



Public Schools of North Carolina  
State Board of Education  
Department of Public Instruction

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# Report to the North Carolina General Assembly

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Expand Computer Science Opportunities  
to All Students in North Carolina K-12  
Schools

SL 2017-157, Part VI

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**Date Due: January 15, 2018**  
**Report # 48**

**NC DEPARTMENT OF PUBLIC INSTRUCTION**

**Mark Johnson, State Superintendent :: 301 N. Wilmington Street :: Raleigh, North Carolina 27601-2825**

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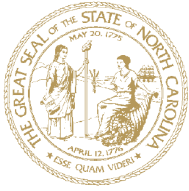
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DEPARTMENT OF PUBLIC INSTRUCTION | Mark Johnson, *Superintendent of Public Instruction*

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January 16, 2018

Chairs and Members of the Joint Legislative Education Oversight Committee:

Thank you for your dedication to education and successful outcomes for the students of North Carolina. Attached are our recommendations for expanding access to computer science to all students in our state.

Over the last two decades, a surge of technological advancements has radically changed the way we operate in everyday life. Handheld devices and applications use innovative approaches to simplify and expedite everyday tasks. In North Carolina, we have many large corporations who have infused technology into their business and rely on a steady pipeline of computer programmers and software engineers to complete complex tasks.

In fact, North Carolina has more than 18,000 unfilled computing jobs with an estimated \$1.5 billion in annual salaries available, yet there are fewer than 6,000 students enrolled in computer science courses across the state. If we do not equip our students with the proper education and training to fill these jobs, North Carolina will not be able to attract and retain this industry. By expanding computer science education, we will provide all North Carolina students with the access, tools, and knowledge in the fastest growing career field in the nation. Such expansion will translate into more jobs and a growing economy for our state. More importantly, we will provide our children the opportunity to work hard and reach their American Dream.

Our vision is to provide opportunities for all North Carolina students to learn computer science and gain the skills needed to create and contribute in the growing digital economy. Providing this for our students will prepare them to enter a successful career in the tech industry, a sector that includes careers that require everything from a high school diploma to a master's degree.

As always, we appreciate your hard work and efforts to help our students have the tools they need to succeed. Please don't hesitate to contact us with any questions.

With best regards,

Handwritten signature of Mark Johnson.

NC Superintendent Mark Johnson

Handwritten signature of Dan Forest.

Lt. Governor Dan Forest

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AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER

# **EXPAND COMPUTER SCIENCE OPPORTUNITIES TO ALL STUDENTS IN NORTH CAROLINA K-12 SCHOOLS**

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*Submitted to:*

Joint Legislative Education Oversight Committee

*Prepared by:*

Office of the NC Superintendent of Public Instruction  
North Carolina Department of Public Instruction  
The Friday Institute, NC State University  
North Carolina School of Science and Mathematics

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# Expand Computer Science Opportunities to All Students in North Carolina K-12 schools: Recommendations for Policymakers

This document provides recommendations to be considered by the General Assembly pursuant to SL 2017-157, Part VI, *Study/Expand Computer Science to All Students*, which called for the following:

**SECTION 6.(a)** The Superintendent of Public Instruction and the Department of Public Instruction, in collaboration with the Friday Institute for Educational Innovation at North Carolina State University (Friday Institute) and the North Carolina School of Science and Mathematics (NC School of Science and Math), shall develop recommendations to further the teaching and student learning of computational thinking and computer science in North Carolina K-12 schools.

In developing recommendations, the Superintendent and the Department, in collaboration with the Friday Institute and the NC School of Science and Math, shall do at least the following:

1. Develop curriculum guidelines that are aligned with K-12 Computer Science Framework (October 2016) developed by the CSforAll Consortium.
2. Develop recommendations to increase the number of teachers prepared to teach computational thinking and computer science, addressing both preservice educator preparation for teachers and professional development for in-service teachers.
3. Develop policy recommendations.
4. Align recommendations with the ongoing implementation of the Digital Learning Plan in North Carolina by the Department and the Friday Institute.

**SECTION 6.(b)** By January 15, 2018, the Superintendent of Public Instruction shall report to the Joint Legislative Education Oversight Committee on the recommendations, including any proposed legislation, developed in accordance with this act.

This document was prepared by the Office of the State Superintendent and North Carolina Department of Public Instruction (NCDPI) in collaboration with the Friday Institute for Educational Innovation at NC State University, the North Carolina School for School and Mathematics (NCSSM), and the North Carolina Chapter (CS4NC) of the Expanding Computer Education Pathways (ECEP) Alliance, through a process that involved input from multiple stakeholders, including a CS4NC Summit in May 2017 that included representatives from the private sector, community groups, non-profits, universities, community colleges, K-12 schools, state agencies, and national computer science education networks. It also included analyses of North Carolina data, the development of a [North Carolina Computer Science Education Landscape Report](#), and the collection and consideration of national recommendations and policy initiatives in other states. The Landscape Report is provided with this document and summarizes the current state of computer science education in NC and the rationale for a focus on expanding computer science in K-12 education.

The recommendations are guided by the [K-12 Computer Science Framework](#) developed in 2016 by a national collaboration of education organizations, states (including North Carolina), school districts, and businesses. This Framework summarizes the importance of computer science for all students, provides high-level guidance on the foundational concepts and practices appropriate for K-12 students, including *computational thinking* (formulating problems and developing solutions with sufficient specificity that they can be carried out by computers), *coding* (translating the steps of solving problems into a language computers can understand), *computer systems* (e.g., how the Internet works), and the *societal implications* of advances in digital technologies (e.g., privacy, security, and social and economic impacts). The recommendations also consider the Code.org [Nine Policy Ideas to Make Computer Science Fundamental in K-12 Education](#) and are designed to move North Carolina forward in implementing each of those ideas to become a leading state in computer science education.

In this document, computer science education is viewed as part of the North Carolina digital-age learning model as described in [NC K-12 Digital Learning Plan](#), and as such should incorporate the approach that includes: personalized learning and flexible resources; advancement based on content mastery and competency; anywhere, anytime learning; student-centered learning with teachers as instructional leaders; digital content; assessments built-in to activities; and project-based learning. The following recommendations also build upon the foundation provided by the ongoing implementation of the NC Digital Learning Plan, which involves preparing district leaders, school leaders, and classroom teachers to implement digital-age teaching and learning, and providing the technology infrastructure necessary to support computer science education in K-12 schools.

### **Goals for Computer Science in K-12 Education**

The overall goal is to provide opportunities for all North Carolina students to learn computer science and gain the skills needed to: (1) create and contribute, not just use and consume, in the digital economy; and (2) actively engage as informed citizens in our complex, technology-driven world. Through collaboration and communication with multiple stakeholders, a coordinated statewide computer science initiative will strengthen pathways from kindergarten to career, address equity gaps, leverage successful programs, and encourage cross-sector partnerships throughout the state.

The recommendations described below are intended to enable North Carolina to add foundational computer science concepts and practices to the North Carolina Standard Course of Study for all students and to provide opportunities for the more advanced study of computer science to interested students in every North Carolina public middle and high school. We propose a plan that will enable computer science education to be fully established and sustained within North Carolina's K-12 education system. To do so, the recommendations address the following to be achieved during that four year period:

**Curriculum:**

1. Rigorous computer science content standards for K-12 students
2. High-quality computer science curriculum materials, aligned with the content standards, approved and available to all schools
3. Articulated computer science and related course sequences in middle and high school to support pathways for students into college and careers

**Teachers:**

4. Preservice and inservice professional development programs that prepare at least 500 certified computer science teachers by 2021-2022
5. Computer science integrated into preservice and inservice programs to prepare teachers to include computer science concepts and practices in their curriculum as appropriate.

**K-12 Schools:**

6. Computer science concepts and practices integrated into the K-12 curriculum to enable all students to meet the workforce technology expectations
7. One computer science course offered to middle school students and both an introductory and an advanced placement course offered to high school students (in-school, virtually, or blended)
8. Strategies implemented to increase participation in computer science courses and interest in computer science related careers by all middle and high school students, with dedicated efforts to engage students from underrepresented groups, including female, low-income, and minority students

**Recommendations for a Four Year Initiative**

We recommend the following action steps, grouped into four categories:

- Phase One Recommendations
- Curriculum Recommendations
- Preparing Teachers Recommendations
- K-12 Schools Recommendations

In each section, we first provide the recommended action steps for the overall four year initiative, and then describe the priorities for Year 1, for consideration during the 2018 legislative session.

**Phase One Recommendations for Immediate Action**

Coordinated efforts will involve the Department of Public Instruction (NCDPI), State Board of Education (NCSBE), the Friday Institute, the North Carolina School for Science and Mathematics (NCSSM), Local Education Agencies (LEAs), public and private Institutions of Higher Education (IHE's), Community Colleges (CCs), the Computer Science for North Carolina Collaborative (CS4NC), regional and local partnerships, private sector business, and others.

<b>Action</b>
Establish a senior position at NCDPI with leadership responsibility and authority for all the computer science initiatives across both core academic and career and technical education programs.
Identify the target number of trained teachers and virtual offerings that combined will be necessary to accomplish the goal of offering one class in every middle school and two classes (one advanced) in every high school.
Begin statewide integration of computer science into the NC K-12 education system, including addressing the shortage of qualified computer science teachers.
Collaborate with private sector and nonprofit organizations to enhance resources available for computer science education.
Prepare and disseminate materials to parents, students, and educators to inform them of computer science education opportunities and the career paths available to graduates with those skills.

### ***Curriculum Recommendations***

These recommendations are designed to make computer science a core part of K-12 education, at equal status with other sciences and areas of mathematics, and to infuse modern technological expectations into the overall NC Standard Course of Study.

<b>Action</b>
Develop K-12 computer science standards to be added to NC Standard Course of Study, aligning these standards with the K-12 Computer Science Framework and the Computer Science Standards developed by the Computer Science Teachers Association.
Work with stakeholders to assist in the review and approval of computer science curriculum materials aligned with workforce expectations.
Develop coherent course sequences and student pathways for K-12 to the workplace and college.
Update policies to make computer science part of the core high school curriculum and allow all computer science course credits earned by students to fulfill science, mathematics, or CTE requirements. Work with institutes of higher education to ensure that these courses are aligned and recognized for minimum entry requirements.
Integrate computer science concepts and practices into the K-12 Essential Standards for Information and Technology.
Utilize existing and developing higher education dual enrollment opportunities for high school students.
Offer virtual computer science courses for middle school and high school students.



Making significant progress on all of the curriculum recommendations is a priority during Year 1, since establishing necessary content standards, course sequences, career pathways, and policies are foundational to developing the teaching workforce required to meet the overall goals of the computer science education initiative.

***Teacher Recommendations***

The major challenge for expanding computer science education is the education workforce. North Carolina, along with all other states, has a lack of teachers prepared to teach middle school and high school computer science classes, teachers of other content areas have not been prepared to incorporate computer science concepts and practices as appropriate to their subject areas, and our capacity to expand our computer science educator workforce is limited.

<b>Action</b>
Review the licensure requirements for all K-12 teachers and determine whether or not to update licensure requirements to include understanding and being prepared to teach computer science concepts and practices.
Leverage existing professional development public-private partnership opportunities to quickly and effectively prepare current North Carolina public school teachers to teach computer science courses and foundational skills.
Update preservice teacher education programs to prepare future teachers to integrate computer science across the curriculum.
Increase the number of preservice teacher education programs that prepare qualified teachers of computer science courses at the middle and high school level, including advanced placement courses.
Continue, expand, and utilize public-private partnerships to prepare teachers of approved middle school and high school computer science courses and to prepare other teachers to incorporate computer science concepts and practices into the curriculum.
Establish focused lateral entry and alternative certification programs to enable people with computer science expertise to be licensed to teach.
Ensure that teacher recruitment and retention efforts target computer science teachers as a high priority group.
Add computer science concepts and practices to the professional development programs offered as part of the NC Digital Learning Plan and to other professional development programs for teachers and administrators as appropriate.
Continue and build upon the Coding & Mobile App grant program to encourage local, workforce-driven professional development, and curricular offerings.

Year 1 will leverage and expand existing programs. In the following years, best current practices and lessons will be used to extend preservice and inservice programs statewide.

### ***K-12 Schools Recommendations***

Districts and schools are at different levels of readiness and have different levels of expertise and resources available. Some already have initiatives well underway and are positioned to serve as models for others. Many are just beginning and will require multiple years and support to reach these goals.

<b>Action</b>
Provide guidance to LEAs and schools in planning and implementing initiatives to address State computer science education goals.
Provide virtual computer science courses for middle school and high school students.
Identify and provide resources to support the integration of computer science concepts and practices into local curricula to enable students to meet the computer science content standards.
Through phased implementation, ensure that every district is able to offer at least one computer science course to middle school students and both an introductory and an advanced course to high school students (either in-school or virtually).
Implement strategies to increase participation in computer science courses and interest in computer science related careers by all middle and high school students, with dedicated efforts to engage students from underrepresented groups, including female, low-income, and minority students.

### ***Immediate Steps for 2017-2018***

1. Establish Computer Science Senior Position at NCDPI
2. Provide to the 2018 Short Session of the General Assembly a detailed budget for the first year of Computer Science implementation across the state
3. Establish the Computer Science Content Standards review structure and internal and external stakeholder input process consistent with State Board policy