To create a pipeline of STEM workers in Virginia, program starts with littlest learners

Adding Coding to the Curriculum

By BETH GARDINER     MARCH 23, 2014

Such knowledge, the advocates say, is important not only to individual students’ future career prospects, but also for their countries’ economic competitiveness and the technology industry’s ability to find qualified workers.
1.4M IT jobs in US
400K graduates

Code.org
Over 10 million views
From The Ivy League To State Schools, Demand For Computer Science Is Booming

Posted May 25, 2014 by Colleen Taylor (@loyalelectron)

Number of CS majors at Harvard, Stanford, MIT, and UPenn
3 Million  Software Developers

1:4  Developers to  End-User Programmers

1:9  Developers to  (Unknown) Programmers
The learning needs of computational scientists and engineers

- To use computation as a tool to enhance *understanding*.

- To write programs of (at most) 100 lines (most often, 10 lines) for themselves.

The learning goals are different than for software developers.
9 out of 10 schools don’t even offer computer programming classes.
Figure 2: Histograms describing (d) the percentage of female exam-takers, (e) the number of Black exam-takers, and (f) the number of Hispanic exam-takers.

Figure 3: Graph of AP CS A exam-takers over time in sample states.

The pass rates vary between states, in part because of few exam-takers in a category. Recall that each asterisk in Table 2 indicates a category where there were less than five exam-takers in the entire state in that demographic group. The number of Black students who earned a passing score in Michigan certainly totals less than 15 over the last six years, and may be zero in Indiana. Georgia and Maryland both do well in terms of number of Black exam-takers (e.g., double-digit percentage Black), but the pass rates are poor – 16% in Georgia and 17.5% in Maryland in 2012. It’s useful to compare these results with other states. Washington (Black population 3.9%) had the highest pass rate for Black students at 60%, but that was only 6 of 10 exam-takers. Texas (Black population 12.3%) had the most Black exam-takers pass the exam at 52 (out of 142). Nine states had no Hispanic students take the exam in 2012, even some states with significant Hispanic populations, e.g., Hawaii (9.5%) and Kansas (11%).

4. INFLUENCES ON EXAM-TAKING

We used regression analysis to explore relationships between the variables that influence exam-taking. We looked into two sets of relationships. We looked at wealth and exam-taking, and we looked at the number of exam-takers from under-represented groups in order to look for an explanation for the variance between states.

Socio-economic status influences education outcomes generally [11]. The Stuck in the Shallow End study [9] found higher-quality computer science classes in the wealthiest school they studied. However, we know of no previous study looking into a quantitative relationship between wealth and participation in computer science education.

Overall, wealth in a state has an impact on the number of exam-takers, but indirectly. We compared a standard score (z-score) for personal income per capita and population variables (number minus mean, over standard deviation). The total number of exam-takers is not correlated with personal income per capita z-score (Fisher, $p = 0.192$). We constructed a regression analysis using the predictors of the number of schools passing the audit, population z-score, and personal income per capita z-score, with the outcome variable of exam-takers ($R^2 = 0.933$, Table 3). With $p = 0.064$, the per capita personal income z-score is not a significant influence. However, the number of schools passing the audit over the population is positively correlated with the per capita personal income z-score (Fisher, $p < 0.001$). A regression analysis with an outcome variable of the number of schools over the population and an income variable of the per capita personal income z-score explains 23.6% of the variance between states ($R^2 = 0.236$, coefficient 0.021, standard error 0.005, $p < 0.001$).

These results suggest that wealth does not directly drive the number of exam-takers. Personal income per capita predicts the number of schools passing the audit. The number of schools passing the audit strongly influences the number of exam-takers. Wealth creates the opportunity to take AP CS (increases the number of schools passing the audit), and the opportunity combined with a larger population results in more exam-takers.
GPS teacher responsible for state's top rank for female students in AP computer science classes

by Casey Philips
Research Questions

1. How do we develop more CS teachers?
2. How do we teach everyone computing?
3. What is the impact of teaching computing?
1. How do we develop more CS teachers?

• What skills do CS teachers need?
  • Our studies suggest that the best CS teachers read and comment on student code – but rarely write code.

• How do we make CS learning more efficient?
  • How do we fit CS learning into a busy teacher’s day?

• How do we motivate teachers to learn CS?
2. How do we teach *everyone* computing?

- What will motivate non-CS students to pursue computing?
  - A media context for liberal arts majors.

- What about average and below-average students?
  - How much of computing is accessible to *everyone*?
  - How much of computing does *everyone* need?
2. How do we teach everyone computing?

• Is learning computing more like mathematics or more like science or something else?
  • Should we be using inquiry-based learning methods?
  • Are issues of “misconceptions” the same when we’re talking about a science of the artificial?
• What are developmental progressions for computing?
3. What is the *impact* of teaching computing?

- Can we expect general, transferable problem-solving skills from learning to program?

- Can we expect *application* of computing to improve learning in other disciplines?
  - Programming helps computational scientists and engineers understand. Students, too?
3. What is the *impact* of teaching computing?

- Can we expect that learning computing *improves* interactions with computers?
  - Are computing-savvy users more productive?
  - Fewer errors? Better recover?
    More secure?
Beyond research to policy

Who decides?

In some US states, no statewide secondary school requirements.

States where CS counts towards secondary school graduation
SPARE SLIDES
Where US STEM Jobs Will Be
Projected Annual Growth of Total STEM Job Openings 2010-2020

- Computing: 51%
- Engineering: 27%
- Life Sciences*: 7%
- Physical Sciences: 5%
- Social Sciences: 9%
- Mathematics: 1%

* STEM is defined here to include non-medical occupations.

Where the STEM Jobs Will Be
Degrees vs. Jobs Annually