HP Technology for Teaching Grant Request for Proposal - 2005 Higher Ed Edition

Required Elements

Institutional Environment

1. Technology vision (~150 words):
a. Describe your campus or school vision on the role of mobile technology in learning environments.

The vision for UCSC is for wireless to be ubiquitous. This includes wireless access for all general assignment classrooms. According to the campus mobile technology plan, the campus needs 400 wireless access points to achieve this goal. 200 wireless access points are in operation. This strategy has provided incentive to students to acquire mobile computing devices and also for faculty to explore the potential applications of integrating mobile technologies into their teaching practice. Currently, 65-70% of students have wireless laptops.

The Baskin School of Engineering has invested in providing faculty and students with the infrastructure necessary for faculty to investigate the affects mobile learning technologies can have on student learning outcomes. This infrastructure includes a 100 seat "Simularium" lecture hall and a 24 seat video conferencing lab, which will be used as educational research laboratories. Our vision is to explore the potential of mobile learning technologies to provide learners with greater opportunities to make their thinking visible, to collaborate with peers and to inform educators of student needs in real time.

b. To assist us in understanding your project, please let us know on a scale of 1 to 5, with 1 being just beginning and 5 being advanced deployment, in terms of how far along your campus is on the road to achieving its mobile technology vision. HP is interested in projects at all stages of deployment.

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2. Synergy (~150 words): How will the project you're proposing for this grant help you make a substantial contribution toward achieving the educational technology vision on your campus?

Achieving the vision for ubiquitous wireless connectivity at UCSC depends upon wide adoption, by faculty **and** students, of mobile education technology and methods. The Baskin School of Engineering's leadership toward complete wireless access to all learning spaces has advanced the campus' mobile technology vision already. This project will provide clear examples of effective methods for the utilization of mobile technologies in the classroom. Because this project will utilize the tablet classroom technology in several ways, faculty within the Baskin School and across campus will be able to draw upon the experience, raising exposure and awareness of the technology and its uses.

Academic and Institutional Leadership

3. Academic leadership (~150 words): Describe how you have demonstrated academic leadership, as evidenced by 1) the adoption of your teaching methodologies, pedagogy, or curricula, or 2) other tangible evidence.

Prof. Mantey holds the Jack Baskin Chair in Computer Engineering and is the director of the Institute for Networking, Information Systems and Technologies, the UC Santa Cruz affiliate director of CITRIS, and serves on the Steering Committee of the UC Industry University Cooperative Research Program.

Prof. Pohl is chair of computer science and Fellow of the ACM. He introduced OO programming methodologies in the mid-1980's, and has written several texts, most notably, "Object Oriented Programming Using C++."

Prof. McDowell chairs the UCSC Committee on Teaching, and is a member of the campus' IT Committee charged with identifying "strategic directions for campus IT support, including learning technologies." Professor McDowell has pioneered pair programming in the classroom

Prof. Elkaim introduced a robotics engineering track. We now have three faculty members working towards establishing a graduate level track in control and systems engineering, and have established the UCSC Group in Controls (GIC).

Prof. Obraczka has introduced a number of networking classes and has secured funding supporting several projects in the area of wireless ad hoc and sensor networks, including multidisciplinary efforts with faculty from Biological and Environmental Sciences.

4. Instructional leadership (~150 words): Describe how you have demonstrated instructional leadership, as evidenced by, 1) course changes have you made, in response to student needs, that have improved student outcomes in your courses, or 2) other tangible evidence.

Prof. Mantey has been using computers with simulations to augment his lectures in a variety of courses in networks, signal processing and control systems. He has been a campus leader in the capture of lecture material and providing access to this (multimedia streaming) material from a web server.

Prof. Elkaim has implemented a low-cost technology for course video capture based on a Tablet PC, a Bluetooth headset, and screen digitization software.

Prof. Whitehead developed course CS 183, Hypermedia and the Web, a senior-level Web Engineering course. He restructured CS 115, Software Methodology, a senior-level introduction to Software Engineering and a follow-on course, CS 116, on software design. All three courses involve teams developing significant term-long projects.

Prof. McDowell created a new 2-unit lab for the introductory programming course (CS12a). He is one of the first on campus to use a tablet PC as an integral for classroom presentation , using the Classroom Presenter. With NSF and Carnegie Foundation support, Prof. McDowell has been studying pair programming in the classroom. He has data to demonstrate that the use of pair programming has important positive impacts on student performance, attitude, and retention in computer science.

5. Project executive summary (~200 words): Provide a high-level overview of your project in an executive summary. Describe how students will benefit from the course redesign and the application of mobile technology.

Our proposal is to develop the classroom support in a modern multimedia classroom to enable students to make much more extensive use of their mobile computer during lectures and discussion. A major objective of our proposal is the use of student computers to provide the students effective real-time assistance in classroom learning. Central to this is semi-automation of some note-taking. Students will also use their mobile computers for a variety of other tasks in this setting, including interacting with the instructor (e.g. giving feedback on level of comprehension), reading from and writing to the large scale tiled classroom display, connecting with other students in the classroom during lectures and discussion, and accessing information relevant to the class from the Internet. We will be experimenting with use of multiple (large and multi-mega pixel)

tiled displays, allowing all lecture visuals to remain in view (and down-loadable) during the lecture, and on protocols for the instructor to enable and manage presentation of selected student responses and results. In addition, we will broaden and improve our support for use of (captured and streaming) lectures by students outside of class. Furthermore, Classrooms will use the Presenter software, developed at the University of Washington by Richard Anderson, to both project and save lecturing material and allow direct interactive participation by students. We hope to augment the Presenter software to make teaching CS courses more stimulating and effective. This will lead to a greater use of tablet computing by students who will find these devices to be their preferred educational computer.

6. Teaching and learning issues (~200 words): Describe the fundamental learning and teaching issues that the project addresses (i.e. Why is this project important for your students and instructors?)

The tiled display in the Simularium will function like an interactive mural. Students will be able to display the contents of the video buffer of their tablet pc, over a wireless connection and under instructor control, to any portion of the tiled display, regardless of the software application and be able to download any portion of the display for immediate or future reference. The ability to save lecture notes in a convenient digital format, we believe, will allow students to focus on the material being presented, rather than focus on taking notes. The inking capabilities of the tablet pc provide a means for students to annotate material presented during the lecture or solve in class problems that the instructor assigns.

Such a collaborative environment will substitute for the traditional scenario of when an instructor asks students to work out a problem on the chalkboard or allows students that solved a particular problem using multiple methods to collaborate and share their results among the other member in the class. In this way the students and their work will become part of the learning experience, engaging with the faculty and each other.

Furthermore, using tablets enabled with project management software, like OneNote, we will equip multiple student teams with Tablet PCs and an associated Sharepoint course repository. These teams will be more effective via the use of tablet technology, which will allow them to overcome coordination issues that make teamwork difficult in a university setting.

7. Goals, objectives and outcomes (~200 words): Describe the project goals, objectives, and anticipated outcomes from the perspective of impact on student learning

Goals:

1. Enhance classroom interaction
    a. Ability to display student work during class
    b. Greater student interaction with class materials, student work, etc.
    c. Ability to post questions/comments via network
    d. Lecture notes and student contributions can be recorded in time sequence with lecture sound freeing students from the need to “record” the lecture themselves.
    e. Student control of classroom display from the Tablet PC will increase efficiency of communication of student(s) deliberations to the class.
2. Enhance collaboration among project teams
    a. Ability to do virtual pair programming
    b. Organize and communicate within a team
3. Improve faculty effectiveness
    a. Use of Classroom Presenter will allow the instructor to focus instruction on those areas where students need help the most.
    b. Students will be more attentive and engaged in the material, provided with more variety in the methods in which they can engage.

4. Supporting broader re-use of lectures for better comprehension and more efficient l learning of material, and accommodating different learning styles.

5. Supporting distant students (synchronous and asynchronous) for lecture material and discussion / office hours

The goals and objectives summarized above will have positive impacts on student enrollment, retention, and achievement. Courses utilizing the tablet classroom will attract more students, engage them in exciting ways, and provide a broader range of tools to impact achievement of a diverse student body.

8. Measures (~200 words): What indicators of advancement in student learning will be measured and how will they be documented?

In the tablet classroom, interaction with recorded course materials will be measured. A graduate researcher, under Prof. Whitehead, will study the ability to transfer classroom display control to student(s) to display digitally inked notes in the classroom , and whether students find benefit in being able to update their on-screen notes in real-time. Specifically designed course evaluations will ask the students about the utility of the increased interaction and recording capability. We will measure the tablet classroom against the identical courses before redesign. Comparing enrollment course-to-course will provide data on student retention.

The effect of distributing Tablet PCs on collaboration will be measured with questionnaires, server log analysis, and direct observation of student meetings using OneNote. To better understand the value of digital ink in this context, the performance of control group(s) using laptop PCs will be analyzed in comparison to team(s) using Tablet PCs.

Prof. McDowell will administer a subset of questions used in previous studies at UCSC on pair programming, to determine if the use of the tablets has affected the student responses. The questions address such topics as satisfaction with the programming process, confidence in programming solutions, and desire to use pair programming in the future. Exam performance will be analyzed in comparison to exam performance produced against previous courses.

9. Project timeline: Describe the project timeline and milestones

1. **Starting date September 1, 2005: test tablets in the Simularium.**
2. **September 15, 2005: Post syllabi for the affected courses for fall 2005**
3. **October 1, 2005: Deploy tablets to student teams and classrooms.**
4. **December 15, 2005: Assessment of performance in the affected classrooms.**
5. **Jan 1, 2006: Deploy tablets in Winter 2006 classes**
6. **Implement new Tablet Software for collaboration that was locally developed for team course CMPS115.**
7. **March 15, 2006: Additional assessment of student satisfaction.**
8. **April 1, 2006: Implement any changes from pre-existing team experience and test in CMPS116. Utilize in capstone software design projects.**
9. **June 15, 2006: First year assessments – report on overall experience.**
10. **June 30, 2006: Academic year report on experiments, including assessment of retention and benefits to underrepresented students, especially woman and latino students in computer science.**

10. Technology integration (~200 words): Describe how you plan to use the granted HP products to support the goals of your project and how will the granted HP technology contribute to resolving the fundamental problem or opportunity this project addresses

The tablet classroom will be the centerpiece of the interactive and recording technology, augmented with inexpensive Bluetooth headsets that can be used to capture the audio portion of the lecture.

The 21 tablet PC's and the wireless access point will be instrumental in achieving success of this project. These machines will allow students that do not own personal laptops to become participants in the lecture through the proposed project. The inking capabilities of the tablet PC complements the collaborative elements of this project (and may motivate more students to get tablet PC's). The instructor tablet PC provides a convenient way to control and monitor large scale tiled display of the Simularium, enabling student input and interaction under instructor control, in order to run an efficient and smooth lecture.

11 tablet PC docking stations can be used for students to burn the lecture material they have saved to a cd-rom (so that they can take it with them). Alternatively, they can also upload the files to their personal university storage account. The 20 unit laptop cart will have a safe and locked home inside a data closet in the back of the Simularium. The all-in-one inkjet printer and digital camera will be useful in the documentation and construction of our proposed project and its implementation.

Project Context 11. Course impacted (~100 words): Describe the course or courses that will be re-designed for this project (include course number). Course # Required_____
Course Level Required : ____Undergraduate ____Graduate

CMPS 12A/L - Introduction to Programming
Required CS and CE majors, undergraduate
Taught by Prof. McDowell and Prof. Pohl

CMPE 12/L - Introduction to Computer Architecture and Assembly Language
Required CE majors, undergraduate
Taught by Prof. Elkaim

CMPE 118/L - Introduction to Mechatronics
Required CE majors, Jr/Sr undergraduate and 1st-year grad
Microprocessor control mechanical and electronic components
Taught by Prof. Elkaim

CMPE 156/L - Network Programming
Required CE majors, undergraduate
Taught by Prof. Obraczka

CMPE 150 – Introduction to Computer Networks
Required CE majors, undergraduate
Taught by Prof. Mantey

CMPE 151 - Network Administration.
Elective CE major, undergraduate
Taught by Prof. Obraczka

CMPS 116 - Software Design Project
Elective, undergraduate (seniors only)
Project course, fills capstone requirement.
Taught by Prof. Whitehead

12. Course redesign (~200 words): Describe how the course will be altered to take advantage of the technology

The CMPE 12/L course will be redesigned to take advantage of the additional interaction. Each lecture will contain some problems to be worked out simultaneously by the teams, such as a binary multiplication or number conversion problem. Given the instructor's ability to see in real time what the solutions are, the instructor can present the faulty one and get the students to correct it in real time. Pair Programming software will enhance the effectiveness of teaching this methodology. The same technique will be used in CMPS 12A/L, CMPE 118/L, CMPE 156/L and 151 courses.

The CMPE150 course will also be redesigned to take advantage of the additional interaction. Plans are to include interactive class activities that use network visualization through programs like Matlab, network simulations, network analyzing tools, probing of the Internet, etc.

Course CS 116 (Software Design Project) will be redesigned such that student project teams will have constant access and use of tablets to coordinate their group activities. A Sharepoint server will allow students to easily share notes and project documents with other team members. The course will also involve in-class student team exercises concerning the application of design patterns, and these exercises will use the tablets to record student team responses to each exercise, with teams displaying their responses using one of multiple displays in the classroom.

13. Department where course resides: This is a core course in one of the following departments: Math, Science (life, physical, earth or computer sciences), Engineering, Business (including M.B.A.)

These courses are in computer science and computer engineering.

14. Faculty (~25 words): How many professors/faculty will be directly involved in this project?

Professor's Mantey and Pohl will oversee and coordinate this effort as co-PIs. Professors Elkiam, McDowell, Obraczka, and Whitehead will implement their respective technologies and curriculum modifications.

15. Students (~25 words): Approximately how many students will be impacted during the first full year of this pilot project implementation?

Minimum direct impact will be the 20 students who are assigned the HP Tablets during any course. Combined with other students in the classes, and by looking at course enrollments in these courses in one year, the larger impact could reach a total in excess of 500 students.

16. On-going student impact (~25 words): Approximately how many students will be impacted per academic year when this course design is fully implemented?

On-going courses that take advantage of these techniques and tablets could exceed enrollments of 800 students.

17. Student financial need: What percentage of your degree students receive need-based assistance under Title IV of the Higher Education Act? (This information should be available through your financial aid office or online at http://nces.ed.gov/ipeds/cool/index.asp select the "Financial Aid" tab. Please indicate the percentage of students receiving Federal grants at your institution.)

Financial aid 2002–03 for UCSC students:

Financial aid to full-time, first-time undergraduate students

Type of aid	Percentage of students receiving aid	Average amount of aid they received
Federal grants (scholarships/fellowships)	20	$3,215
State/local grants (scholarships/fellowships)	28	$2,457
Institutional grants (scholarships/fellowships)	30	$4,323
Loans to students	41	$3,667

18. Ethnic representation: Please indicate the ethnic representation of students at your institution (give percentages, which must total 100%) African American, Asian/Pacific Islander, Caucasian/White, Hispanic, Native American, Other

	Undergraduates	Graduate Students
Euro-American	52.0%	51.0%
Asian American	13.8%	17.9%
Chicano	10.6%	4.1%
Latino	3.8%	4.1%
Filipino American	4.1%	1.0%
African American	2.4%	1.7%
American Indian	0.9%	1.0%
Other Minorities	1.8%	3.9%
Not Stated	10.1%	15.3%

http://www.ucsc.edu/about/statistics.asp

Project Support and Visibility

19. Campus involvement (~100 words): How will your campus educational technology and instructional leaders be involved in this project? What other departments or functions, if any, will provide support to the project?

The campus Information and Technology Services will provide instructional support to faculty and technological solutions for presentations. If the technology spreads, they will provide funding for training faculty on the technology.

20. IT infrastructure: The environment where my project will be deployed has an IT infrastructure with Internet access that can accommodate an 802.11b/g Access Point [Yes/No]

YES

21. IT support (~50 words): Describe the support the IT department has committed to providing to this project (such as support for networking, Tablet PC imaging, onsite help, etc.)

Instructional Computing staff and Engineering IT staff are aware of the one-time and ongoing logistical, infrastructure and equipment replacement costs to support the HP tablet lab. In a recent wireless laptop project, the Instructional Computing group provided .3 FTE to image the laptops, and 1 student FTE to staff the laptop checkout, as well as wireless network, software, physical and virtual security.

22. Project visibility (~100 words): Please describe your interest in and method for developing visibility for the project on your campus and beyond (publications and presentations at academic events, industry events, etc.).

The intention is to publish our findings in such places as the ACM SIGCSE Technical Symposium on Computer Science Education, or the annual Innovation and Technology in Computer Science Education conference, also sponsored by ACM and SIGCSE. A conference paper (e.g. IEEE Frontiers in Education) on educational technology will provide a formal means of conveying our project to the academic and industry communities.

We expect the Simularium to be used for special faculty lectures and seminars, adding opportunities for colleagues to experiment with its capabilities. Seminars on this facility and project will be given in coordination with our campus Center for Teaching Excellence, see: http://ic.ucsc.edu/CTE/events.html

Also, a web page documenting the large scale interactive tiled display system will be provide as a reference for faculty that are interested in evolving their traditional classroom techniques.

23. Please provide the following contact details:
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Institution Mission Statement:
The mission of the Jack Baskin School of Engineering at UC Santa Cruz is to develop and sustain first-rate education and research programs that integrate the fundamental principles and sound practice of science and engineering. The School strives to serve the needs of the greater Silicon Valley region and the State of California by creating and disseminating knowledge through research and teaching, and by offering curricula that nurture creative thinking and prepare our students for productive careers at industrial and academic settings in rapidly evolving areas of science and engineering.

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