

USAID Unsolicited Concept Paper

A. Institutional

1. Offerer's name and address and type of organization; e.g., profit, nonprofit, educational, small business

Name: The University Corporation, California State University, Northridge

Address:

Prof. Carol Shubin
California State University, Northridge (CSUN)
18111 Nordhoff Street, Northridge, CA 91330
Phone: 818-677-1200

Type of organization: 501C3 / Higher Education

2. Names and telephone numbers of technical and business personnel to be contacted for evaluation or negotiation purposes

Mr. Scott Perez
Director, Office of Research and Sponsored Projects
California State University Northridge
818-677-2901

3. Identification of proprietary data to be used only for evaluation purposes

We will be tracking student progress, so we will include student records in our evaluation process. These records are confidential. We will also use surveys and collect comments and evaluation of teaching personnel and tutors.

4. Names of other Federal, State, local agencies, or parties receiving the proposal or funding the proposed effort

California State University Northridge has put \$50,000 into the development of this online homework, assessment, and tutoring service for Calculus students.

5. Date of submission: March 31, 2011

6. Signature of a person authorized to represent and contractually obligate the offeror.

See letter of support from the Provost and Vice President of Academic Affairs.

B. Technical Proposal

1. Title: Building Mathematical Capacity in Rwandan Higher Education Institutions Using Online Homework, Assessment, and Tutoring

2. Abstract: California State University, Northridge (CSUN) requests funding from USAID Rwanda to work with the Kigali Institute of Science and Technology (KIST) and Tumba College of Technology (TCT) faculty, staff, and students to share effective, free, easy to modify, online tools for mathematics instruction. As we have seen at our own university, the online learning environment, which connects to a national library of mathematics problems, can be scaled up to other courses, other higher educational institutions, teacher training programs, vocational training schools, and secondary education schools.

Freshmen students at the Kigali Institute of Science and Technology and TCT enter college with fair arithmetic and algebraic math skills. However, their secondary school training does not prepare them well to conceptualize or solve problems, especially those that require strong graphical skills. Moreover, their computer skills are weak. Most are English learners. Also, students at KIST are typically instructed in cohort structures. When students fail, they must repeat the entire year, which is not only devastating to the student, but also very expensive. If students had access to support services similar to the academic and tutorial services that are common in US institutions, students could be expected to do much better in math.

CSUN is proposing to partner with KIST and TCT to offer these kinds of services, using a mix of online and personal interaction. The proposed effort will lead to the creation of an online homework, assessment, and tutorial environment for mathematics at Rwandan institutions.

3. Organization's capability statement: With an enrollment exceeding 33,000 students, California State University Northridge (CSUN) is among the largest single campus universities in the United States. Nearly half the undergraduate students in Mathematics (43%) are from underrepresented minority groups. Most come from economically disadvantaged backgrounds, and are first in their families to attend college. As lead institution, CSUN offers an experienced faculty, both in the instruction of mathematics, especially for underrepresented minorities, and in the operations and management of externally funded programs. The project will use resources of the CSUN server, which comprises eight CPU and eight GBs of memory. Two Moodle servers have been installed, and the wvassignment module is also installed.

The project will use existing computer facilities at both KIST and TCT. State-of-the-art computer laboratories have been established at KIST, including eight labs, equipped with 300 computers and sufficient bandwidth for planned efforts. KIST management is ready to reserve up to 20 computers for conducting the pilot project on Online Math Tutoring (see the KIST Letter of Support). Tumba College of Technology (TCT), located in Byumba in North Province, offers three courses leading to a national diploma (A1): Alternative Energy (AE), Electronics and Telecommunication (ET), and Information Technology (IT). It has 150 Dell computers to be used in the project, but their internet bandwidth is very low (54Mbps).

Names of key personnel who would be involved: From the US: (1) Dr. Carol Shubin (CSUN

Lead); (2) Dr. Jacek Polewczak. From Rwanda: (1) Dr. Irina Zlotnikova (Country Coordinator); (2) Dr. Rene-Michel Shumbusho (Math Coordinator, KIST); (3) Mr. Michael Gahirima (Tutor); Gatabazi Pascal Thomas (principal, TCT) Principal (4) Mr. J.M.V. Niyitegeka (Tutor, TCT); (5) Mr. Jean Paul Murara (Tutor) (6) Mr. Denis Ndanguza (Tutor); (7) Dr. A.N. Wali (Head, Department of Applied Mathematics, KIST).

Dr. Shubin worked with Dr. Zlotnikova during 2007, when she served as a US Fulbright Scholar at the Kigali Institute of Science and Technology. They worked together again when Dr. Shubin returned to Rwanda during 2008-2009 as an African Mathematics Millennium Science Initiative Fellow. Drs. Polewczak and Shubin have worked together on developing online homework, assessment, and tutoring tools for California State University Northridge. Dr. Shubin worked with M. Gahirima, J.M.V. Niyitegeka, J.P Murara, and D. Ndanuza in her previous visits.

4. Objectives. The overarching goal of the activity is to support Mathematics education in Rwanda through online tutoring. There are hundreds of web sites that offer lecture material or other resources, but most have serious deficiencies – they do not use trained mathematicians to create the materials, tutors provide misleading information and incorrect solutions, and most offer no meaningful assessment. Using evidence-based practices, this project is expected to increase the passing rates in mathematics courses for participating students, improve scientific reading and writing of English, and define best practices for instructional staff (including tutorial assistants) of Calculus I.

The model proposed here mirrors a successful intervention at CSUN where, from a pilot of 230 students, we were able to scale up to more than 3,000 students. The scalability derives from the train-the-trainer approach; at CSUN, we increased from just 5 trained student tutors to 27 tutors in one semester. This methodology also supports sustainability beyond project funding. In carrying out the proposed work, we expect to overcome a problem in the use of resources – while the Rwandan institutions do have computers, they routinely underutilize them in instruction. An important aspect of the project is the commitment by the Vice Rector of Academics at KIST. When fully operational, literally thousands of students will be able to learn math and utilize this resource annually. Both KIST and TCT, and other interested educational institutions in Rwanda, will be closer to achieving President Kagami’s Vision 2020 of becoming the IT capital of Africa.

5. Location of activities: KIST and TCT in Rwanda; CSUN in Northridge, California

6. Implementation methodology: KIST students majoring in Applied Math and Applied Physics are taught Calculus while other majors are taught Math for Life Science. Exam results show a pass rate for those two courses at 75% and lower. Some of the contributing factors are the limited numbers of qualified teaching staff, frequent staff changes, inconsistent implementation of course material, lack of textbooks, and untrained student assistants who might be able to tutor undergraduates. Fortunately, KIST has fairly new computer labs; although they are currently underutilized for mathematics. All have internet capability, though limited in some cases.

California State University, Northridge (CSUN), has created an e-learning system that contains a number of courses, including Calculus. Students and teachers in Rwandan institutions will be given access to the Calculus course materials, adjusted to the local conditions and curricula. To

provide the first-year students with the pedagogical support, two groups of tutors will be involved. A first group of tutors will include members of the academic staff of KIST and TCT. The second group will include third- and fourth year students identified among those who showed the best results in Math (students-mentors). They will be given small incentives for mentoring. Both groups of tutors will undergo training. During the pilot phase, 20 students at KIST and 10 students at TCT will be trained, with participation widening to target more than 550 students enrolled at the two campuses.

The project will use resources at CSUN including a server and course materials housed on our Learning Management System Moodle integrated with WeBWorK, an open-source online homework system for math and science courses. WeBWorK is supported by the Mathematical Association of America and the National Science Foundation and comes with a National Problem Library (NPL) of over 20,000 homework problems. Supported courses include college algebra, discrete mathematics, probability and statistics, single and multivariable calculus, differential equations, linear algebra and complex analysis.

6. Anticipated measurable results: We expect to see higher pass rates for students, improved skills of tutors, and greater numbers of teachers and tutors prepared to utilize the online resources in teaching mathematics. Each of the factors contributing to the poor educational outcomes for these students is addressed by the proposed scope of work. The great variability in teacher competence is overcome by the access students will have to materials developed to set standards and criteria. The use of English-only materials in combination with computer technology, which allows students to make multiple attempts on problems, is expected to increase both math and English language comprehension. The use of computer technology will also maximize resources already in place at the Rwandan institutions. Furthermore, by improving students' math skills, especially Calculus, which is a gateway course to other science and technology disciplines, the proposed project offers important opportunities to KIST and TCT to increase the numbers of students who pursue careers in these fields.

7. Evaluation: A key component of the action plan is the formative and summative evaluation effort. Project implementation requires faculty to continuously monitor and track program utilization, student success with the module elements, faculty satisfaction with the support, and student progress. Using a comparison group model, we will also compare the performance of student cohorts who use the new academic resource to the performance of groups who currently have no such support. An evaluation specialist will be hired to support project evaluation.

8. Sustainability plans

The Online Math tutoring system will have been created and working. First, a pilot project will be conducted involving three tutors and 20 students in Applied Math and Applied Physics. Once the exam results show the higher average mark and pass rate in an experimental group, the tutoring will be extended to other students at KIST and TCT, including others majors, and to other Rwandan tertiary and higher education institutions.

9. Duration: Two years

10. How the work will support accomplishment of USAID's mission: Currently, USAID

Rwanda priorities include Public Health, Rural Development and Primary Education. The proposed pilot project will be one step in the direction of increasing access to curriculum-based teaching and learning materials in the preparation of Rwandans for career entry in health and education fields, and for advanced studies in the sciences that support achievement of these priorities. Mathematics is a “gatekeeper” for many of these fields. Project resources, lessons learned, and instructional practices can be extended to all students in KIST and TCT then to other Rwandan institutions (Kigali Institute of Education, National University of Rwanda etc.). The content also supports teaching Math in secondary education and teacher training colleges.

11. How the program supports USAID's country development strategies: The goal of the work is to improve the human and institutional capacity of Rwandan tertiary and higher education institutions in teaching Mathematics, thus contributing to the Science, Technology, Engineering, and Mathematics (STEM) development in the country. It was written in Rwanda Vision 2020: "Rwanda lags behind in professional training, with the most acute deficiency being apparent in the fields of applied and natural sciences and ICT." In spite of a number of policies adopted by the Rwandan government, the development of STEM in Rwanda is still meager, and students experience numerous challenges studying Mathematics. The partnership with CSUN will strengthen Mathematical capacity in Rwandan higher education institutions.

12. To what extent host country collaborators have participated in the design process: Dr. Shubin and Dr. Zlotnikova have developed this proposal together during several months of consultation with faculty and staff at CSUN, KIST, and TCT. Staff will continue this collaborative effort throughout the months of planning and implementation. The plan includes a visit by CSUN experts to Rwanda with the goal of needs assessment and establishing the online tutoring centers; a visit by the Rwandan tutors to CSUN to undergo training on using the CSUN e-learning system and innovative pedagogy; collaboration on data collection and evaluation of student and teacher learning outcomes, and broader impact of the program.

C. Financial Proposal

Type of support requested: (1) Personnel costs for training; (2) Technical support and DSL service and modems; (3) Travel. No extra software is required; resources are platform independent and can be accessed using any browser (Firefox, Internet Explorer, Opera, Chrome, Safari, and others). When the program expands to other educational levels, this will be important. For example, the project can be adapted for primary schools; materials will even work with the One Laptop Per Child computers. Total request: \$159,000.

Personnel cost for training and program evaluation: US Team (2 faculty, evaluator/2 years): \$30,000; Rwandan team (5 KIST/1 TCT x 2 years): \$30,000; Rwandan Tutors (4x2 years): \$8,000; Student stipends: \$5,000. With fringe benefits, and administrative costs, Personnel Total Estimate = \$87,000

Technical Support: DSL service and modems \$10,000; Tech support (2 x 2 years): \$12,000
Technical Support Total = \$22,000

Travel: 2 trips for US team (3 people) to Rwanda: \$24,000; 1 trip for Rwandan team (4 people) to US: \$16,000. Travel Total = \$40,000

Match: The CSUN Provost/Vice President of Academic Affairs is contributing a cash contribution of \$50,000; the CSUN server and CSUN student tutors are also being contributed.