Diversifying Computing: Its Contradictions And Challenges

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CRA Snowbird Conference
July 15, 2002
Outline

1. Motivating the need for success for all.
2. Some failures, contradictions and obstacles including closing a meaningless K-12 gap.
3. Things we must do.
Guiding Theme: Quality Education Leads to a Quality Workforce That Reflects Diverse Representation
The supply of scientists and engineers will be maintained by turning to the country’s underrepresented groups.
Reality – Our History

The supply of scientists and engineers has been maintained by turning to foreigners (It is our history).

- The easy fix (importation of solutions).
My Standard Old Argument

Crisis in America

“No first world nation can maintain its economic health when such a large part of its population is outside mainstream activity including all technological, scientific, and computational activity.”

Underrepresentation endangers the health of the nation, and not the health of the various professions.
Current World Trends

The “Easy Fix” Threatened

- Many foreign nations on the move in science/engineering education and research.
- United States on decline in non-life sciences research spending and in science/engineering doctoral productivity.
Foreign Nations on the Move
Ratio of Natural Sciences and Engineering First University Degrees to 24-year Old Population

Source: National Science Board, Science and Engineering Indicators-2002

NOTES: Natural sciences include physics, chemistry, astronomy, and earth, atmospheric, ocean, biological, agricultural, as well as mathematics and computer sciences. The ratio is the number of natural science and engineering degrees to the 24-year-old population. China’s data are for 1985 and 1999. Other countries’ data are for 1975 and 1998 or 1999.
Natural Sciences and Engineering Doctoral Degrees

Source: National Science Board, *Science and Engineering Indicators-2002*
United States Doctoral Degree Productivity and Research Spending
S&E Doctoral Degrees

Source: National Science Board, *Science and Engineering Indicators-2002*
Federal R&D Funding, by Budget Function

NOTE: The 1998 increase in general science and decrease in energy resulted from a reclassification.

Source: National Science Board, *Science and Engineering Indicators-2002*
Changes in Share of Federal Academic Research Obligations, by Field: 1990-99

Source: National Science Board, *Science and Engineering Indicators-2002*
My New Argument

- For the health of the domestic science and engineering enterprise we must now seriously consider the “hard fix” (inclusion of members of underrepresented groups in the science and engineering workforce).
- The hard fix is hard – we haven’t made much progress, if any, over the past decades.
Problem at the Top: Ph.D’s

Severe underrepresentation of minorities in science, engineering, mathematics, and technology.

<table>
<thead>
<tr>
<th></th>
<th>1977</th>
<th>1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>9,003</td>
<td>12,051</td>
</tr>
<tr>
<td>White</td>
<td>85.5%</td>
<td>75.5%</td>
</tr>
<tr>
<td>Asian</td>
<td>7.0%</td>
<td>15.0%</td>
</tr>
<tr>
<td>Black</td>
<td>1.2%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.2%</td>
<td>3.5%</td>
</tr>
<tr>
<td>N. Amer</td>
<td>0.2%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Other</td>
<td>4.9%</td>
<td>1.4%</td>
</tr>
</tbody>
</table>

Percent of the doctoral degrees in science, math, engineering, and technology earned by people of various races/ethnicities, 1977-1998.
Problem at the Top: Bachelor’s Degrees

Af. Am, His, N.Am, Of all degrees earned

1975 1995
6% 8%

But grown to approximately 25% of population.
The Hard Fix

- A high point: US graduate education in science and engineering is the envy of the scientific world. We do it best.
- A low point: The current status of US K-12 education is not good.
- A contradiction? (Good graduate education – bad K-12 education) No.
The Hard Fix

There exist pockets of excellence in our current K-12 system. We have a strong lack of homogeneity throughout and most underrepresented minorities live in cities and get the short end of the education stick.
Managers and Chairs Say It’s a Pool Problem

- Is it a pool problem (They just aren’t there)? Yes, but not completely.
- Can we the universities solve the problem? No.
- Can we help? Yes
- OK, K-12 is not doing its part.
- Are we the universities doing our part? No
- Do we demonstrate meaningful commitment? (With bite) No.
Universities greatly contribute to the loss of the precious few. Those few that do well in K-12, are talented, and want computing, or computational science, and mathematics in college.
The Loss of the Precious Few (Reflections on the Hard Fix)

Failures, Contradictions, and Obstacles

- Our evaluation systems
  - Very one-dimensional; yet many view them as fair.
  - Very traditional – the question is not do they include bad people, but do they exclude good people?
  - Gets worse as we go up the ladder – k-12, undergraduate, graduate, faculty hiring.
  - Creativity – we value what we measure because we don’t know how to measure what we value.
- Diversity versus underrepresentation (We seem to forget).
The Loss of the Precious Few (Reflections on the Hard Fix)

- Minority leadership nonexistent – must be nurtured and developed.
- Society
  - Youth (especially minority) hold a negative view of science and engineering and those that practice these professions.
  - Value system for today’s youth dictated by society (city) and popular media.
  - Lack of science and engineering role models that youth relates to or can interact with.
The Loss of the Precious Few (Reflections on the Hard Fix)

- K-12 system
  - Closing gaps that are meaningless.
  - Meaningless accountability.
  - Very non-homogenous in terms of quality.

- Colleges and Universities
  - Selective schools – minority students migrate away from science and engineering towards areas where self-esteem can be maintained (they have not been adequately prepared).
The Loss of the Precious Few (Reflections on the Hard Fix)

- Colleges and Universities (cont.)
  - Selective schools – minority students not guided to (indeed, discouraged from) graduate school in science and engineering (they were not the superstars).
  - Minority serving institutions – often don’t give adequate preparation for graduate school or the workforce.
  - Colleges and universities are not held accountable for these crimes.
The Loss of the Precious Few (Reflections on the Hard Fix)

- We criticize K-12 for not nurturing underrepresented minorities and driving them away from computing and science. Yet, in good undergraduate schools we do the same thing, with our sink or swim mentality.
- We do not nurture, we do not guide, we do not engage, we do not make them feel that they belong, or that they can contribute to a bigger picture (health of our people).
- Many excellent Rice students migrate from computing and physical sciences to the humanities (loss of the precious few).
A Recent Questionnaire of Rice University Science and Engineering Faculty on Their Perceptions Concerning Underrepresented Minorities (Confidential Data)
## Survey Response Rate by Faculty Member’s Department

<table>
<thead>
<tr>
<th>Department Name</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics</td>
<td>71.4</td>
</tr>
<tr>
<td>Ecology &amp; Evolutionary Biology</td>
<td>71.4</td>
</tr>
<tr>
<td>Chemistry</td>
<td>65.0</td>
</tr>
<tr>
<td>Biochemistry &amp; Cell Biology</td>
<td>61.0</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>56.0</td>
</tr>
<tr>
<td>Physics and Astronomy</td>
<td>48.6</td>
</tr>
<tr>
<td>Electrical and Computer Engineering</td>
<td>42.9</td>
</tr>
<tr>
<td>Computational &amp; Applied Mathematics</td>
<td>40.0</td>
</tr>
<tr>
<td>Mechanical Engineering and Material Science</td>
<td>40.0</td>
</tr>
<tr>
<td>Mathematics</td>
<td>29.0</td>
</tr>
<tr>
<td>Computer Science</td>
<td>25.0</td>
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</tbody>
</table>
Other Responses

- “Richard Tapia is very successful at attracting and retaining such students to our dept. This is tolerated to the degree that it does not overwhelm the dept.”
- “The department may very well have made a formal and written commitment to increasing and retaining underrepresented minorities, but I have seen no action to back up these words.”
- “The issue arises but not as a priority.”
Other Responses

- “We have always attempted to recruit women and American minorities instead of foreign graduate students. We have never been rewarded for this policy. The other S/E departments frequently have more foreign graduate students than American ones. In the aggregate, the Administration could do much more to encourage recruitment of American women and minorities INSTEAD of foreign students.”

- “We always use academic performance in making admissions decisions.”
"My department is already following a policy of preferring American women and minorities over foreign students, in spite of the fact that foreign students frequently test better. I would suggest that, unless there is a definite plan to institute a policy of recruiting American women, minorities and economically disadvantaged in preference to foreign students, we should save ourselves time by stopping the discussion of it."

"The current chair is committed but I do not believe our department has ever established this as a goal."
Other Responses

- “The department recognizes that increasing the number of underrepresented minority students is desirable, however, we have no formal policy to that effect. We are as concerned in admitting a minority student that they have the skills to succeed. Our experience has been that bringing in under qualified minority students get us into a very bad situation and is probably not fair to the student.”
Faculty Respondents’ Perception of Departmental Activity

<table>
<thead>
<tr>
<th>Departmental Activity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>In departmental meetings, strategies for increasing and maintaining underrepresented minority graduate students are discussed.</td>
<td>23</td>
</tr>
</tbody>
</table>
How Members of Faculty Respondents’ Department Generally View Underrepresented Minority Graduate Students

<table>
<thead>
<tr>
<th>Items related to underrepresented minority students</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation depends on quality of the undergraduate institution</td>
<td>63</td>
</tr>
<tr>
<td>Requiring a lot of time and effort</td>
<td>34</td>
</tr>
<tr>
<td>Prepared for graduate work</td>
<td>27</td>
</tr>
<tr>
<td>Lacking in research experience</td>
<td>27</td>
</tr>
<tr>
<td>Under-prepared for graduate work</td>
<td>26</td>
</tr>
<tr>
<td>Hard workers</td>
<td>20</td>
</tr>
<tr>
<td>Possessing talent in the field of study</td>
<td>6</td>
</tr>
</tbody>
</table>
Faculty Respondents’ Perspective on Which Factors Pose Challenges for Underrepresented Minority Graduate Students

<table>
<thead>
<tr>
<th>Challenge Items</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recruitment</td>
<td>67</td>
</tr>
<tr>
<td>Academic preparation</td>
<td>56</td>
</tr>
<tr>
<td>Retention</td>
<td>45</td>
</tr>
<tr>
<td>Financial support</td>
<td>30</td>
</tr>
<tr>
<td>Faculty culture</td>
<td>20</td>
</tr>
<tr>
<td>Admissions</td>
<td>18</td>
</tr>
</tbody>
</table>
Faculty Respondents’ Perception of Whether Funding Agencies Reward Researchers for the Recruitment of Underrepresented Minorities

<table>
<thead>
<tr>
<th>Response</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>37</td>
</tr>
<tr>
<td>No</td>
<td>44</td>
</tr>
</tbody>
</table>
Success For All: Necessary Ingredients

- Must have high expectations for all at all levels and successes.
- Monitoring of progress: Look for proportionate representation in advanced level courses, in garnering of awards and no score-differential on standardized tests at all levels.
- We must do what it takes to ensure that this happens. If minority students are behind at all earlier levels, they will stay behind. It is impossible to catch up on the job as a Science/Engineering professional (or graduate school).
Success For All: Necessary Ingredients

- We must ensure that we all finish the earlier laps of the academic race together. This will require a serious extra time commitment and enhancement programs for minorities along the line of the Escalante approach (*Stand and Deliver*) and Treisman’s Emerging Scholar.

- The last thing that minority students need is a full summer off. This summer tends to make the educational gap wider. Summer activities for minorities do not include enough academic enrichment activities.
We talk a lot, but are not really doing anything because it is not a real priority. We know what to do, but it takes significant resources and we are not willing to commit these resources.
Richard Tapia
Josef Sifuentes
Travis and Josef
Car Heavy Metal