

## **Pilot studies on the potential for wireless computing in lecture-based, undergraduate teaching**

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**Overview of project:** Advances in technology provide unique opportunities to enhance teaching and learning in the "traditional", lecture-based classroom. The development of relatively low cost handheld computers combined with wireless access to the internet has created the potential for integration of student computing into classroom lectures, discussions and problem sessions. We propose to evaluate a wireless system with two types of handheld computers and to explore several potential uses for wireless computing in both freshmen and upper level undergraduate courses. The results of our ongoing pilot studies will be available to the UNC community and the Collaborative on a website. We will give workshops illustrating the technology and will invite interested members of the collaborative to visit our courses for observation of the pilot studies in action.

**Rationale and specific goals:** As undergraduate enrollment spirals upward, we will be faced with increasingly larger lecture audiences, especially in introductory courses. Such large courses are notorious for promoting disinterest and low motivation among students. Use of wireless computing offers ways to combat these problems by creating opportunities for students to become actively involved in learning while in the classroom and by providing easy access to course materials outside of class. Our pilot studies for 2000-2001 will be as follows:

Fall 2000--ZO 420 Evolution (35-40 students) and ZO 370 Development Anatomy and Histology of the Vertebrates I (50-60 students)

In both of these upper level courses, reliable students majoring in Biological Sciences or Zoology will be assigned handheld computers for their use during the semester. Twenty students in ZO 420 will receive Palm computers for use with text based material, and 10 students in ZO 370 will be assigned Windows CE computers for use with both text and color images. In these initial pilot studies, both teacher and student will become familiar with the potential and limitations of the equipment. Students will be instructed to bring the computers to lecture and encouraged to use them for note taking and to download text excerpts and figures from the course website as the lecture proceeds. In ZO 370, students will be instructed to download each lecture prior to class. These lectures (on the web since Fall 1998) will be provided with new links which will download selected images in BMP format into a graphics application on the student's computer. During the lecture, students may access the image under discussion and add labels, arrows, highlighting or brief notes which will be saved on their computer for later study. Outside of class, students may choose to review course materials which are loaded into their handheld computers. This will allow them to study anywhere without voluminous stacks of papers from note taking and printing of web pages. Alternatively, they may prefer to load notes and images made during class into a personal computer to view them on a larger screen.

Spring 2001--Bio 125 Introduction to Biology (2 sections of 150-180 students each) and ZO 371 Developmental Anatomy and Histology of the Vertebrates II (25-30 students)

Students will be provided computers for use during class only, thus all 30 computers can be used in both classes. The goal of Spring pilot studies is to assess the use of wireless computing for quizzing, problem solving and immediate instructor feedback during lecture. In both classes, short quizzes will be given during the lecture to ascertain student comprehension of difficult

concepts. The quiz questions will be posted on the web using WebAssign, a program developed and administered by NCSU. WebAssign supports questions in multiple choice, short answer or essay format, including the use of graphics, audio or video clips. Student responses are immediately visible in summary form on a faculty WebAssign site. Thus the instructor can ask students to answer one or more questions using the handhelds and view the percent of students giving the correct answer in real time via the lectern computer. This tool will allow instructors to determine the level of student comprehension, to correct misconceptions immediately, and to adjust the time awarded to a given topic. In both courses, the wireless computing will be further used to introduce problem solving and collaborative learning into the lecture environment. During selected class meetings, students will be divided into groups to work on a problem related to recent lecture material. Students can upload their "solution" (which may include images or graphs) to a class website at the end of the class period for later review and/or class discussion. In Bio 125, students with computers will also be asked (during the last 5 min of the lecture) to compose and upload questions based on the lecture material for use in a class study guide. In ZO 371, problem solving may require a brief search of other websites during class with subsequent downloading or bookmarking of relevant data or images.

**Benefits for UNC campuses and the Collaborative:** This pilot study will assess both the potential and limitations of wireless computing combined with handheld computers in classroom teaching. Usefulness in cognitive learning and student preference for small Palm-type handhelds vs. larger (but more expensive) mini-laptop versions will be ascertained. Members of the Collaborative will be invited to visit classes to observe (and to use the equipment as "students") during various aspects of the pilot studies. Input from members as well as student feedback will determine future directions in the ongoing study. The outcomes of the study should be helpful to the Collaborative in future advising and recommendations concerning wireless and/or handheld computing. After 2001, the classrooms and equipment used in this study will be made available for other NCSU faculty with interests in teaching technology.

**Dissemination of information:** We will quiz students periodically on their use of the computers, likes, dislikes and suggested potential uses. At the semester's end, the students will be given a more lengthy questionnaire regarding their use of the handheld computers both in and out of the classroom. In Spring 2001, instructors will keep a weekly journal of wireless computing activities performed in class. All of this information plus relevant class web materials will be organized on a "wireless computing" web site available to the Collaborative and to interested faculty throughout the UNC system. We will also present workshops and are willing to give seminars at other Universities, if asked.

**Funds requested:** Wireless Equipment for 802.11 wireless lan in two multimedia lecture halls:

Lucent Orinoco WavePOINT-II Bridge	995	
Lucent Orinoco Gold PCMCIA 802.11 (2)	600	
50' Low Loss Cable	105	
Patch Cable	95	
Orinoco Range Extender 5DB Antenna (2)	700	
Mounting Hardware	300	
	2,795	for 1 room x 2 = 5,590
Windows CE Handheld computers with network card for 10 students and instructor:		
HP Jornada 820 Handheld	660	
Lucent Orinoco Gold PCMCIA 801.11	275	
	935	x 11 = 10,285

Palm Handheld computers with network card for 20 students and instructor:

Palm IIIxe	249	
UniLinear PCMCIA Adapter	150	
Lucent Orinoco Gold PCMCIA 801.11	<u>275</u>	
	674 x 21 =	<u>14,154</u>
	Total =	30,029

**Resources provided by NCSU:** The University will install the wireless equipment in two multimedia lecture halls and will assist in preparation of the "wireless computing" website.