Improving Undergraduate STEM Education: Computing in Undergraduate Education

IUSE: CUE

NSF 19-546

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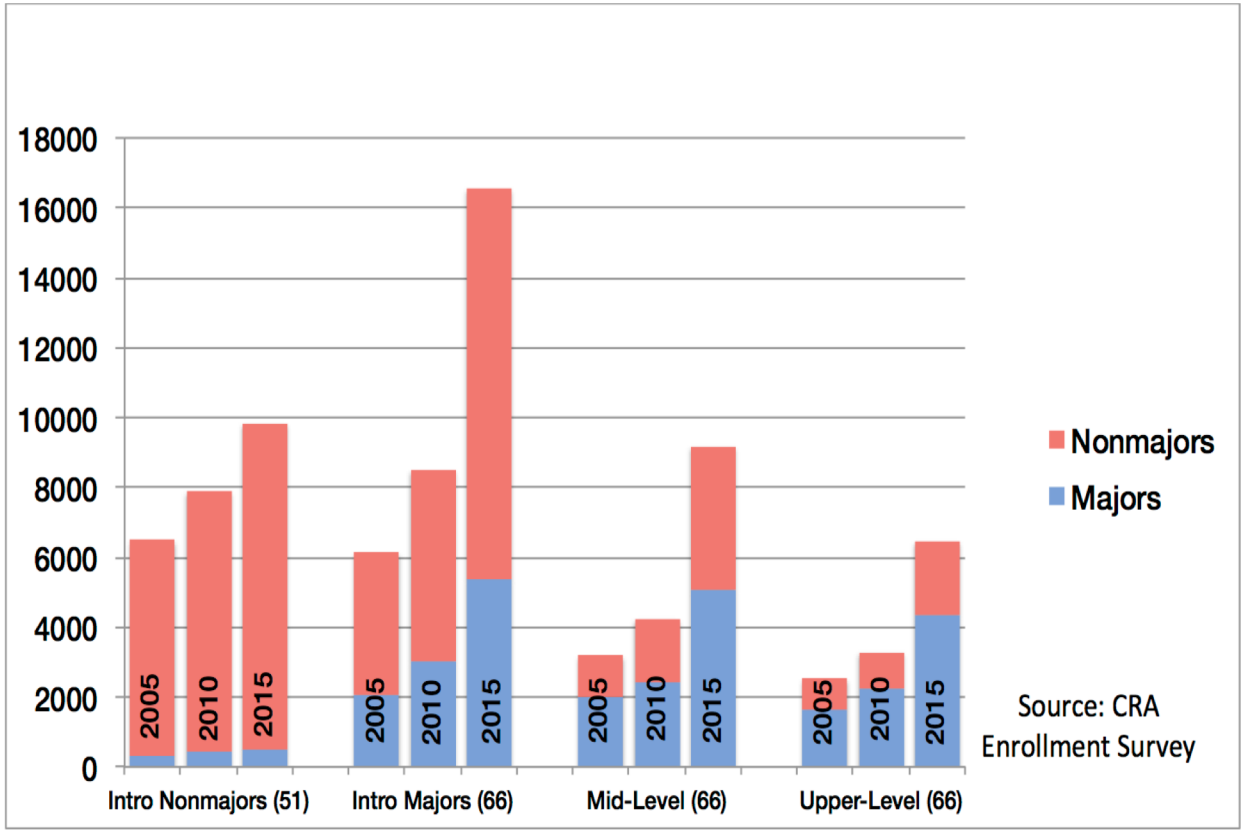
“It is a time for institutions to consider their missions and the constituencies they serve, and to determine what role computing should play in the experience, knowledge, and skills of its graduates of 2025 and beyond.”

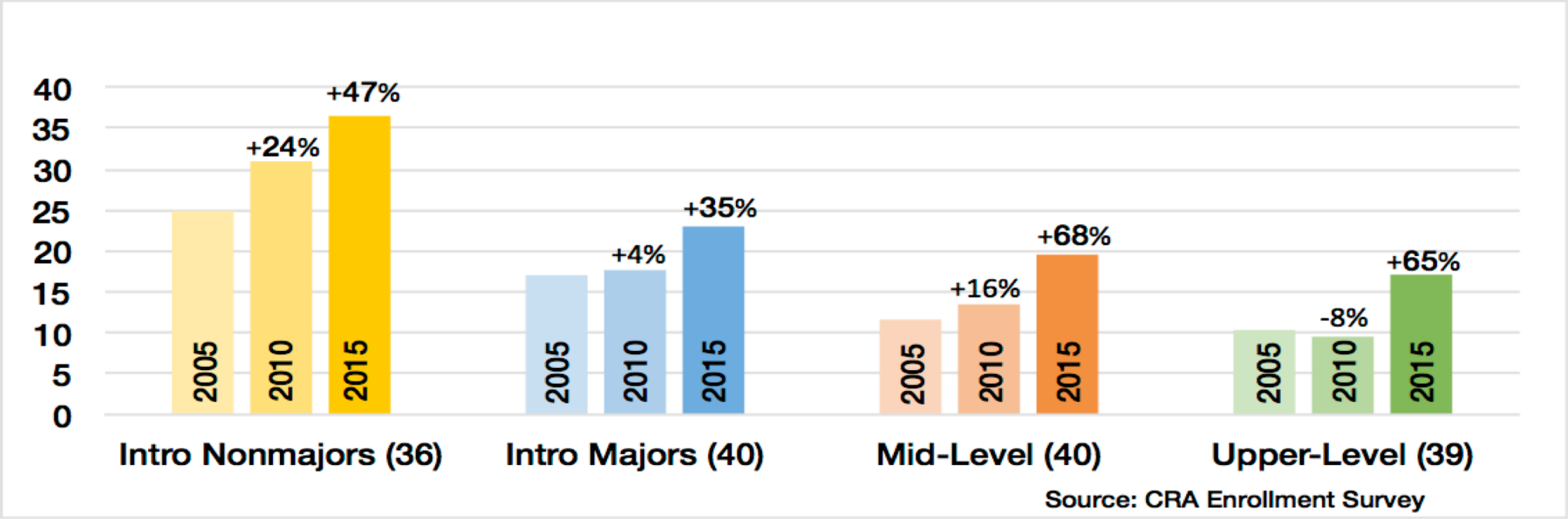
—National Academies Report: Assessing and Responding to the Growth of CS Undergraduate Enrollments, 2017

The landscape of undergraduate CS education

- Surge in undergraduate enrollments
- Rapid increases in non-CS majors in higher-level computing courses
- Influx of students Interested in integrating advanced computation skills with domain-specific knowledge from non-CS majors



Growth of CS non-majors



These students are often not well-served by the traditional CS curricula pathways.

A (welcome) opportunity to broaden participation in computing (BPC)

- Non-CS majors attracted to CS courses are more diverse than traditional CS programs
- Opportunity to recruit, welcome, and retain a much broader group of students

CS departmental responses to increasing need for interdisciplinary contexts

- Special interdisciplinary programs, e.g. data science and AI
- "CS+*X*" or "*X*+CS”
  - *X* is a discipline or set of disciplines that may include both STEM and non-STEM subjects, or *X* is a significant societal problem requiring interdisciplinary approaches
  - Study of *X* is combined with relevant computing courses tailored to *X*
- Elevating computing to a school or college

CUE: Repositioning/Re-envisioning computing in undergraduate education

- Not a minor addition of computational elements to some courses but a comprehensive rethinking of computing as it cuts across undergraduate programs
- Holistic restructuring of interdisciplinary degree pathways

GOAL: To better prepare a wider, more diverse range of students to collaboratively use computation across a range of contexts and challenging problems

Two key program requirements:

1) Collaborations of 3 to 5 IHEs working together, structured and functioning (formally or informally) as a Networked Improvement Community (NIC)
2) All proposals must include specific BPC efforts

Networked Improvement Communities (NICs)

- Design communities where partners:
  - Share a common goal
  - Have a common understanding of how to reach that goal
  - Employ common metrics
  - Meet often to discuss activities, successes, challenges and progress
- Engage in rapid research cycles of Plan, Do, Study, Act (PDSA)
  - “Learn fast, fail fast, and improve quickly”
  - Develop, test, and refine interventions across a variety of educational contexts

Who is in a NIC?

- Faculty from different disciplines and departments
- University administrators
- Education researchers who answer questions generated by the participants and based on the common data collected
- Evaluators who evaluate any implmentations

What do you need to do for BPC component?

- Provide demographic information about the student populations served at each department/IHE
- Identify relevant characteristics and needs of participants from the underrepresented or under-served groups you are addressing
- Include specific plans or strategies for addressing or accommodating those needs
- Include metrics for measuring success

Resources for BPC

- Broadening Participation in Computing Alliances (https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503593)
- Collaborations with projects in the NSF INCLUDES network
- BPCnet.org

Ethics component encouraged

- Risks of technology:

  Erosion of privacy, Lack of fairness or accountability in algorithmic decision-making, Spread of misinformation
- Incumbent to better prepare students in the ethical use of technology and to guard against misuse
- NSF encourages integration of ethics into curricula
  - Within core CS courses
  - Across relevant interdisciplinary application areas
- Complementary to the Responsible CS Challenge (Omidyar Network, Mozilla, Schmidt Futures, Craig Newmark Philanthropies)
  - https://foundation.mozilla.org/en/initiatives/responsible-cs/

Review Criteria

- **Intellectual Merit:**
  - Potential to advance knowledge
- **Broader Impacts:**
  - Potential to benefit society and contribute to the achievement of specific, desired societal outcomes
- **Additional Specific Review Criteria (BPC):**
  - Does the proposal identify the characteristics and needs of the identified underrepresented or underserved groups to be addressed?
  - Does the proposal include specific plans or strategies for addressing or accommodating the particular needs of participants of the identified underrepresented groups?

Additional constraints

- *Must* be a multi-institutional partnership (functioning as a NIC) with a lead IHE + 2-4 additional IHE partners
- *Should* budget for team members to attend two principal investigators' (PI) meetings over the 18-month award period

Proposal size classes

1) Without an ethics component
   - Maximum budget of $300,000 for up to 18 months

2) With an ethics component
   - Maximum budget of $350,000 for up to 18 months.

Expectations for awards

- 12 to 15 awards
- Total program funding of $4,500,000.
- *Estimated program budget, number of awards and average award size/duration are subject to the availability of funds*

Contacts and Further Information:

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Further Information:

- https://bit.ly/2UrWwXY
- Twitter chat
  - Tomorrow Friday March 15th 2pm
  - @NSF_CISE

The transcript, audio and presentation will be posted at:

https://www.nsf.gov/events/event_summ.jsp?cntn_id=297914&org=CISE

after the webinar is concluded.