

# **Developing an Interactive Learning Network Using Tablet PCs in Sophomore-Level Engineering Courses**

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## **EXECUTIVE SUMMARY**

The importance of active and interactive learning in science and engineering education has long been recognized, and interactive and collaborative teaching and learning techniques are routinely employed in small laboratory and discussion sessions. Wireless technology, coupled with pen-based computing technology that is suited for analyzing and solving engineering problems, provides an ideal venue for applying these interactive teaching and learning methods to a larger, more traditional lecture setting.

This study focuses on how Tablet PCs and wireless technology can be used during classroom instruction to create an Interactive Learning Network (ILN) that allows real-time student assessment and assistance. The ILN is designed to enhance the instructor's ability to solicit active participation from all students during lectures, to conduct immediate and meaningful assessment of student learning, and to provide needed real-time feedback and assistance to maximize student learning. This interactive classroom environment is created using wireless Tablet PCs and a software application, NetSupport School, that allows various levels of interactions between the instructor and the students during lectures, thereby enhancing the instructor's ability to systematically monitor and control individual student progress, assess their understanding, and provide immediate feedback and assistance through the wireless network. This study addresses the effects of these technology-enhanced interactions on student performance, on student attitudes towards the ILN model of instruction and the use of Tablet PCs in the classroom, and on students' level of engagement and confidence in the learning process.

To study the impact of the Interactive Learning Network model of instruction, two case studies were done: Study 1 involved comparing two Cañada College Dynamics courses, the Fall 2005 class that used the ILN model (seventeen students), and the Fall 2004 class that used the traditional instructor-centered model (eighteen students). Study 2 involved comparing two Dynamics courses from two different institutions in the Fall 2006 semester, a class at Cañada College that used the ILN model (ten students), and a class at San Francisco State University that used the traditional model (seventeen students). For each of the case studies, the performance of the ILN and non-ILN groups on homework assignments, quizzes, tests, and a final exam were compared. The average scores for the experimental and comparison groups were computed and independent *t*-tests were used to evaluate the statistical significance of the results.

To determine students' attitudes towards the use of Tablet PCs and the Interactive Learning Network model of class instruction, an attitudinal survey was given to the two experimental groups at the end of the semester. This survey was designed to determine students' perceptions of the impact of the ILN model on student learning and teaching effectiveness. For both the ILN and non-ILN groups of Study 2, additional surveys were

designed and administered to determine students' attitudes towards the course, study habits during the semester, expected grade in the course, and confidence in their performance in and knowledge of the course.

The Interactive Learning Network resulted in better performance in the class. Comparison of the performance of the ILN and non-ILN groups shows that the biggest gains were on homework and quizzes, with statistically significant differences for both case studies. The observed gains in the tests and the final exam were statistically significant for Study 1 but not statistically significant for Study 2. Although not statistically significant, the gain in the average test score for Study 2 resulted in an improvement in the corresponding letter grade – a “B” for ILN class, and a “C” for non-ILN class. Furthermore, the difference of 6.7 points on the average test score most likely would have been statistically significant if the class sizes were larger.

The Interactive Learning Network also resulted in better student engagement as evidenced by lower attrition, higher attendance rates, and more time spent on assigned tasks outside class time. Students also expressed positive attitudes towards the use of the ILN model of instruction and towards student and instructor use of Tablet PCs in the classroom. They attributed their improved performance to increased focus and attentiveness during class as a result of the instructor's survey questions and the awareness that the instructor observed their progress. Furthermore, the “Help Request” feature of NetSupport was found useful by the students because it allowed them to ask specific questions anonymously and receive individual help from the instructor.

The use of Tablet PCs in the classroom further resulted in a number of distinct advantages that could have contributed to the improved performance of the ILN students. Student use of Tablet PCs during lectures provided enhanced note-taking ability, improved their ability to organize class materials, and allowed them to integrate hand-written notes and course materials. These features make a Tablet PC highly adaptable to individual student's learning strategies. The instructor's use of the Tablet PC in presenting material, coupled with the ability to incorporate hand-written annotations, sketches, mathematical equations, derivations, and animations, increased teaching efficiency.

The sample sizes involved in the studies were small, and bigger class sizes are needed in further studies to verify that the benefits of the Interactive Learning Network model of instruction can be extended to larger class sizes. Furthermore, studies should be done in a larger institution using multiple sections of the same course to ensure that the experimental and comparison groups are comparable, thus increasing the reliability of the results. These studies should attempt to isolate the impact of the various components of the Interactive Learning Network on student learning to determine whether the immediate feedback through instant polling during lectures, the guided questions during problem solving, the individual monitoring of student progress, the individual assistance and instruction, or some combinations of these factors are responsible for improved student performance.