- 1.5 The Bank regards these lines of activity as part of its long-standing initiatives aimed at maximizing the return to investments in education technology. It sees its role in these initiatives as one of encouraging awareness of new initiatives, such as incorporating promising technologies into the teaching-learning process, among the Region's ministries of education and of adding value to investments made along these lines.

## **II. PROGRAM DESCRIPTION**

### **A. Program goal and purpose**

- 2.1 The overall goal of this operation is to improve the quality of secondary education in mathematics in the region through the application of technology enhanced learning activities. Its purpose is to provide new mechanisms for improving efficiency in the teaching-learning process in the short-term, producing a more sustained pipeline of students interested in pursuing scientific disciplines at the university level over the medium term and, in the longer term, better placing the region to compete in an ever globalized world.

### **B. Components**

- 2.2 Three main components are envisioned: (i) the introduction of technology enhanced learning opportunities in math; (ii) the creation of local learning communities and a repository of technology enhanced learning materials for mathematics; and (iii) assessment and evaluation. Activities will be implemented in upper secondary schools in five countries (Chile, Ecuador, Mexico, Colombia, El Salvador).

#### **1. Component 1: Introduction of Technology Enhanced Learning (TEL) opportunities in mathematics (US\$435,000)**

- 2.3 This component focuses on technologies designed to enhance how students learn versus technologies that provide basic skills for using computers or accessing the internet. The main line of activity and innovation in this component will be the adaptation and use of cognitive tutoring systems. More specifically, this component will support the development of 30 modules for first year mathematics and parts of the upper secondary cycle. The content of each of these modules will be internationally referenced and normed internally to each country's curriculum. An estimated 1,000 students and 50 teachers per country will be the direct beneficiaries of concrete activities to be carried out including:
- a. Revision of curricula and assessment of teaching strategies used in mathematics in each country (US\$30,000). This revision and assessment will be done by a team of international consultants, all members of the RELATED school-university network which has been operating throughout the Region for more than seven years, working in close collaboration with local teachers and ministry officials. Results from this review and assessment will be compared between countries and benchmarked to international standards of learning in mathematics (e.g., to the Program of International Student Assessment, PISA, administered by the OECD).<sup>1</sup> Module content determined from these activities.

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1 To date, six Latin American countries have participated: Mexico (an OECD member), Argentina, Brazil, Chile, Peru and Uruguay.

- b. Development of cognitive tutoring modules and supporting documentation (US\$230,000). Building on the repository of resources currently held by RELATED, specialized consultant services will be contracted to adjust existing modules or, where relevant, to produce new modules. In some instances this will include translation and metric conversions; in others, it will entail the development of a new module.
- c. Adjustment of cognitive tutoring modules to specific school contexts (US\$45,000). RELATED will work together with local teachers and ministry staff to make necessary adjustments to the cognitive tutor modules, ensuring their relevance and usability at the school level. This may include changes in examples presented or language used.
- d. Specialized teacher and staff training (US\$130,000). RELATED will work with teachers, school administrators and, where relevant, ministry staff to provide specialized training on the use of these modules. This will include training on how best to integrate the modules within existing curricula and related learning activities, self-paced learning pedagogies and methodologies, monitoring and student assessment, and community outreach and support. From the initial group of teachers trained, top performers will be selected and given training in mentoring, thus creating a pipeline of teacher trainers with the capacity to train others if the initiative were to be extended to other schools. Specialized training in technology management and planning also will be provided to school directors. Additional training will be given to technical support staff in schools with responsibilities for maintaining ICT infrastructure.

**2. Component 2: Creation of local learning communities and repository of technology enhanced learning materials for mathematics (US\$10,000)**

- 2.4 This component seeks to increase the capacity of mathematics teachers to use new forms of ICT technology to motivate students to pursue scientifically oriented careers. To do so, it will create local learning communities within and between the schools, thus stimulating the exchange of experiences and best practices. RELATED will work with groups of teachers both within schools and project-wide to share new ways of teaching mathematics and to create deeper understanding on effective approaches, including project-based activities and the use of different technology enhanced “learning objects” – such as multimedia components to demonstrate concepts, games, and simulations - in the classroom. Through these activities, a repository of best practices will be created and used to promote knowledge exchange among teachers. In addition, the learning community setting will be used to collect, maintain and analyze basic project data, and to use to support decision-making at the school and/or ministry level. This activity is expected to directly benefit teachers and students in at least four schools per country (an estimated 4,000 beneficiaries per country).

### 3. Component 3: Assessment and evaluation (US\$30,000)

- 2.5 This component will assess project-induced changes in schools, teacher practices and student performance in mathematics. It will support the creation of an assessment tool for capturing and evaluating change through both qualitative and quantitative measures. In the specific case of student performance, this tool will incorporate a quasi-experimental design. In this way, the data collected through this component will serve to evaluate changes at the school level as well as the overall effect of the project across countries. The assessment tool will be designed by RELATED, which will assume responsibility for working with each school to interpret the data and use them for purposes of decision making. RELATED also will provide specialized training at the school level on the application of the tool, maintain responsibility for evaluating program impact across countries, and document each intervention in a way that allows for eventual replication in other contexts.

## III. COST AND FINANCING

### A. Description and composition of financing

- 3.1 The overall cost of this operation will be US\$740,000, US\$500,000 of which will come from the Korean Partnership Fund for Technology and Innovation (KPK). PUC-Chile will contribute US\$240,000 to this operation. This contribution will include in-kind support to the project.

Table III-1 Project cost US\$

| Description   | IDB                   | PUC                   | TOTAL                 |
|---|-----------------------|-----------------------|-----------------------|
| <b>Component 1. Introduction of TEL opportunities in mathematics</b>              | <b><u>435,000</u></b> | <b><u>180,000</u></b> | <b><u>615,000</u></b> |
| Activity 1. Revision of curricula and assessment of teaching strategies.          | 30,000                | 30,000                | 60,000                |
| Activity 2. Development of cognitive tutoring modules and documentation.          | 230,000               | 30,000                | 265,000               |
| Activity 3. Adjustment of cognitive tutoring modules to specific school contexts. | 45,000                | -                     | 45,000                |
| Activity 4. Specialized teacher and staff training.                               | 130,000               | 120,000               | 250,000               |
| <b>Component 2. Creation of local learning communities for mathematics</b>        | <b><u>10,000</u></b>  | <b><u>60,000</u></b>  | <b><u>70,000</u></b>  |
| <b>Component 3. Assessment and evaluation</b>                                     | <b><u>30,000</u></b>  | <b>-</b>              | <b><u>30,000</u></b>  |
| <b>Contingencies</b>  | <b><u>15,000</u></b>  | <b>-</b>              | <b><u>15,000</u></b>  |
| <b>Audit</b>  | <b><u>10,000</u></b>  | <b>-</b>              | <b><u>10,000</u></b>  |
| <b>TOTAL</b>  | <b><u>500,000</u></b> | <b><u>240,000</u></b> | <b><u>740,000</u></b> |

### B. Sustainability

- 3.2 The sustainability of this project stems from two main sources: (i) the participation of RELATED in the project; and (ii) the participation of the respective ministries of education in the project. RELATED will serve as the organizational mechanism to deploy this project in each of the participating Latin American countries. It represents a partnership of committed universities and individuals who have worked together for more than seven years to improve

educational opportunities for marginal populations. Each university has a long and sustained trajectory of work in the secondary schools in the countries targeted by this operation. It is precisely this type of partnership that allows schools to plan for a smooth transition of students from the secondary level to the tertiary level as well as for universities to supply schools with the requisite profile of trained teachers. In addition, RELATED maintains a close relationship with the ministries of education in the respective countries. This relationship ensures that project activities are not an end but rather are disseminated within the respective ministries and that the lessons they offer are incorporated into ministry processes of decision and policy making (e.g., including processes of curricular reform and the incorporation of technology in the teaching-learning process).

- 3.3 In addition, the software and supporting documentation developed by this operation will be made available to interested parties on the Bank's website and on the websites of RELATED participants.

#### **IV. EXECUTING AGENCY AND MECHANISM**

##### **A. Executing agency**

- 4.1 This operation will be executed by the PUC-Chile, through its Center for Technologies for Education (CIE). PUC-Chile will be responsible for all aspects of project management, including the administration of resources, the contracting of specialized consulting services, the coordination of activities, and reports to the Bank.
- 4.2 PUC-Chile was founded in 1888 and is among the leading and most prestigious universities in Latin America. It is well known by its international research reputation in technologies, social sciences, natural sciences, engineering, health, economics, philosophy and education. PUC-Chile will provide the infrastructure, human resources and networking for the successful execution of the project. PUC-Chile is a member and the coordinator of the RELATED network, which has focused on improving the quality of math education at the secondary level for students in public institutions throughout Latin America for the last decade.<sup>2</sup> Through RELATED, PUC-Chile has proprietary access to cognitive tutoring and a ready network of schools in which to apply this new technology. In addition, PUC-Chile has participated in the ENLACES since its conception, and thus has acquired unique experience in the integration of technology into the learning process and the use of technology to improve learning outcomes.

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2 The RELATED network includes: PUC, *Pontificia Universidad Católica de Chile*; UNAB, *Universidad Autónoma de Bucaramanga*, Colombia; ESPOL, *Escuela Superior Politécnica del Litoral*, Ecuador; ESEN, *Escuela Superior de Economía y Negocios*, El Salvador; ITESM, *Instituto Tecnológico y de Estudios Superiores de Monterrey*, Mexico, and CMU, *Carnegie Mellon University*, USA.

**B. Executing mechanism**

- 4.3 The RELATED network will be instrumental in implementing this operation in the five beneficiary countries (Chile, Ecuador, Mexico, Colombia, and El Salvador). Each of the secondary schools to be served by this Technical Cooperation has established partnerships with their respective RELATED member. These partnerships will allow for the timely implementation of key activities at the country level. In addition, an executive committee formed by key representatives of RELATED will oversee project activities, supporting PUC-Chile with activities related to the planning, coordinating, technical supervision and implementation of activities within each country.

**C. Program implementation readiness**

- 4.4 As noted above, RELATED maintains an ongoing and working relationship with each of the secondary schools to be benefited by this operation. It thus will ensure that each school has the inputs necessary for the implementation of this operation prior to its approval.

**D. Execution period and disbursement schedule**

- 4.5 This operation will be executed in 18 months and disbursed within 24 months.

**E. Procurement**

- 4.6 The execution of procurement and contracting will be carried out in accordance with the *Policies for the Procurement of Goods and Works Financed by the Inter-American Development Bank* (GN-2349-7 and current version) and the *Policies for the Selection and Contracting of Consultants Financed by the Inter-American Development Bank* (GN-2350-7 and current version) and the [Annex III](#).

**V. MONITORING AND EVALUATION**

**A. Monitoring**

- 5.1 Through its close working relationship with beneficiary schools, RELATED will provide continuous monitoring of this operation. In addition, activities in Component 3 will create and apply an assessment instrument to capture and interpret project-induced changes in schools, teacher practices and student performance in mathematics.

**B. Technical and basic responsibility**

- 5.2 Technical responsibilities will be shared between Country Office of Chile (CSC/CCH) and RELATED. CSC/CCH will have operational responsibility for this operation and will provide supervision of all aspects of its execution.

**C. Progress and final reports**

- 5.3 PUC-Chile will be responsible for preparing quarterly progress reports and a final report.

**D. Description of proposed evaluations**

- 5.4 As noted in Component 3, a quasi-experimental design to determine the impact of this operation on student performance will be undertaken. In addition, the impact of the program on other variables collected at the school level (e.g., teacher practices) will be conducted, and results between all participating schools will be compared and contrasted to generate lessons learned and best practices.

**VI. PROGRAM BENEFITS AND RISKS**

**A. Program benefits and developmental impact**

- 6.1 This operation intentionally targets secondary students, in that it is at the secondary level where: (i) students receive full instruction in mathematics, sciences and technology – that is, these subjects are treated as discrete curricular material; (ii) the quality and preparation of teachers of these subjects tend to be inadequate; (iii) the availability and proper use of technology enhanced learning materials are absent; and, (iv) knowledge sharing is not a common practice. Although these issues plague secondary education in general, they often appear more serious in public schools, particularly those located in marginal areas. In addition, this operation offers a short-term response to urgency to improve the teaching of mathematics which, in the longer-term is expected to help generate a pipeline of high-end human resources trained in critical sectors of the economy.

**B. Target beneficiaries**

- 6.2 The target beneficiaries of this operation are secondary students and teachers in public schools in rural and marginal urban areas in five countries (Chile, Ecuador, Mexico, Colombia, El Salvador). It is estimated that at least 5,000 students and about 250 teachers will directly benefit from Component 1 and that there will be approximately 4,000 beneficiaries for Component 2.

**C. Risks**

- 6.2 The expectations of Information and Communications Technologies (ICTs) in education in Latin America and the Caribbean are high. Not all initiatives have produced equally positive results. The principal risk associated with this operation is that it falls short of expectations, with technology frustrating, rather than facilitating, the teaching-learning process. To mitigate this risk, this operation builds on the lessons learned over the course of the last decade and the concrete experience of a network of universities in schools in operation for more than seven years. It starts from the view that ICTs positively impact education when

both the social environment and the technological environment work together to provoke change and, accordingly, proposes activities to change attitudes, beliefs, and infrastructure and, within this change-context, introduces technologies specifically designed to improve learning. In addition, the operation will fully support the introduction of cognitive tutoring in the classroom with teacher training and close in-school supervision by RELATED members.

## **VII. ENVIRONMENTAL AND SOCIAL REVIEW**

- 7.1 The project was reviewed by the Environmental and Social Impact Review (ESR) Committee on January 18, 2008. No negative environmental or social effects were identified and the TC has been classified as a “C” according to the Safeguard Classification Tool. The TC does not involve any investments in infrastructure or equipment.

## **VIII. APPROVAL**

**(ORIGINAL FIRMADO)**

\_\_\_\_\_  
Marcelo Cabrol  
Chief SCL/EDU

**07/30/08**

\_\_\_\_\_  
Date

Concur: **(ORIGINAL FIRMADO)**

\_\_\_\_\_  
Jaime Sujoy  
Representative CSC/CCH

**07/30/08**

\_\_\_\_\_  
Date



## COGNITIVE TUTORING SYSTEMS FOR SECONDARY EDUCATION IN LATIN AMERICA

(RS-T1359)

### RESULTS FRAMEWORK MATRIX OF INDICATORS

|   |  |   |   |   |
|---|--|---|---|---|
| <b>Project objective</b>  | The overall objective of this operation is to improve the quality of secondary education in the Region through the application of technology enhanced learning activities. |   |   |   |
|   | <b>Base</b>  | <b>Year 1</b>   | <b>Year 2</b>   | <b>Target</b>   |
| <b>Introduction of technology enhanced learning opportunities in math</b>                                       |  |   |   |   |
| Outputs   |  | Revision of curricula and assessment of teaching strategies in five countries.<br><br>Development of cognitive tutoring modules.<br><br>Teacher training. |   |   |
| Intermediate outcomes   |  | 15 modules created and applied in schools targeted by project.  | 15 modules created and applied in schools targeted by project.  |   |
| Outcomes  |  |   |   | Learning in math (secondary level) improves in the schools targeted by the project.                 |
| <b>Creation of local learning communities and repository of technology enhanced learning materials for math</b> |  |   |   |   |
| Outputs   |  | Teacher training on project-based approaches to teaching and the use of technology.   | Repository of best practices created through work with teachers.  | Math teachers utilize project-based and technology-based approaches in schools targeted by project. |
| Intermediate outcomes   |  |   |   | Learning in math (secondary level) improves in the schools targeted by project.                     |
| <b>Assessment and evaluation</b>  |  |   |   |   |
| Outputs   |  | Project-induced changes in the teaching and learning of math documented.  |   |   |
| Intermediate  |  | Teachers and principals have data on teaching and learning in math.   | Teachers and administrators use data collected through the project to make decisions (e.g., allocation of resources for teacher training, materials). |   |
| Outcomes  |  |   |   | Learning in math (secondary level) improves in the schools targeted by project.                     |

## COGNITIVE TUTORING SYSTEMS FOR SECONDARY EDUCATION IN LATIN AMERICA

(RS-T1359)

### DETAILED BUDGET

| COMPONENTS   | IDB                   | CIE/PUC/<br>RELATED   | TOTAL                 | %                   |
|--|-----------------------|-----------------------|-----------------------|---------------------|
| <b>1. Introduction of TEL opportunities in mathematics</b>                                     | <b><u>435,000</u></b> | <b><u>180,000</u></b> | <b><u>615,000</u></b> | <b><u>83.1%</u></b> |
| 1.1 Consulting services: Revision of curricula and assessment of teaching strategies.          | 30,000                | -                     | 30,000                |                     |
| 1.2 Local support to revision of curricula and assessment of teaching strategies.              | -                     | 30,000                | 30,000                |                     |
| 1.3 Consulting services: Development of cognitive tutoring modules and documentation.          | 230,000               | -                     | 230,000               |                     |
| 1.4 Local support to development of cognitive tutoring modules and documentation.              | -                     | 30,000                | 30,000                |                     |
| 1.5 Consulting services: Adjustment of cognitive tutoring modules to specific school contexts. | 45,000                | -                     | 45,000                |                     |
| 1.6 Consulting services: Specialized teacher and staff training.                               | 130,000               | -                     | 130,000               |                     |
| 1.7 Local support to specialize teacher and staff training.                                    | -                     | 120,000               | 120,000               |                     |
| <b>2. Creation of local learning communities for mathematics</b>                               | <b><u>10,000</u></b>  | <b><u>60,000</u></b>  | <b><u>70,000</u></b>  | <b><u>9.5%</u></b>  |
| 2.1 Consulting services: Teacher support in and between schools.                               | 10,000                | -                     | 10,000                |                     |
| 2.2 Local support to teachers in and between schools.  | -                     | 60,000                | 60,000                |                     |
| <b>3. Assessment and evaluation</b>  | <b><u>30,000</u></b>  | <b>-</b>              | <b><u>30,000</u></b>  | <b><u>4.1%</u></b>  |
| 3.1 Consulting services: Development and implementation of assessment tool.                    | 30,000                | -                     | 30,000                |                     |
| <b>4. Contingencies</b>  | <b><u>15,000</u></b>  | <b>-</b>              | <b><u>15,000</u></b>  | <b><u>2.0%</u></b>  |
| <b>5. Audit</b>  | <b><u>10,000</u></b>  | <b>-</b>              | <b><u>10,000</u></b>  | <b><u>1.3%</u></b>  |
| <b>Total</b>   | <b><u>500,000</u></b> | <b><u>240,000</u></b> | <b><u>740,000</u></b> | <b><u>100%</u></b>  |

Inter-American Development Bank  
Project Procurement Division (DEV/PRM)

**PROJECT PROCUREMENT PLAN**

**Model A - for specific projects**

**General information**

**Country:** Regional

**Executing agency:** *Pontificia Universidad Católica de Chile*

**Project name:** Cognitive Tutoring Systems for Secondary Education in Latin America

**Project and loan contract numbers:** RS-T1359

**Brief description of the project's objectives and components:** The overall goal of this operation is to improve the quality of secondary education in mathematics in the region through the application of technology enhanced learning activities. Three main components are envisioned: (i) the introduction of technology enhanced learning opportunities in math; (ii) the creation of local learning communities and a repository of technology enhanced learning materials for mathematics; and (iii) assessment and evaluation. Activities will be implemented in upper secondary schools in five countries (Chile, Ecuador, Mexico, Colombia, El Salvador).

**Estimated date of project approval:** June 2008

**Estimated date of signature of the technical assistance:** July 31, 2008

**Estimated date of the final disbursement:** November 2009

**A. Introduction**

Procurements for the proposed project will be carried out in accordance with the *Policies for the Procurement of Works and Goods Financed by the Inter-American Development Bank* (GN-2349-7), of January 2005; and the *Policies for the Selection and Contracting of Consultants Financed by the Inter-American Development Bank* (GN-2350-7), of January 2005, and with the provisions established in the loan contract and this procurement plan.

**B. Procurement plan**

The procurement plan for *Technology Enhanced Learning by Means of Cognitive Tutoring Systems for Secondary Education in Latin America* which covers the project in its entirety has been agreed between the Bank and the *Pontificia Universidad Católica de Chile*. The plan, which is summarized in Appendix 1, indicates the procedure to be used for the procurement of goods, the contracting of works or services, and the method of selecting consultants, for each contract or group of contracts. It also indicates the estimated cost of each contract or group of contracts; the requirement for prior or post review by the Bank; and estimated dates for the publication of specific procurement notices and completion of the contracts included in this project. The procurement plan will be updated annually or whenever necessary or as required by the Bank.

Inter-American Development Bank  
Project Procurement Division (DEV/PRM)

The procurement plan is available from the *Pontificia Universidad Católica de Chile*. It is also available on the Bank's website: [Project procurement information](#).

**C. Project procurement**

The following is a general description of the procurement planned for the proposed project.

**Works procurement:** The works to be contracted include the following: **N/A**

**Goods procurement:** The goods to be procured for this project include the following: **N/A**

**Procurement of non-consulting services:** **N/A**

**Procurement of consulting services:** Consulting services for the project include:

1. Sole-sourcing of the Center of Technologies for Education at the *Pontificia Universidad Católica*, Chile to carry out all project activities

**Operating expenses:** **N/A**

**Others:** **N/A**

**Advance contracting and retroactive financing:** **N/A**

**D. Bank review of procurement decisions**

All contracts will be subject to prior review by the Bank in accordance with Appendix 1 of the policies for the procurement of works and goods and the selection of consultants, respectively.

**E. Domestic preference**

Bids offering goods originating in the borrower's country will receive a 15% price preference in contracts requiring international competitive bidding, as established in Appendix 2 of the procurement policies. **N/A**

## Appendix 1

### Procurement Plan<sup>1</sup>

**Country:** Regional

**Executing agency:** *Pontificia Universidad Católica de Chile*

**Project name:** Cognitive Tutoring Systems for Secondary Education in Latin America

**Project and loan contract numbers:** RS-T1359

**Brief description of the project's objectives and components:** The overall goal of this operation is to improve the quality of secondary education in mathematics in the region through the application of technology enhanced learning activities. Three main components are envisioned: (i) the introduction of technology enhanced learning opportunities in math; (ii) the creation of local learning communities and a repository of technology enhanced learning materials for mathematics; and (iii) assessment and evaluation. Activities will be implemented in upper secondary schools in 5 countries (Chile, Ecuador, Mexico, Colombia, El Salvador).

**Estimated date of project approval by the Board of Executive Directors:** June 2008

**Estimated date of signature of the technical assistance:** July 31, 2008

**Estimated date of the final disbursement:** November 2009

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<sup>1</sup> All project contracts should be included, even if not financed by the Bank, indicating the source of funding in each case.

**Project: Cognitive Tutoring Systems for Secondary Education in Latin America**

**Project number: RS-T1359**

**Period included in this Procurement Plan: From: 07/08 until 11/09**

| Ref. No. <sup>2</sup> | Description and type of the procurement contract  | Estimated Contract Cost (US\$) | Procurement method <sup>3</sup> | Review (ex-ante or ex-post) | Source of financing and percentage |                | Pre-qualification <sup>4</sup><br><br>(Yes/No) | Estimated dates                            |                        | Status <sup>5</sup><br>(pending, in process, awarded, cancelled) | Comments |
|-----------------------|---|--------------------------------|---------------------------------|-----------------------------|------------------------------------|----------------|--|--|------------------------|--|----------|
|                       |   |                                |                                 |                             | IDB %                              | Local/ Other % |  | Publication of specific procurement notice | Completion of contract |  |          |
|                       | <b>1. <u>Consulting services</u></b><br><br>Center of Technologies for Education, <i>Pontificia Universidad Católica de Chile</i> | 500,000                        | SSS                             | Ex-ante                     | 100%                               |                | No   | July-08                                    | November - 09          |  |          |

<sup>2</sup> If a number of similar individual contracts were to be executed in different places or at different times, these can be grouped together under a single heading, with an explanation in the comments column indicating the average individual contract amount and the period during which they would be executed. For example, an education project that includes school construction might include an item "school construction" for a total of US\$20 million, and an explanation in the comments column such as: "This encompasses some 200 contracts for school construction averaging US\$100,000 each, to be awarded individually by participating municipal governments over a three-year period between January 2006 and December 2008."

<sup>3</sup> **Goods and Works:** **ICB:** International competitive bidding; **LIB:** limited international bidding; **NCB:** national competitive bidding; **PC:** price comparison; **DC:** direct contracting; **FA:** force account; **PSA:** Procurement through Specialized Agencies; **PA:** Procurement Agents; **IA:** Inspection Agents; **PLFI:** Procurement in Loans to Financial Intermediaries; **BOO/BOT/BOOT:** Build, Own, Operate/Build, Operate, Transfer/Build, Own, Operate, Transfer; **PBP:** Performance-Based Procurement; **PLGB:** Procurement under Loans Guaranteed by the Bank; **PCP:** Community participation procurement. **Consulting Firms:** **QCBS:** Quality- and Cost-Based Selection **QBS:** Quality-Based Selection **FBS:** Selection under a Fixed Budget; **LCS:** Least-Cost Selection; **CQS:** Selection based on the Consultants' Qualifications; **SSS:** Single-Source Selection. **Individual Consultants:** **NICQ:** National Individual Consultant selection based on Qualifications; **IICC:** International Individual Consultant selection based on Qualifications

<sup>4</sup> In the case of new Policies it applies only for Goods and Works. In the case Old Procurement Policies it applies for Goods, Works and Consulting Services.

<sup>5</sup> This column "Status" should be used for retroactive procurement and for procurement plan updates.

Inter-American Development Bank  
Project Procurement Division (DEV/PRM)

## **Appendix 2**

### **Capacity of the executing agency and supervision of procurement**

#### **Assessment of the executing agency's capacity to administer procurement**

PUC-Chile was founded in 1888 and is among the leading and most prestigious universities in Latin America. It is well known by its international research reputation in technologies, social sciences, natural sciences, engineering, health, economics, philosophy and education. The Center of Technologies for Education (CIE, joint program between PUC-Chile schools of engineering and education) will provide the infrastructure, human resources and networking for the successful execution of the project.

#### **Frequency of procurement supervision**

Ex-ante.

## **TERMS OF REFERENCE**

### **COGNITIVE TUTORING SYSTEMS FOR SECONDARY EDUCATION IN LATIN AMERICA**

**(RS-T1359)**

#### **I. BACKGROUND**

- 1.1 Over the past decade, several initiatives to improve computer literacy have been introduced in Latin America with varying degrees of success. The incorporation of Information and Communications Technologies (ICTs) in the teaching-learning process is an innovative means of leapfrogging many of the obstacles currently plaguing education systems across the Region and thus of improving learning in a shorter time span than traditional approaches and doing so within traditional budgetary limits.
- 1.2 In general, the focus of ICT initiatives in education has been two-fold, providing both basic technology infrastructure and computer literacy. The specific ICT educational technology supported by this operation – cognitive tutoring - integrates technology with pedagogy to promote system-wide change. Cognitive tutoring follows a self-paced approach, allowing students to sequentially tackle progressively more difficult tasks and freeing up teacher time to work with slower students and on more difficult problems. It is a computer-based, interactive technology that tracks students in real time as they solve problems, provides feedback and hints when errors/questions are made in key points. An innovative feature of this technology thus is that it provides diagnostic data that identify obstacles to learning and possible training interventions to facilitate problem solving. It also can be tied to other multimedia educational materials such as games and simulations.
- 1.3 Cognitive tutoring has shown considerable potential, and some evidence presented to date suggests that it has proved effective in improving mathematics education. Specific math tutors have been used in large school systems (secondary level) in the United States, including Los Angeles and Chicago, as well as in rural schools; more than 300,000 secondary school students have benefited from such interventions. A critical lesson learned from these experiences is that cognitive tutoring requires extensive and constant support from the teaching staff and/or parents, absent which the technology may not produce the desired results within the expected timeframe.
- 1.4 Building from these experiences and incorporating the lessons they present, this operation seeks an important innovation: the application of cognitive tutors, fully supported by training and supervision in schools, at secondary schools throughout Latin America. The method offers considerable potential to improve learning in mathematics at the secondary level, long deemed to be among the weakest areas of the curricula throughout the Region.



- 1.5 The Bank regards these lines of activity as part of its long-standing initiatives aimed at maximizing the return to investments in education technology. It sees its role in these initiatives as one of encouraging awareness of new initiatives, such as incorporating promising technologies into the teaching-learning process, among the Region's ministries of education and of adding value to investments made along these lines.

## II. CONSULTANCY OBJECTIVE

- 2.1 The objective of this consultancy is to develop and implement cognitive tutoring modules and supporting activities for mathematics in upper secondary schools in five countries: Chile, Ecuador, Mexico, Colombia and El Salvador.

## III. CHARACTERISTICS OF THE CONSULTANCY

- 3.1 **Type of consultancy:** International firm (university).
- 3.2 **Duration:** Work is expected to be 300 non-consecutive days within a period of 24 months.
- 3.3 **Place of work:** Chile, Ecuador, Mexico, Colombia and El Salvador.
- 3.4 **Qualifications:** Leading international firm/university with unique experience in the design and application of cognitive tutoring.

## IV. ACTIVITIES

### A. Introduction of Technology Enhanced Learning Opportunities in Math

- 4.1 This activity focuses on technologies designed to enhance how students learn versus technologies that provide basic skills for using computers or accessing the internet. The main line of activity and innovation in this component will be the adaptation and use of cognitive tutoring systems. More specifically, this activity will include the development of 30 modules for first year mathematics and parts of the upper secondary cycle. The content of each of these modules will be internationally referenced and normed internally to each country's curriculum. Sub-activities to be carried out include the following:
- a. Revision of curricula and assessment of teaching strategies used in mathematics in each country. Results from this review and assessment will be compared between countries and benchmarked to international standards of learning in mathematics (e.g., to the Program of International Student Assessment, PISA, administered by the OECD).<sup>1</sup> Module content determined from these activities.

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1 To date, six Latin American countries have participated: Mexico (an OECD member), Argentina, Brazil, Chile, Peru and Uruguay.

- b. Development of cognitive tutoring modules and supporting documentation.
- c. Adjustment of cognitive tutoring modules to specific school contexts.
- d. Specialized teacher and staff training. This will include training on how best to integrate the modules within existing curricula and related learning activities, self-paced learning pedagogies and methodologies, monitoring and student assessment, and community outreach and support. From the initial group of teachers trained, top performers will be selected and given training in mentoring, thus creating a pipeline of teacher trainers with the capacity to train others if the initiative were to be extended to other schools. Specialized training in technology management and planning also will be provided to school directors. Additional training will be given to technical support staff in schools with responsibilities for maintaining ICT infrastructure.

**B. Creation of local learning communities and repository of technology enhanced learning materials for mathematics**

- 4.2 This activity seeks to increase the capacity of mathematics teachers to use new forms of ICT technology to motivate students to pursue scientifically oriented careers. To do so, it will create local learning communities within and between the schools, thus stimulating the exchange of experiences and best practices. Teachers will be brought together to share new ways of teaching mathematics, including project-based activities and the use of different technology enhanced “learning objects” –such as multimedia components to demonstrate concepts, games, and simulations- in the classroom. Through these activities, a repository of best practices will be created and used to promote knowledge exchange among teachers. In addition, the learning community setting will be used to collect, maintain and analyze basic project data, and to use to support decision-making at the school and/or ministry level.

**C. Assessment and evaluation**

- 4.3 This activity will assess project-induced changes in schools, teacher practices and student performance in mathematics. It will support the creation and implementation of an assessment tool for capturing and evaluating change through both qualitative and quantitative measures. In the specific case of student performance, this tool will incorporate a quasi-experimental design. Key staff in each school will be trained on how to interpret the data collected and how to use them for purposes of decision making.

**D. Audit**

- 4.4 Following Bank procedures, contract an external audit of all funds related to these terms of reference. The main focus of this audit will be on the financial management of project resources. This includes the verification of resources received from various sources (Bank funds, local counterpart, and other

financing); the use of these resources, in accordance with the chart of accounts approved by the Bank for project execution; compliance with financial contractual clauses; and internal control procedures.

## **V. REPORTS**

- 5.1 A work plan should be presented one week after signing the contract. The work plan will include a schedule for completing the research plan.
- 5.2 Submission of a draft progress report.
- 5.3 Submission of a final progress report that addresses the points enumerated under activities above.

## **VI. COORDINATION**

- 6.1 The consulting firm will coordinate its work with the Bank's office in Chile.