



PROGRAMMING NEW YORK CITY STUDENTS FOR SUCCESS

A view of computer science education in New York City schools

BRONX BOROUGH PRESIDENT RUBEN DIAZ JR.

OCTOBER 2018



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Dear Friend:



Thank you for your interest in my latest report, “Programming New York City Students for Success,” and for your continued interest in the important education issues that face our city.

Throughout my time as an elected official I have always held the educational needs of our youth as one of my highest priorities. In particular, I have provided \$34,754,000 in capital funding for technology projects in our schools since taking office. This funding helped build and upgrade computer labs in schools across the borough, provide students with laptops and desktops, and give our teachers the smart classroom technology they need to deliver for our children.

My office’s advocacy for a fair and equitable educational system goes well beyond my capital budget. In recent years my office has pushed for greater fairness in our specialized high schools, expanded access to gifted and talented programs at every grade level and helped to create new service and job training programs that allow our children to prepare for the future, including the Bronx Youth Corps and the Bronx Private Industry Council.

We are also advancing plans to create a new tech hub in the South Bronx, working with business and community partners at every level. Given our Borough and our City’s place as a leader in education, workforce development planning and tech hub development, we must ask the following question: “How do we educate our students today in computer science and technology so they can be best prepared for the jobs of tomorrow?”

It is my intention to answer that question in this report, and to spark a conversation on how this city and state can provide a path forward on the equitable creation and implementation of a rigorous computer science curriculum in every school.

I look forward to your comments and feedback on this critical issue.

Sincerely,

A handwritten signature in black ink that reads "Ruben Diaz Jr." with a stylized flourish at the end.

Ruben Diaz Jr.

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A view of computer science education in New York City schools

Technology and education experts agree that computer science education is crucial to developing the logic, critical thinking and computational skills necessary to excel in many areas of life and learning. Additionally, there is much talk about STEM education and the gender and racial-based gaps in access to this valuable knowledge and skill set.

This report addresses the following question:

How do we capitalize on best practices in computer science education to optimally prepare New York City's students to develop the logic, critical thinking, reasoning and computational skills necessary to allow them to compete within a broad spectrum of careers?

INTRODUCTION

This report weaves together three (3) issues where Bronx Borough President Ruben Diaz Jr. has led for New York City.

Borough President Diaz has always been a staunch advocate for students and the necessity of strategic education policy. He has been a city-wide leader in strengthening educational policy, through the Borough Presidents' Task Force's multi-borough hearings and his recommendations for both Gifted and Talented Education and the Specialized High Schools admissions process, recommendations that were outlined in his task force report this past year.¹ Borough President Diaz has also provided guidance on issues such as school overcrowding and class size reduction by advocating for small class-size caps and calling for renewed focus on these issues by the current administration.

Further, The Office of the Bronx Borough President has promoted the establishment of a coding curriculum in our schools. This past year, The Bronx Borough President continued supporting our schools through capital funding, providing nearly \$10 million for much needed technology and school upgrades all over The Bronx. Since taking office in 2009, Borough President Diaz has provided \$69,997,000 in capital funding to 443 school projects, nearly a quarter of his office's total capital allocations during the time period.

Moreover, The Office of The Bronx Borough President has been actively engaged in career pathways and workforce development initiatives that engage in-school youth and youth from the ages 16 to 24 – a key age group in which the groundwork for future career success is laid – through work with the Bronx Overall Economic Development Corporation and other organizations that focus on workforce development and career readiness education. Borough President Diaz has pioneered and co-founded the “Bronx Private Industry Council,” a first-of-its-kind coalition of employers that brings together business leaders and educational institutions to provide pathways to good careers for Bronx youth through internships and other initiatives. These employers, which span a wide variety of businesses in The Bronx, have committed to hiring Bronx high school students for internships during the school year and summer positions and are looking towards providing many additional opportunities for them in the future.

The Bronx Private Industry Council brings local employers and the community closer together while providing high school students with valuable work experience and the added incentive of a real paycheck. The Bronx Private Industry Council’s pilot program began this summer, with over 225 students in The Bronx landing highly-coveted paid internships with diverse employers such as Montefiore, the Wildlife Conservation Society, Silvercup Studios and JetBlue, among others.

The Bronx has made great strides in increasing employment opportunities for its residents. As of May 2018, The Bronx unemployment rate was 4.7 percent, and roughly 120,000 more Bronx residents have jobs today than when Borough President Diaz first took office in 2009.ⁱⁱ However, the success of Bronx youth and their job readiness is still an area with much room for improvement. As of 2016, The Bronx had the highest rates of youth unemployment in New York City at 21.5 percent, approximately five percentage points higher than the citywide statistic,ⁱⁱⁱ and much higher than national statistics as of July 2017 showing youth unemployment at 9.6 percent.^{iv} For these reasons among others, youth workforce development is a priority.

The most recent Department of Education data indicates that the Bronx high school graduation rate is the lowest in The City at approximately 64%.^v This is due, in part, to The Bronx not getting its fair share of resources. There is a resource gap between schools even within New York City itself, when a comparison between schools in poorer versus wealthier neighborhoods in New York City are drawn.^{vi} Given the educational inequity that still pervades New York City’s schools, there is no doubt that The Bronx will benefit from new resources earmarked for computer science education.

The Office of Bronx Borough President has taken the lead in spearheading the plan of creating a Bronx Tech Hub in Mott Haven, convening its first Bronx Tech Summit at Hostos Community College in 2015 and second Bronx Tech Summit this past year at Metropolitan College of New York (Bronx Campus). The Office of the Bronx Borough President, in partnership with HERE to HERE, additionally convened a Digital Education Summit in Fall 2017. Tech education and computer science education were prominent themes of the Summit. These events, well attended by key leaders in the field, brought The Bronx one step closer to forming the Tech Hub. The Office of The Bronx Borough President engaged a team of NYU Wagner Capstone students who have assisted in drafting plans for its creation. In addition, The Office of the Bronx Borough President is actively working on the \$10 Million Dollar Bronx Downtown Revitalization Initiative, made possible by Governor Cuomo, that will bring this

Bronx Tech Hub closer to fruition.^{vii} As plans for a Tech Hub in The Bronx are being finalized, The Bronx Borough President's Office is turning its attention to the larger issue of the Bronx workforce and educational system as these are key components of a flourishing local economy.

The Office of The Bronx Borough President conducted independent research and interviews with stakeholders and experts in education. Together, these empirical methods provide the foundation for this report.^{viii}

SUMMARY OF RECOMMENDATIONS IN THIS REPORT

- 1. Create a widely-implemented model curriculum that embodies best practices that are timely, rigorous, innovative, and novel approaches to teaching math, science, and computer science curricula.** These methodologies, which include student-led inquiry (a format that allows students' curiosity and intellect to guide the learning process) are the key guiding principles recommended in this report. Implementation of the curriculum and the curriculum itself should address socio-economic, racial and gender disparities that inhibit equal access to computer science and tech education, resulting in disparities in career options.
- 2. Increase the required hours of Computer Science education mandated in elementary through high schools that surpasses the limited New York City Computer Science for All requirements ("CS for All"), currently being phased-in.** There is broad-based agreement that computer science education is essential, and full incorporation in the curriculum with a sufficient number of hours truly "walks-the-walk" instead of just "talking the talk" about the importance of computer science education. We can and must create more robust learning opportunities for all students in these areas.
- 3. Make addressing the resource gap a priority as a matter of public policy.** It is imperative that any proposed curriculum is implemented and funded equitably. Any phase-in of computer science curricula should first be aimed at creating avenues of access in areas where funding has historically been lacking. Adequate funding is vital to fostering excellence in this area and is key to achieving parity across New York City schools. Bronx educators report continuing resource scarcity when it comes to challenges they face in implementing robust computer science programs.
- 4. Additionally, it is imperative that the curriculum remains timely.** The curricula must be subject to constant review in order to keep pace with advances in the field and evolving technology. The Department of Education must also be held accountable for ongoing teacher training that parallels technology. Industry leaders in technology should, additionally, be consulted in framing the curriculum to ensure that students have access to cutting-edge advances in technology in their curricula.

5. Finally, education advocates should work towards enacting a specific project-based graduation requirement for Computer Science education. An initial step in this direction is to require sufficiently robust units of computer science in math and science Regents courses that are required for graduation in New York State. The existing curricula in these areas should be studied for sufficient inclusion of computer science units.

CURRENT LANDSCAPE OF COMPUTER SCIENCE

Netscape co-founder Marc Andreessen has said:

“The spread of computers and the Internet will put jobs in two categories. People who tell computers what to do, and people who are told by computers what to do.”

This statement implies that persons with the ability to understand and program computers will undoubtedly have greater access to high-level positions. This ability to “tell computers what to do” is one of the many skills a computer science education yields. Thus, it is crucial to creating opportunities for individuals in low-income communities to have access to a robust computer science education in order to realistically promote socio-economic mobility. Also, the eventual decline and fall of Netscape itself makes it clear that any new curriculum must be flexible and have the ability to adapt to changing trends in an ever-evolving industry.

Yet there remain significant disparities in who currently has access to computer science education.

A resource gap means that not all students have the tools required to support a quality education in computer science, and therefore are not provided equal access or exposure to computer science educational opportunities. There are examples of schools that receive donations of computers by parents or corporations, as one differentiating factor creating a “resource gap” between schools in more affluent areas and many under-resourced Bronx schools.

There are also noteworthy differences when race is factored in with who has access to computer science education and in who chooses to access such resources when they are available. Google’s own highly informative report on the topic cites the following:

“Overall, just over half (56%) of 7th to 12th grade students in the U.S. say their school offers at least one dedicated computer science class, and about half (51%) report that computer science is taught as part of other classes at their school. More than 4 in 10 students (44%) say there are after-school groups or clubs where students can learn computer science. African American students are less likely than Caucasian students to say their school offers a dedicated computer science class (47% vs. 58%).”^{ix} A student’s race must not determine his or her access to computer science education.

There is more inequality prevalent in this area than just the oft-cited problem of socio-economic and racial educational achievement gap. When it comes to computer science education, we also have a gender gap. Google’s report states:

“Female students are also less interested (16% vs. 34%) and less confident they could learn CS (48% vs. 65%). The lesser awareness, exposure, interest, and confidence could be keeping female students from considering learning CS.”^x This data presents a further compelling argument for mandatory exposure that serves to normalize computer science education for all, and serves to encourage girls and young women to have the confidence that they can learn computer science just as well as their male peers.

Consider the disparities in who seeks out computer science learning outside of schools:

“Female students are less likely than male students to be aware of CS learning opportunities on the Internet and in their community, to say they have ever learned CS, and to say they are very interested in learning CS. Despite presumably equal access to CS learning opportunities in schools, female students are not only less aware but also less likely than male students who have learned CS to say they learned it online (31% vs. 44%) or on their own outside of a class or program (41% vs. 54%).”^{xi}

The racial and gender gaps in this area are important when salary draw is factored in. We all have seen and heard news reports regarding the multi-million dollar salaries and bonuses attendant to Silicon Valley CEOs or technology managers. Additionally, more than two-thirds of tech jobs are, in actuality, outside the “tech sector” in high paying fields such as banking.^{xii} Further, mandatory computer science exposure is a key feminist issue that may result in better pay equity, according to the data from Google’s report cited about a lack of confidence and interest by girls in this subject. In short, investing in computer science education may work to lessen the racial disparities in access to education and economic opportunities, but also work tangentially to close the gender pay gap by offering women better access and a foundation to higher paying jobs and career tracks.^{xiii}

The racial and gender disparities in Computer Science education at the high school level are evident in an examination of who sits for the Computer Science Advanced Placement exam as well.

“The College Board offers two Advanced Placement (AP) exams where high school students can demonstrate their understanding of computer science and earn college credit: AP Computer Science A and AP Computer Science Principles. The latter test was launched this year. Code.org found that the number of AP computer science test takers more than doubled from last year to 111,262 test takers in 2017. However, only 20% of the test takers were students of color and 27% of the test takers were female. These percentages highlight the need to provide each student with access to computer science education throughout their schooling, enabling them to learn important knowledge and skills to help close equity gaps in achievement and employment.”^{xiv} [emphasis added]

This report proceeds from the notion that schools must provide opportunities for educational, intellectual, financial and professional success for *all* students. Computer Science affords these opportunities.

According to Code.Org, only 22 states have computer science standards.^{xv} New York has the opportunity to be a state at the forefront of a computer science educational initiative.^{xvi} Only

40 states and D.C. allow high school students to count computer science classes towards graduation requirements.^{xvii} And, while 90 percent of parents want their children to study computer science, only 40 percent of schools even teach computer programming.^{xviii} Thus, we must make computer science more widely available.

NYC DOE's "CS for All," while a step in the right direction, falls short of meeting rigorous standards for computer science instruction at the middle and high school levels. If there is general agreement that computer science instruction is important, why not mandate substantial instructional time to it and fund teacher training at the requisite levels? Investing in computer science education is a cognitive boon, a key skill for the new workforce. President Obama's administration, in implementing an initiative on it, even termed the lack of computer science preparedness of our country's students a national cyber-security issue.^{xix} This is the true magnitude of the issue.

RECOMMENDATIONS FOR COMPUTER SCIENCE EDUCATION

As we move towards more full-scale implementation of computer science curricula throughout New York City and New York State by expanding Computer Science requirements, we must examine the principles that should guide the curricula, and the values the curricula should exemplify. This report examines best practices.

Current Requirements

The current requirements of NYC DOE's "CS for All" are insufficient to advancing the goals of access and proficiency when it comes to truly investing in computer science education. The "CS for All" website states that by 2025 every student will have a "meaningful unit" of computer science education. In examining this plan, we must pose the question: What exactly is a "meaningful unit?" Per the "CS for All" criteria, a "meaningful unit" is 10-25 hours of instruction time.^{xx} Simply stated, we need higher standards. We must mandate and fund computer science education at a level greater than the current standard of a "meaningful unit." In short, additional hours should be required at the elementary, middle school and high school levels.

The Borough President's office urges the DOE to be more courageous in its plan for computer science education in our schools. Computer science required units must far exceed the 10-25 hour "meaningful unit" standard currently required under the "CS for All" plan. **Why bother to make a gesture rather than a full-fledged effort to effect children's' educational trajectories? This subject is too important to remain timid in changing the course of our students' future. To be truly impactful, a more robust minimum "meaningful unit" requirement is needed in New York City schools, especially at the middle and high school levels.**

Key principles for a model curriculum

The model curriculum must:

- a. Teach students the principles of logic and critical thinking, as well as encourage the development of computer science skills that will serve to enhance their options for varied career tracks in a constantly evolving workforce.
- b. Encourage the methodology of student-led inquiry, training students to lead and to drive technology, not to have technology drive them.
- c. Integrate technology into the curriculum.^{xxi}
- d. Incorporate elements of CSTA standards in the New York State model standards: which are:
 - “Introduce the fundamental concepts of computer science to all students, beginning at the elementary school level.
 - Present computer science at the secondary school level in a way that can fulfill a computer science, math or science graduation credit.
 - Encourage schools to offer additional secondary-level computer science courses that will allow interested students to study facets of computer science in more depth and prepare them for entry into the workforce or college.
 - Increase the availability of rigorous computer science for all students, especially those who are members of underrepresented groups.”^{xxii}
- e. Review and revise curriculum on a consistent basis to ensure alignment with core competency areas necessary for success in academia and the workforce. Curricula should be frequently updated as technology evolves. Frequent updates to any curriculum in this area are a key component in order to give students the best chance at development and workforce skills.
- f. Expand access/opportunity for teacher training. The good news is that there is a method for obtaining teacher certification in Computer Science, professionalizing the teaching of this subject as a discipline that was established this year by the New York State Board of Regents.^{xxiii} It is now a tenure area for teachers.^{xxiv}
- g. Include coding as part of the curriculum. Coding should not dominate the curriculum, however, as it is only one aspect of computer science.
- h. Encompass best practices in curriculum design informed by discussions with stakeholders, including university educators and employers in the computer science field.
- i. Merge thoughtful approaches to integration of computer science into other subject areas. Computer science elements should be integrated into other subjects to engage students who may not initially choose higher-level computer science classes without earlier exposure in subject areas in which they already have a strong interest.
- j. Undertake computer science education even in schools with failing math scores. Children who have the least resources have the most to gain from the implementation of novel approaches that enhance their educational options.

CONCLUSION

We must impose greater requirements for computer science education at the elementary, middle and high school levels that exceeds the NYC DOE “CS for All” Standards. New York City must model a curriculum that is interesting yet robust so that it challenges students through student-led inquiry and integrates the necessary skill sets into other subjects that benefit from this interdisciplinary work. In order to start addressing the inequity that exists in computer science educational pipelines along racial and gender lines, the recommendations in this report should be implemented expeditiously. The academic success and career readiness of tomorrow’s students in a world that rely more on technology each day depends on how this issue is addressed today. Moreover, in order to truly incorporate computer science education into the fabric of our schools a dedicated approach is required. Providing opportunities for computer science studies is the critical first step to be representative of the population of users that technology serves.

ⁱ The Gifted & Talented and Specialized High Schools Task Force was jointly run by The Brooklyn Borough President.

ⁱⁱ <http://bronxboropres.nyc.gov/old-site/pdf/bx-bk-bps-GiftedTalentedReport17.pdf>

ⁱⁱⁱ Data available at <https://www.labor.ny.gov/stats/nyc/index.shtm> (last accessed July 5, 2018).

^{iv} Source: <https://osc.state.ny.us/osdc/rpt4-2019.pdf>

^v Source: Bureau of Labor Statistics <https://www.bls.gov/news.release/youth.nr0.htm>

^{vi} <https://data.nysed.gov/gradrate.php?year=2017&county=32>

^{vii} <https://www.nytimes.com/2012/06/03/nyregion/at-wealthy-schools-ptas-help-fill-budget-holes.html>

^{viii} <https://www.governor.ny.gov/news/governor-cuomo-announces-bronx-civic-center-10-million-new-york-city-region-winner-second-round>

^{ix} Thank you to the Bronx educators and other computer science education experts who took the time to be interviewed about this important issue.

^x <http://services.google.com/fh/files/misc/diversity-gaps-in-computer-science-report.pdf>

^{xi} <http://services.google.com/fh/files/misc/diversity-gaps-in-computer-science-report.pdf>

^{xii} <http://services.google.com/fh/files/misc/diversity-gaps-in-computer-science-report.pdf>

^{xiii} See <http://fortune.com/2016/04/27/tech-skills-gap-stem/> (last accessed February 11, 2018)

^{xiv} See eg. <http://time.com/money/5233753/gender-pay-gap-every-state/>

^{xv} See: <https://www.regents.nysed.gov/common/regents/files/318hea2.pdf> (last accessed September 12, 2018)

^{xvi} <https://code.org/promote> (last accessed September 27, 2018)

^{xvii} Ibid

^{xviii} Ibid

^{xix} Ibid

^{xx} <https://obamawhitehouse.archives.gov/the-press-office/2016/01/30/fact-sheet-president-obama-announces-computer-science-all-initiative-o>

^{xxi} <https://blueprint.cs4all.nyc/what-is-cs/>

^{xxii} DreamYard in The Bronx told The Office of the Bronx Borough President narratives of success and student engagement that resulted from doing this.

^{xxiii} <https://www.csteachers.org/page/standards>

^{xxiv} See: <http://www.crainsnewyork.com/article/20180327/NEWS/180329893/new-york-will-finally-have-certified-computer-science-teachers>;

^{xxv} See: <https://www.nysut.org/resources/all-listing/research/fact-sheets/fact-sheet-certification-in-computer-science>



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