

An Integrated Laboratory Course in “Wireless and Mobile Systems Design” Survey Results from Spring 2003¹

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Introduction

The Intel Corporation awarded Virginia Tech a “Wireless Curriculum Development and Instructional Laboratory” in August 2002 to develop a new senior/masters-level course in “Wireless and Mobile Systems Design.” The course was first taught in Spring 2003. This report presents results from a survey of students who took that first offering of course.

We offered the course in Spring 2003 to 49 students majoring in Computer Science (CS), Computer Engineering (CPE), Electrical Engineering (EE), Industrial and Systems Engineering (ISE), Systems Engineering (SE), and Information Systems (IS). Students and teaching staff were located at Virginia Tech’s Blacksburg campus and at Virginia Tech’s Northern Virginia Center in Falls Church. Table 1 shows the distribution of the students. Students in Blacksburg were undergraduates (16) and graduate students (9). Students in Northern Virginia were mostly graduate students (23), many of whom were practicing professionals in part-time masters programs. There was one undergraduate enrolled in Northern Virginia while he was on a co-op assignment in the area.

Table 1. Distribution of Students by Major and Location

	CS	CPE	EE	ISE	SE	IS	Total by Location
Blacksburg	9	13	3				25
Northern Virginia	11	4	6	1	1	1	24
Total by Major	20	17	9	1	1	1	
Percent by Major	41%	35%	18%	2%	2%	2%	

For additional information about this course, see <http://www.irean.vt.edu/courses/wmsd/>.

Survey Overview

To assess the effectiveness of the course in meeting our stated objectives, we developed a survey tailored to the course. Students anonymously completed the survey in addition to the university’s general instructor evaluation form. Our primary objectives in designing this evaluation instrument were to:

- Assess the effectiveness of in-class and at-home exercises and design projects in providing hands-on experience with and insight into the topics covered in the lectures;
- Determine students’ perception of the value of hands-on experience with commercial off-the-shelf wireless networking equipment and adequacy of the equipment loaned to students during the course;
- Assess the adequacy of the selection of topics included in the course and identify topics that might be added or omitted in future offerings of the course; and

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- Determine what students view as the main differentiating characteristics of this course with respect to other offerings in the networking curriculum.

Every student who completed the course in Spring 2003 (49 in total) filled out one such evaluation form. Responses were tabulated separately for students in the main campus in Blacksburg and in Northern Virginia. We present selected results of the survey in this section.

Survey Results

Results were consistently positive – 84% of students found in-class exercises effective or very effective; 69% of students expressed the same opinion of at-home exercises. Lectures were found effective or very effective by 68% of students. If we included the students who answered that the in-class exercises, at-home exercises and lectures were “moderately effective,” these percentages increase to 98%, 94% and 92%, respectively. Students in the main campus proved to be slightly more critical in most of the survey questions; this may be explained by the mix of undergraduate and graduate students (undergraduate students tend to give lower scores in course and instructor evaluations). These results are detailed in Figure 1.

The two design projects received the highest rating from students – the UPnP project was considered to be effective or very effective by 82% of students and the “hot spot” project was considered to be effective or very effective by 94% of the students. In general, students expressed a preference for open-ended, design-oriented experiments over guided laboratory exercises. We believe a mix of the two is appropriate. Guided exercises can fit into the time constraints of class sessions and provide exposure to and reinforcement of concepts discussed in lecture, while open-ended projects provide greater insight into design and implementation issues and leave room for students to be creative.

Students also responded positively to the equipment loaned to them for this course – 90% rated the equipment as adequate or very adequate. With repeated offerings of the course, obsolescence of equipment is a concern, especially due to the rapid evolution of local wireless networking technology. However, at present the equipment used in the course seems to be adequate.

When asked what the most valuable aspects of the course were, the opportunity for hands-on experience received the most positive scores. This is consistent with all the other responses to the survey. Experience with Bluetooth received the lowest scores. One possible reason is that the majority of the experiments in the course used IEEE 802.11 technology, not Bluetooth. Most experiments with Bluetooth focused on usability issues (for instance, coexistence with IEEE 802.11), rather than design.

Several students pointed out that the course imposes a considerable time commitment, due to multiple at-home assignments. Somewhat paradoxically, when asked whether they believe there should be more or less coverage of each topic (middleware, mobility, ad hoc routing, etc.), students tend to ask for *greater* coverage. We have identified some areas in which we can decrease time demands (for instance, in repeating exercises multiple times with different parameters) without much impact on learning outcomes. We foresee, however, that this course will continue to be more time consuming than the average course (this tends to be true in general for courses that require extensive experimentation and design). Numerous additional topics were suggested by students. These range from location management, wearable computing, sensor networks, and integration of wireless local area networks to cellular systems to how to build an antenna out of a Pringles® potato chip can. There were multiple requests for greater coverage of security issues. Some of these suggested topics will be incorporated, when feasible, into future offerings of the course.

There is no question that students highly value the opportunity for hands-on experimentation. This came up consistently in the survey responses and comments, as well as in informal feedback. Having actually configured and used the equipment and designed applications and services that work in a wireless environment gives the students a level of confidence in their mastery of the underlying concepts that is difficult, if not impossible, to achieve purely with classroom lecturing or even through simulation.

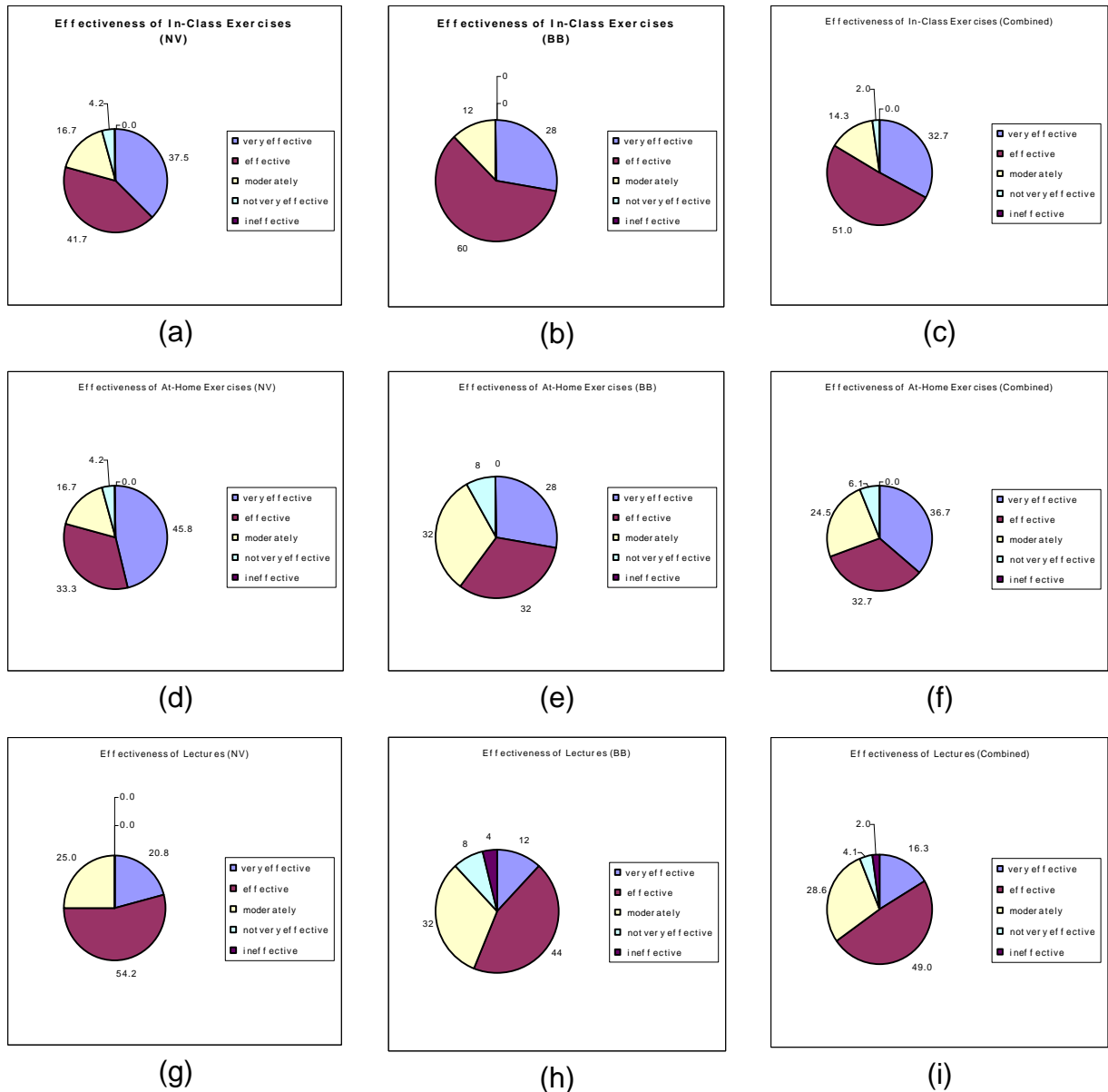


Figure 1 – Student perception of the effectiveness of in-class laboratory exercises [(a), (b) and (c)], at-home exercises [(d), (e) and (f)] and lectures [(g), (h) and (i)]. Individual results for both locations (Blacksburg and Northern Virginia), as well as combined results, are shown.