

# Student and Faculty Choices that Widen the Experience Gap

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## INTRODUCTION

A major teaching challenge for higher education faculty is students' wide differences with respect to experience or knowledge with the subject matter or skill set of a class. In computing education research, this is often referred to as the "experience gap." Research shows that the experience gap contributes to the low participation of women in professional information technology (IT) careers. Women are significantly more likely to enter college-level IT courses with little or no computer programming experience than are their male peers (College Board, 2004). Yet, programming experience is positively associated with success, especially in introductory classes (Taylor & Mounfield, 1994; Bunderson & Christensen, 1995; Brown, 1997; Margolis & Fisher, 2002), and low grades are positively associated with attrition from the major (Strenta, Rogers, Russell, Matier, & Scott, 1994). When women receive low grades due to inexperience, they may be more likely than males to lose confidence and leave the major (Cohoon & Aspray, in press).

Another type of experience gap becomes evident in cross-disciplinary teams, where students encounter others whose areas of expertise and knowledge are substantially different, often to the point where students have difficulty understanding each other. According to IEEE Computer Society/ACM Computing Curricula Task force, "Computing education is also affected by changes in the cultural and sociological context in which it occurs" (IEEE and ACM Joint Task Force, 2001, p. 10). For this reason, both Computing Curricula 1991 and 2001 strongly recommend the integration of experiences and opportunities for student understanding of real-world applications and the people who need them. Courses

that provide opportunities for collaborative and interdisciplinary learning are also often recommended to increase retention of women in science, technology, engineering and mathematics (STEM) courses in general (Agogino & Linn, 1992; Felder, Felder, Mauney, Hamrin, & Dietz, 1995) and in computing, in particular (McDowell, Werner, Bullock, & Fernald, 2003; Barker, Garvin-Doxas, & Roberts, 2005). Yet, collaborative learning and, in particular, project-based courses, must be carefully planned and managed for students to have similar learning outcomes. In this article, we demonstrate how students' choices can reinforce and even widen differences in experience and reduce their ability to develop cross-disciplinary understandings.

## BACKGROUND

Unlike most assignments in the computer science curriculum, team projects are too complex to be completed by a single student. Team projects involve building practical solutions to substantial problems, requiring that students evaluate alternative designs in terms of cost, performance and so forth. Team members must determine what they will deliver and how—and how to distribute the work. The process of bringing idea to product is part of what gives students the professional experience.

In their review of projects within the traditional computer science curriculum, Fincher, Petre and Clark (2001) characterize project work as a way for students to "show their stuff." To be successful in project work, they note, students must demonstrate mastery of a diverse collection of technical skills acquired over terms or years of study. The authors believe that the most diverse project teams are

formed by splitting up “affinity groups” (friendships or cultural groups) and creating a mix of interpersonal and technical abilities. Such teams may increase the potential for peer learning. Teams formed from computer science majors from a single institution, however, are quite likely limited in their diversity of knowledge and may not bring students professional experience in interacting with people substantially different from themselves.

More innovative IT programs present the possibility of more heterogeneous project teams with students of different majors. Ideally, the tasks performed by such groups require that all students share their knowledge and expertise as well as their questions and uncertainties in ways that lead to peer learning (Tinzmann, Jones, Fennimore, Bakker, Fine, & Pierce, 1990). However, this ideal assumes that students take equal responsibility for the roles of teacher and student, and that tasks focus on learning through dialog and hands-on activities (Johnson & Johnson, 1994). Knowledge asymmetry, when one group member is more expert on a topic than another, is to be encouraged and expected in group projects because it creates an opportunity for peer tutoring, benefiting both the more expert and less expert students. Further, in successful learning groups, students alternate between different types of roles and communication: those involving peer tutoring in which the roles of “teacher” and “student” are clear and well defined, and collaborative sequences where students work together in free discussion to create knowledge and understanding with no clear role differences (Haller, Gallagher, Weldon & Felder, 2000).

Yet, simply putting students in project groups does not automatically lead to improved or cross-disciplinary learning through the processes described above, because students’ understanding of collaboration may be quite limited by lack of experience and even a belief that collaboration is cheating (Barker, Garvin-Doxas, & Jackson, 2002). Instead, they often divide the work, taking on the part most consistent with their “comfort zone” or most expedient for finishing the project. When students have different levels or areas of knowledge, students of both sexes can take on gendered roles or roles based on experience. Further, students may accept less learning in the interest of getting a product and “showing their

stuff.” The case study we present below demonstrates how students take on roles in project groups.

## **WIDENING THE EXPERIENCE GAP**

This case study describes one project team from Technology for Community (T for C), an undergraduate computer science course taught at the University of Colorado at Boulder. In T for C, student teams work with local community service agencies, building computational solutions to problems confronting those agencies. The course has no prerequisites, and participants have diverse backgrounds in terms of educational experience, major and expertise with technology. Although few computer science majors are female, this course has consistently attracted a large proportion of female students. Most of those women, however, come from the technology, arts and media (TAM) certificate program.

The TAM certificate program, open to all undergraduates, requires that students take six courses, three of which require hands-on development in project teams. Students acquire expertise with high-end software packages (e.g., Flash, Photoshop) and some HTML programming, with the goal of designing and producing multimedia materials both for self-expression and to serve clients. Programming courses (e.g., Java) are optional, and most students do not take them. Three of the courses are focused on historical issues related to information and communication technologies, communication theory, implications of media for society and the like. TAM student enrollment is consistently more than half women.

In each T for C project, students are expected to acquire new skills and experience. While most students improve their abilities to interact with a real client with real needs and to design for and test with real users, not all succeed in enhancing their technical skills. Instead, students, succumbing to real or imagined time constraints, fall into their comfort zones. Because of the multidisciplinary nature of the course, students arrive with different levels of technical, communication and design experience. Learning to work across disciplines within project teams is a new experience for many of the students, and

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