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Programming for Communication: Overcoming Motivational Barriers to Computation for All

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Abstract

Computer science as a discipline is failing to reach a diverse audience. As a result, computational illiteracy threatens many groups of underserved students—women, minorities and possibly other, as yet undocumented groups, such as students of the humanities. If learning programming were contextualized in domains relevant to different audiences, more students would be motivated to learn to program. I contend that teaching computer science in the context of digital media manipulation will attract and engage many students who would otherwise not choose to learn programming.

1. Introduction

The inability of post-secondary computer science departments to attract and engage a diverse audience has been documented in the form of declining enrollment and completion by women and minorities [7,8] and dramatically high field attrition [6]. Universities in the United States have reported withdrawal, failure, and D-grade (WFD) rates in introductory computer science reaching 50% [3,5]. The potential repercussions of these trends include widespread computational illiteracy among females, minorities and possibly as yet undocumented groups such as students of the humanities and other fields.

It seems that traditional introductions to computer science (CS) are more likely to frustrate many students than encourage them to pursue further learning. Studies of the under-representation of women in particular fault the emphasis in CS courses on technical detail rather than application, the perception of computing as an uncreative or asocial field, and a frequently uncongenial "computer culture" [1,4]. Turkle and Papert maintain that the dearth of women in computing is induced not only by historical prejudice or discrimination, "but by ways of thinking that make them reluctant to join in" and that "equal access to even the most basic elements of computation requires an epistemological pluralism, accepting the validity of multiple ways of knowing and thinking" [9].

At the Georgia Institute of Technology, these problems exist in microcosm: the overall WFD rate in introductory CS has averaged nearly 30% over the past three years and female enrollment in the College of Computing has dropped by roughly a percentage point in each of the last four fall semesters (currently 11%) [2]. A new course at Georgia Tech has recently been developed to provide an alternate introduction to CS, one that focuses on using computers for communication instead of calculation. *Introduction to Media Computation* combines learning about the fundamentals of digital media with basic programming skills and CS concepts. It is open to non-CS, non-engineering students such as liberal arts, management, and architecture majors.

I believe that Media Computation will provide an introductory CS experience that overcomes reasons that many students, especially females, seem unreceptive to CS. Media manipulation as a creative context for computing combined with the collaborative course implementation trialed at Georgia Tech will lead to lower WFD rates, increased interest in computing among female students, and, eventually, record numbers of non-CS majors taking elective CS at Georgia Tech.

2. Pilot Study

During the spring semester, 2003, Georgia Tech offered a pilot of the media computation course. I managed a research team that recorded and analyzed student achievement and attitudes through a series of surveys, interviews, assessments and observations. In some areas the results have been dramatic; in others, inconclusive.

Generally, response to the pilot course was extremely encouraging. WFD rates reached only 11.5%, compared to 42.9% in the traditional introductory CS course. Overall, students were positive in their opinions about media computation. At midterm, over 20% of media computation students named content as their favorite aspect of the course. No media computation students reported a complete aversion to the course, compared to over 18% of respondents in the traditional introductory course who stated that there was nothing enjoyable about the course at all. On the final survey, media computation students were asked whether or not they plan to take more CS courses. Only 6% responded affirmatively; however, when asked whether they would be interested in taking advanced media computation (which is not currently offered), the percentage of affirmative responses rose to *over 60%.* Clearly, media computation has captured the interest of many students who otherwise would not choose to pursue CS learning.

Survey responses, homework assignments and interviews with media computation students all indicated that students were not only enjoying the material, they were also taking advantage of the creative aspects of the course and doing interesting things on their own. Students reported programming "just for fun" in order to reverse popular songs, create online scrapbooks, and alter their own personal photographs.

Media computation attracted a large number of female students. In order to capture a qualitative view of female students' experiences in media computation, interviews were conducted with volunteers at midterm and during finals. Interviewees reported that they liked the course, and that the classroom culture was one in which they felt comfortable and competent. Several reported that they had used programming on their own. Some students reported that the absence of CS majors made it easier to ask questions and seek help. Dramatic changes in attitude and self-confidence were evidenced by allusions to the falsity of the "computer science stereotype," statements that computer science is not all about "nerds" and "things that no-one could understand," and the revelation that "programming is not scary, it's actually pretty cool."

3. Future Work

While some media computation students are clearly better engaged than many of their counterparts in the traditional introductory CS course, it is not yet clear whether or not their achievement in programming can be compared to that of students in the traditional course. Logistical difficulties and modifications made by individual instructors rendered common exam problems incomparable. In general, media computation students exhibited many of the same misapprehensions of programming concepts as novice programmers in other introductory courses. The question of actual programming achievement is one that will continue to be addressed in evaluation efforts through the fall semester and beyond.

The effects of the liberal collaboration policy that was adopted for the media computation course are still unknown. The freedom to seek help from and work collaboratively with peers may contribute to reductions in retention and failure rates. Funding is currently being sought to support an extended investigation of the effects of collaborative learning on retention.

Students' self-reported inclination to take more CS is a less reliable indicator of their attitudes toward computing than the number of students who actually take more classes. Longitudinal data on both non-CS majors who take the traditional course and those who take media computation will eventually augment self-reported data.

4. Conclusion

Media computation is not a panacea for the ills of computer science education and it does not make learning to program an easy accomplishment. Learning to program is cognitively challenging and entails hard work and perseverance; however, if students are motivated enough to start and interested enough to persist, we can expect programming achievement to follow. Results from this pilot course offering indicate that media and computation together provide a motivating and engaging framework that encourages some students to excel in programming who would otherwise prefer not to try.

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