

Challenges and Opportunities in Computing Education

Clayton Lewis, University of Colorado

Challenge: We and our students sometimes *confuse techniques with purposes*. This leads to the confusion of programming with computer science, and lack of attention to the goals that computing and communication serve.

Opportunity: Work to identify the intellectually valuable ideas in computer science, those that have application to future developments and to other endeavors. Promote an understanding of the roles of computing and communication in science, technology, commerce, and government. Keep technique in perspective. Our field is full of *crucial trivia*: things that you have to know for some purposes, but that have no intellectual content. We need to be clear about both facets, the crucialness and the triviality, and to help our students be clear about these things, too.

Challenge: Increasingly, computing and communication are not just means to independently arising ends, but intertwined in the development of new ideas, institutions, and social processes.

Opportunity: Stress the role of computing and communication as *tools for thought and organization*.

Challenge: Increasingly ideas are being developed in *open settings* with international participation. They are not well represented in textbooks or traditional publishing venues.

Opportunity: Support students in joining these open dialogs, such as open source projects and online discussion forums. Understand what knowledge and skills are needed for effective participation, and promote these.

Challenge: Increasingly, effective contributions come not from joining established enterprises but from forming them. Affiliations change often. International collaboration is key in many areas.

Opportunity: Support students in developing their *human networks*, connections they will rely on to form and reform their affiliations, find worthwhile projects, and develop and maintain their knowledge. Emphasize international connections in these networks.

Grasping the opportunities

CS Education needs to *turn outward*, fighting the centripetal forces identified in Donald Campbell's fish scale paper on interdisciplinarity (consensus-oriented

voting groups pull toward their centers, away from the boundaries where they contact other fields). To do this we need to submit our programs to *meaningful assessment by outsiders*: alumni, people in industry, people in other countries, people in other disciplines. If we don't do this we won't be radical enough.

At the same time, we must confront the fact that many CS faculty lack experience outside academic research in CS. This means we need not only assessment of our programs by people outside our programs, but also participation by them.

Traditional courses defined by content often emphasize the wrong view of the field, emphasizing ideas of merely transient or historical interest. Courses defined by content should be fewer and very carefully crafted, so as to focus on ideas of lasting and general value. Many courses should be defined around *processes and objectives* (project participation, knowing current trends in software development, whatever those are at the moment.) *Supplements to courses in other disciplines*, that bring out the connections between those disciplines and computing and communication, may be useful until such time as this content emerges in these courses themselves.

Building human networks, including international connections, should be supported and assessed as a fundamental educational goal. Related to this, participation in open arenas such as open source projects and online forums should be supported and assessed.

A significant barrier to progress on CS education (and on undergraduate education in general) is *neglect of undergraduate education by faculty in favor of research* (cf Larry Cuban's *How Scholars Trumped Teachers*, and the recent book and TV presentation, *Declining by Degrees*.) This is a complex problem complicated by the almost complete lack of public debate, or even awareness. *Declining by Degrees* was a rare exception, but seems to have engendered little response from the public, from government, or from higher education.

A related barrier is the holdover of 19th C *class-based ideas of education in which preparation for gainful employment is denigrated* (for example by being labeled as "training" rather than as "education".) These traditional, exclusive, ideas of liberal education contribute to the breakdown of connections between students and faculty, as documented in *Declining by Degrees*, because students demand that college prepare them for work, and faculty largely ignore the demand. This leads students to the "ticket punching" model of higher education, because they do not expect it to meet their actual needs. See Humphreys and Davenport in *Liberal Education*, vol 91, no 3 (2005)... see <http://www.aacu-edu.org/liberaleducation/le-sufa05/le-sufa05leap.cfm>.

CS is an excellent position to improve this situation by showing how Big Ideas and practical accomplishments are mutually reinforcing, not antagonistic.