The TIDES Approach to Increasing Diversity and Equity in Computer Science

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Presentation Overview

• US Context regarding:
  • Increasing demand for CS degree holders
  • Who gets CS degrees by gender and race/ethnicity
  • Student demographics

• Intro to TIDES

• Methods

• Preliminary results

• Next steps
Current and Growing Demand for CS Grads

• In 2014, there were 238,158 postings for cybersecurity-related jobs nationally. Cybersecurity jobs account for 11% of all IT jobs.

• Cybersecurity postings have grown 91% from 2010-2014. This growth rate is more than faster than IT jobs generally.

• In the US, employers posted 49,493 jobs requesting a Certified Information Systems Security Professional (CISSP) in 2014, recruiting from a pool of only 65,362 CISSP holders nationwide.
US Computer Science Degrees by Sex

<table>
<thead>
<tr>
<th>Degree Level</th>
<th>Population 2010</th>
<th>CS Bachelor's degree 2010/11</th>
<th>CS Master's degree 2010/11</th>
<th>CS Doctor's degree 2010/11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>49.2%</td>
<td>82.4%</td>
<td>71.8%</td>
<td>79.8%</td>
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<tr>
<td>Female</td>
<td>50.8%</td>
<td>17.6%</td>
<td>28.2%</td>
<td>20.2%</td>
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Sources: [https://nces.ed.gov/programs/digest/d12/tables/dt12_349.asp](https://nces.ed.gov/programs/digest/d12/tables/dt12_349.asp)  
[http://www.census.gov/quickfacts/table/PST045214/00](http://www.census.gov/quickfacts/table/PST045214/00)
US Computer Science Degrees by Race/Ethnicity

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<td></td>
<td>64%</td>
<td>60%</td>
<td>61%</td>
<td>51%</td>
<td>67%</td>
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<tr>
<td>White</td>
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<td>American Indian</td>
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<td>Other</td>
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Sources: [http://www.census.gov/quickfacts/table/PST045214/00](http://www.census.gov/quickfacts/table/PST045214/00)  
All Undergraduate Students by Race by Sex

1976 Female
- White: 82%
- Black: 11%
- Hispanic: 4%
- Asian/Pacific Islander: 1%
- American Indian/Alaska Native: 2%

2012 Female
- White: 57%
- Black: 16%
- Hispanic: 16%
- Asian/Pacific Islander: 6%
- American Indian/Alaska Native: 1%

1976 Male
- White: 83%
- Black: 9%
- Hispanic: 4%
- Asian/Pacific Islander: 1%
- American Indian/Alaska Native: 2%

2012 Male
- White: 59%
- Black: 13%
- Hispanic: 15%
- Asian/Pacific Islander: 7%
- American Indian/Alaska Native: 1%

What Is TIDES?

• Teaching to Increase Diversity and Equity in STEM
• 3-year professional development intervention for CS faculty, with course redesign projects
• Brainchild of Dr. Kelly Mack, Vice President for Undergraduate STEM Education and Executive Director of Project Kaleidoscope, AAC&U
• Networked Improvement Community of teams from 19 institutions of higher education (14 fully funded)
• Funded by the Helmsley Charitable Trust
Simplified Logic Model

- TIDES Summer Institutes, Structured Projects, & Networked Improvement Community
- Increased faculty awareness of and self-confidence with CCP; (re)designed courses; expanded reach to students
- Improved scores; perception of relevance; sense of belonging; & self-efficacy in students
- Increased retention; graduation; and pursuit of CS careers among diverse students
# Outcomes and Indicator Measures

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<tr>
<th>Outcome</th>
<th>Indicator</th>
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| The broadest reach possible to "touch" URM students in STEM by bringing together a diverse group of institutions as a networked improvement community | - Number of institutions serving predominantly diverse students  
- Number of courses/students taught by TiDES faculty  
- Number of additional institutions, faculty, and students “touched” |
| Increased faculty awareness of and confidence with culturally responsive pedagogy | Changes in faculty and administrator responses on the assessment instruments |
| (Re)designed computer science courses intended to be relevant and engaging to diverse students | # of (re)designed courses |
| CS is more appealing and relevant to diverse students                    | Changes in student survey responses (From project outcome data)            |
| Increased number and diversity of CS students                            | Changes from baselines in institutional data                               |
| Increased CS scores and retention of diverse students                    | Changes from baselines in institutional data                               |
| Increased Sense of Belonging in STEM and self-efficacy of diverse students | Changes in student survey responses (From project outcome data)            |
| Increased graduation rates in CS of diverse students                     | Changes from baselines in institutional data                               |
Methods

- Annual week-long summer institutes
- Annual autumn STEM conference
- Course (re)design projects
- Support from an expert “institution coach”
- Webinars and online resources (STEM Central.com)
- Annual assessment of faculty self-efficacy with CCP
- Pre- and post- course survey of student perceptions
- Annual assessment of student data
Goals by Number of Funded Projects

- Increase student graduation: 4 Direct, 10 Indirect, 0 Not a Focus
- Increase student retention: 7 Direct, 7 Indirect, 0 Not a Focus
- Improve student scores: 8 Direct, 3 Indirect, 3 Not a Focus
- Improve student self-efficacy: 8 Direct, 4 Indirect, 2 Not a Focus
- Recruit students: 6 Direct, 5 Indirect, 3 Not a Focus
- Help students see the relevance: 9 Direct, 5 Indirect, 0 Not a Focus
- Enhance student sense of belonging: 7 Direct, 6 Indirect, 1 Not a Focus
- Change faculty behavior (CCP): 11 Direct, 2 Indirect, 1 Not a Focus
Where We Are Now

• Just finishing 2\textsuperscript{nd} project year, evaluating the 1\textsuperscript{st} year of full implementation

• Working with 49 faculty members:
  • 6,659 students have taken TIDES courses
    • 10 New courses created
    • 58 New modules created
    • >60 offerings of redesigned courses
  • >500 faculty participants in workshops/trainings
  • ~20,000 students estimated to be indirectly touched

• 2 Summer Institutes, 1 fall STEM conference (next week is second in Seattle)
Changes in Faculty Self-Efficacy from Y1 to Y2

To What Extent Am I Confident in My Ability to:

Create a learning environment that reflects a variety of cultures (n=23)

Teach students about their cultures' contributions to science (n=22)

Revise and/or prepare instructional materials to include a better representation of cultural groups (n=25)

Identify solutions to problems that may arise as the result of diversity (n=24)

Use my students' cultural background to help make learning meaningful (n=24)

BLUE represents 2015 "post" data, BROWN represents 2014 "pre" data, shapes represent means, bars represent 95% Confidence Intervals

Scale: 1=To an extremely small extent, 2=To a very small extent, 3=To a small extent, 4=To a moderate extent, 5=To a large extent, 6=To a very large extent, 7=To an extremely large extent
Assessment of Changes in Student Outcomes

• Fairleigh Dickinson University (NJ):
  • Black, Native American, and Hispanic students up from 33% to 39%
  • Female students up from 11% to 22%
  • 79% of females earned an A or B in new courses compared to the class average of 59%

• Montgomery College (MD):
  • Female students up from 19% to 21%
  • URM students up 44% to 54% (women 39% to 56%; men 45% to 54%)
  • Retention up from 35% to 47% for women, from 46% to 51% for men, and from 39% to 50% for URM students.
  • Women earning As from 17% to 27%, URM 17% to 22%
Next Steps

• Continue project implementation and monitoring
• Continue implementation and outcomes assessment
• Increase network activities (STEM Central.com, webinar series, journal club, sharing of resources for grant writing and publishing)
• Disseminate promising practices through other US funding agencies’ projects
Questions or Comments?