

**California State University  
Online Math Tutoring Support Center:  
Homework, Assessment and Tutoring to Support Students  
Project Proposal May 2011**

## **Summary**

California State University, Northridge (CSUN) requests funding from the CSU for development, operation and maintenance of effective, free, easy to modify, online tools and pedagogy 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, and K-12 schools.

## **Fall 2010-Spring 2011: CSUN Online Math Tutoring Center**

In response to high failure rates in mathematics, the CSUN Math Department initiated an Online Math Tutoring Center in Fall 2010. The Center provides a virtual space where students can receive step-by-step assistance with homework, learn strategies for solving problems, and collaborate with other students. The Tutoring Center seeks to accommodate all learning styles to make mathematics accessible to our diverse student body. Math Tutors are STEM majors who are trained and carefully supervised daily by faculty throughout the semester. To accommodate non-traditional student schedules, the Online Tutoring Center is open in the evening and on weekends.

## **Benefits**

The Fall 2010 pilot project showed that online tutoring improves not only mathematics skills but writing skills as well. This is believed to be the case because the primary mode of communication is conducted through written forums and chats. The improvement was demonstrated in the evolution of student-tutor, question-response in six sections of M150A Calculus I with total enrollment of 230 students. Five tutors were supervised by three faculty members in the Math Department. An improvement was verified in the fluency with which students used mathematical vocabulary, articulated their questions, and demonstrated an understanding of mathematical concepts.

In Spring 2011, the Math Tutoring Center is open to more than three thousand CSUN students enrolled in Calculus, Business Calculus, College Algebra, some statistics courses, and Developmental Mathematics. The Tutoring Center is part of the campus effort to decrease time to graduation by increasing passage rates in CSUN's highest D-U-F mathematics courses.

The math tutoring center is easily scalable and serves as a model for the CSU. It can be used an outreach tool to improve student performance in middle and high school mathematics.

## **Future Plans: Online Math Tutoring Support Center and Early Assessment Program (EAP)**

Students who test below the prescribed cutoff scores on the Entry Level Mathematics Exam (ELM) are required to enroll in appropriate remedial classes or programs before enrolling in CSU as freshmen. Expanding the Online Math Tutoring Support Center to serve the CSU will help freshmen who are weak in arithmetic and algebraic math skills. A CSU Online Math Tutoring Support Center would offer a repository for learning objects that faculty believe provide the best in on-line materials, self assessment tools and tutorials. Leveraging the shared strength of the CSU in a coordinated effort would allow individual faculty to spend time teaching students rather than continually gathering curriculum materials that can more easily be shared via the Online Math Tutor Support Center. The CSU could benefit from economies of scale if this project was expanded system-wide.

Instruction must contain 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 useable anywhere within the CSU that can be easily tailored to individual campus needs. All resources will

be available on the browser level. No extra software is required; resources are platform independent. Firefox, Safari, and others are all acceptable. When the program expands to other educational levels, this will be important. The resource can tie into the existing CSU Math Success site.

### **Online Math Tutoring Support Center and the Next Generation Learning Challenges**

The Online Math Tutoring Support Center has great potential to improve course completion, and college completion through a broad-scale technology-enabled center system-wide.

#### **Potential benefits of expanding the Online Math Tutoring Support Center:**

- Scaling of a blended learning model that improves learning outcomes and keeps cost down.
- Creation of a repository of learning objects and activities to improve student success.
- Providing deeper learning and engagement through the use of richly interactive technologies to improve student learning outcomes.
- Supporting the development and adoption of high-quality, modular, openly licensed core courseware.

#### **CSU Wide Implementation Project Goals**

- Support Mathematics education through shared online instructional materials and tutoring.
- Identify activities, resources, and tutor training models, which have been evaluated by trained mathematicians. There are hundreds of web sites that offer lecture materials or other resources, but most have serious deficiencies. Often sites provide misleading and incorrect solutions.
- Use evidence-based practices for teaching mathematics.
- Collect stories from students, tutors, and faculty about usage of the site.
- Increase the passing rates in mathematics courses for participating students.
- Improve student skills in scientific reading and writing of English.
- Define best practices for a broad-scale technology-enabled center system-wide.
- Provide students with a pool of faculty approved math problems organized to support their learning objectives.
- Provide a platform to share pedagogically innovative and student engaging instructional resources, which can be beneficial to education and teacher training programs.
- Define Universal Design best practices for teaching mathematics to all learners, with and without disabilities. This will be achieved by collaborating across and within campuses with STEM related faculty as well as the Universal Design Center, Center on Disabilities, Nation Center on Deafness, Communication Disorders, Human Factors, and various faculty and staff across the CSU.
- Identify barriers to access presented by the software applications used and define reasonable alternative methods of access as appropriate.
- Communicate compliance barriers to the Open Source community and/or application vendors regarding accessibility, interoperability, and usability of the products in use in this project.
- Provide a continuous improvement model for deployment of services and support to students with disabilities.
- Improve skills of tutors, and increase the number of teachers and tutors prepared to utilize the online resources in teaching mathematics.

The expanded proposal mirrors a successful intervention at CSUN. The pilot, initiated by three CSUN math faculty members Alex Alekseenko, Jacek Polewczak, and Carol Shubin, started with 230 Calculus I students. Funding for the project came from CSUN Provost Hellenbrand, Dean Stinner, ATI Director Susan Cullen, and Math Department Chair Werner Horn, scaled up to more than 3,000 students. Additional funding came from Developmental Math Director, Kate Stevenson. The scalability derives from the train-the-trainer approach; at CSUN, we increased from just five

trained student tutors to 27 tutors in one semester. This methodology also supports sustainability beyond project funding. The process for implementing the curriculum enables easy customization which is essential for scaling across the CSU.

## System Integration

The original project will use the free Content Management System (CMS), Drupal and the free Learning Management System (LMS), Moodle. Other CMS and/or LMS that support  $\text{\LaTeX}$  ASCII-Math, and MathML will suffice. However, one advantage of using Moodle is that WeBWorK, an open-source online homework system for math and science courses, is well integrated within Moodle.

WeBWorK is developed and supported by the Mathematical Association of America and the National Science Foundation and comes with the National Problem Library (NPL) of over 20,000 homework problems including high school mathematics, college algebra, discrete mathematics, probability and statistics, single and multivariable calculus, differential equations, linear algebra and complex analysis. The problem sets are of high quality and are used by 240 colleges and universities in the US. The online resource has similar features as ALEKS, but are free to use and easy to modify by the faculty at each campus on the CSU. Drupal will serve as a gateway and front webpage for Moodle, WeBWorK, and other online tools.

## Assessment Plan

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. A detailed evaluation process needs to be hammered out. We will try to measure the site's effectiveness. 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.

### Budget for 2011 -2012

Jacek Polewczak

#### Cost

Convert to 12-month faculty position (\$14,369)

\$30,000 additional salary

Release time: 9 units each semester at replacement cost of \$30,000

Total – \$74,369

Carol Shubin

Convert to 12-month faculty position (\$13,644)

\$10,000 additional salary

Release time: 6 units each semester at replacement cost of \$20,000

Total – \$43,644

Faculty Consultants

\$20,000

4 Tutors, 20 hours per week,  
at \$12 per hour for 30 weeks

\$28,000

Travel

\$12,000

Year 1 Total

\$178,813

### Budget for 2012 -2013

Jacek Polewczak

#### Cost

Convert to 12-month faculty position (\$15,000)

Release time: 6 units each semester at replacement cost of \$20,000

Carol Shubin	Convert to 12-month faculty position (\$14,200) \$10,000 additional salary Release time: 6 units each semester at replacement cost of \$20,000
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Faculty Consultants	\$25,000
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4 Tutors, 20 hours per week, at \$12 per hour for 30 weeks	\$29,500
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Travel	\$12,000
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Year 2 Total	\$145,700
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### **Budget for 2013 -2014**

Jacek Polewczak	<b>Cost</b>
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Convert to 12-month faculty position (\$15,500) Release time: 6 units each semester at replacement cost of \$20,000
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Carol Shubin	Convert to 12-month faculty position (\$14,500) \$10,000 additional salary Release time: 6 units each semester at replacement cost of \$20,000
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Convert to 12-month faculty position (\$14,500) \$10,000 additional salary Release time: 6 units each semester at replacement cost of \$20,000
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Faculty Consultants	\$25,000
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4 Tutors, 20 hours per week, at \$12 per hour for 30 weeks	\$30,000
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Travel	\$12,000
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Year 3 Total	\$147,500
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### **Budget Totals**

2011-12	\$178,813
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2012-13	\$145,700
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2013-14	\$147,500
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<b>3 Year Total</b>	<b>\$472,013</b>
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### **Budget Justification:**

Both Jacek Polewczak and Carol Shubin request that their 9-month faculty positions are converted to 12-month Online Math Support Center co-director positions.

#### **First year budget justification for Jacek Polewczak**

*Tasks related to creation and setup of online pilot services:*

- (1) setting up of a new server (with hostname math.csun.edu); this includes installation of basic libraries/packages for the operating system;
- (2) installation of the needed tools (*Apache, Perl, Python, Moodle, WeBWork, L<sup>A</sup>T<sub>E</sub>X* etc);
- (3) creation of the database of problems using NPL. In many cases new (better suited) problems will be created within *Moodle* and *WeBWork* systems;
- (4) creation of supplementary content materials for hints, review, and study by students. The content, created in *L<sup>A</sup>T<sub>E</sub>X*, will be easy replaceable and/or modified by instructors, if needed, Furthermore, use of *L<sup>A</sup>T<sub>E</sub>X* will enable various (accessible) modes of presentation/display by users; these include hypertext, pdf, or flash formats.

- (5) integration of items (2) and (3) within *Drupal* framework;
- (6) creation of the assessment tools within *Moodle* and *WeBWork* systems;
- (7) enrollment of students into the online system.

*Estimated number of hours for the above listed tasks:*

- Tasks (1) and (2) – 50-75 hours;
- Task (3) – 100 hours;
- Task (4) – 200-250 hours;
- Task (5) – 50-75 hours;
- Tasks (6) and (7) – 100 hours;

*Estimated total number of hours:* 500-600 hours. Using \$100 per hour rate, the requested salary for the first year is \$60,000.

**Year 2 and Year 3: continue maintenance of the server and the online services.**

### First year budget justification for Carol Shubin

*Tasks related to creation and setup of online pilot services:*

- (1) responsibility for overall project management including the hiring and training of tutors and supervising faculty and consulting faculty;
- (2) review of content materials and problem set selection;
- (3) interaction with high school math teachers and counselors and students;
- (4) development of a project evaluation plan;
- (5) review work for accessibility and universal design;
- (6) contact, collect input, and support CSU Early Start and EAP Coordinators;
- (7) presentation of site to CSU math departments;
- (8) reporting to CSU.

*Estimated number of hours for the above listed tasks:*

- Tasks (1) and (2) – 100-120 hours;
- Task (3) – 30-50 hours;
- Task (4) – 30-50 hours;
- Task (5) – 20-40 hours;
- Tasks (6) and (7) – 100 hours;
- Task (8) – 10 hours.

**Year 2 and Year 3: continue management of the Online Math Support Center.**

**Tutors:** 4 Tutors, 20 hours per week, at \$12 per hour for 30 weeks.

**Faculty Consultants:** Full-time faculty, retired faculty, or part-time faculty must monitor the site daily. We also need high school and developmental math teachers' input about the math content created, problem sets, and general construction of the site.

**Travel for Susan Cullen, Jacek Polewczak, and Carol Shubin:** Attendance and presentations for the project: ACM ASSETS, AHEAD, W3C, Moodle Consortium, Drupal Consortium, and presentations and travel across the CSU to share with the CSU.

**Note:** *Additional expenses, not easy anticipated/predicted at this moment, are possible.*