Practicum/powerPen: Four-Year Student Software Teams for Newton

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New computer science graduates from most universities are not ready to go to work in modern software companies. As software professionals are quick to point out, these students have only learned how to write 300-line programs by themselves from scratch. These programs were class assignments that focused on elegance rather than efficiency or maintainability. The specifications came out of thin air, the code was poorly tested, the interface was a simple command line, and there was never any user's manual. The students did not learn how to reuse existing code or how to work in teams (that would be cheating). They did not learn how to trade-off features and deadlines with customers.

Enough battering of the current university system. That type of education provides basic knowledge of data structures and algorithms essential for engineering software. Our idea is to supplement the traditional, fundamental coursework with a four-year practical curriculum modeling the activities of a software company. From the university's point of view, entering freshmen are enrolled in a four-year, software engineering course called Team-Oriented Software Practicum. From the student's point of view, they have joined a software company called powerPen. The combination of fundamental and practical works well because students become highly motivated. For example, they want to learn in their English course because they want to write effective marketing material or a clear user's manual. They want to understand compilers because they want to add an authoring language to their application.

To be more specific, Practicum is roughly divided into two stages. In the first two years, student teams study activities that surround programming in a software company, i.e., marketing, testing, project management, user documentation, and technical support. Freshmen and sophomores can tackle these topics before they become effective programmers. Each semester the team of students studies a text or two on the topic and completes a related project for a regional software company, sometimes under nondisclosure. In return, the company provides written feedback on the student work. (We have found that students take constructive criticism from future employers much more seriously than from professors.) The goal of this first stage is to develop basic skills in various software development tasks. We want them to "walk in the shoes" of others that they will be working with when they become software developers.

In the second stage of Practicum, students are reorganized into product groups to build and support commercial-quality applications. Students in these product groups design, program, market, and support either a new version of an existing application or an initial version of a new application. This process includes the following steps: a user survey, a marketing requirements document (often done in conjunction with a freshman team), a design specification, a program, testing (with a freshman team), a user's manual (with a sophomore team), and a product release. The goal of this second stage is to build experience while developing complete, high-quality applications. We want them to see the whole software process in action, and occasionally, make mistakes before jobs are riding on their decisions.

After a year's experience, we found that students had trouble applying themselves to their industry projects in the first two years because we did not have a common technology base. Some of the students knew only Windows programming (and had PCs), some only Mac. To remedy this, we adopted Newton as our common technology with the help of Apple in early 1994. Apple donated a MessagePad for each of our students and helped us set up a senior-level course in mobile computing that focuses on

Newton programming. The university purchased several Macs to host the Newton Toolkit and allocated space for a development lab. Students in Practicum/powerPen take the mobile computing course and gain common, essential skills for building modern, graphical user-interface applications. Newton has turned out to be an excellent choice because of the huge potential in the hand-held market and the ease of developing NewtonScript applications. It has also helped that the Newton developer community is small and cooperative. Our freshmen and sophomore teams have been able to do Newton marketing, testing, and documentation projects for Newton companies. They have also volunteered at Newton conferences and had summer internships with Newton companies.

Our first team started in 1992 with 10 freshmen. A second team followed the next year, and a third in 1995. Currently 17 students are involved in Practicum/powerPen: 5 seniors, 6 juniors, and 6 freshmen. Like many companies, we experience regular turnover, losing about 50% of the new students in the first year and another 25% of the overall group upon graduation. The students are currently supporting six Newton applications and developing a seventh. Each application is available in at least one of six foreign languages. They have over 500 registered users in 25 countries.

Our most significant marketing channel is the Internet, and in specific the World-Wide Web. We host a series of pages with the most current version of each application. We distribute applications for free because we want to have as many users as possible. These pages list known defects, feature requests, source code, functional specs, and other development information. We make our development information and source freely available because we want to help others understand how we are doing development — including other students not at our university. For applications with a significant content market, the pages also list content we and others have developed (e.g., plug-in dictionaries for hangMan or decks of cards for flashCard). Where possible, the pages list related applications commercially available from Newton companies.

Practicum/powerPen also provides an excellent opportunity to study and refine the software development process. Two areas in which we hope to contribute are localization and design methods. In localization, we have devised techniques for managing the user-interface strings of a Newton application so it can be easily converted from one human language to another. Our latest efforts make it possible for a non-programmer (but language expert) to specify strings by filling out a Web form, submitting it, and receiving a compiled Newton application correctly localized. This represents a dramatic savings compared to Apple's marketing estimates of US$10-25K to convert a Newton application into each new language. We are inviting our international users to test this system. It will leverage their expertise and provide additional international access to Newton applications.

In design methods we have adapted a functional specification technique for event-driven programming in general and Newton programming in specific. Based on a table structure, this specification type is easy to code against and provides a ready-made test plan. Our initial attempts with this methodology are also available on our Web pages (under flashCard).

As an educational project, Practicum/powerPen relies on industry support in three major ways. First, Newton companies can help by making a tax-deductible donation to purchase new hardware. With Apple's help we have recently upgraded most of the students to Newton 2.0 OS but we will fall short when new freshmen join Practicum/powerPen next fall. Second, companies can hire our students for internships or upon graduation. Besides the benefit of personal experience and growth, returning students share their expertise. Third, companies can propose and evaluate marketing, testing, or user

documentation projects. Every fall a freshman team is looking for a marketing project. Every spring a freshman team is looking for an application to test, and a sophomore team is looking for an application to write a user's manual for.

In retrospect, it seems obvious that the way to prepare students to work in industry was to put them in a teaching company. In such an environment they build high quality software as well as an understanding of the software process. They also become pretty good friends.

For more information about Practicum/powerPen, drop us a line at powerPen@eecs.wsu.edu or visit our pages at http://www.eecs.wsu.edu/~schlimme/newton/index.shtml .