Computer Science and Technology in Public School Task Force:

Report of Activities, Findings, and Recommendations
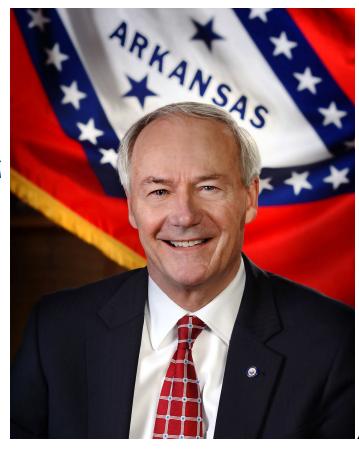
November 1, 2016

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Arkansas Governor Asa Hutchinson

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Commissioner of Education Johnny Key

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Overview of Report

Background

The Arkansas Computer Science and Technology in Public School Task Force (CSTF) was established by Act 187 of the 2015 Regular Session of the 90th Arkansas General Assembly. Act 187 of 2015 was sponsored by Representative Bill Gossage and others.

On April 3, 2015, Gov. Asa Hutchinson appointed the members of the CSTF and provided them with a charge to research and recommend computer science and technology courses and standards, study the computer science and technology needs of the state, and recommend strategies to meet the anticipated computer science and technology workforce needs of the state.

Johnny Key, Commissioner of Education, called the inaugural meeting of the CSTF to order at 9:30 a.m. on April 17, 2015. Commissioner Key, believing that the CSTF should be led by someone not working for a state agency, asked for chairperson nominations. Dr. James Hendren was nominated, unanimously elected, and agreed to serve as Chair of the CSTF. In addition to the April 17th meeting, the full CSTF has held five (5) additional meetings: May 8th; June 8th; July 22nd; September 3rd; and October 13th, and numerous subcommittee meetings.

Statutory Authority

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Report Highlights

The 2016 report of the CSTF contains information and suggestions regarding Arkansas's efforts and needs of recruiting and retaining computer science teachers; providing relevant and purposeful professional development for all teachers; active and sustained engagement of the initiative for students, parents, educators, industry leaders, and state agency representatives; and other critical success factors for the initiative.

Act 187 requires that every Arkansas public high school and public charter high school offer at least one computer science course at the high school level; however, the greatest obstacle to the long-term success of the initiative is the lack of qualified and certified computer science teachers in the state.

Computer science teacher recruitment and retention is also critical to the expansion of computer science course offerings, beyond the minimums required by Act 187, across the state.

Ongoing state funding for teacher preparation, recruitment, professional development; state, district, and school infrastructure/hardware; and curriculum development at both the state and local level is necessary for the success and long-term growth of this initiative.

According to Code.org, 67% of new STEM jobs are in computing, but only 8% of STEM graduates are in computer science. There are currently over 1,750 open computing jobs in Arkansas at an average salary of $68,933.00, yet there were only 250 computer science graduates in 2015. Therefore, funding computer science education provides Arkansas with the opportunity for a very high job-market return-on-investment.

Beliefs for Computer Science Education in Arkansas

During the July 22, 2015 meeting, the CSTF voted unanimously to adopt the following: **Beliefs for Computer Science Education in Arkansas**
- Arkansas believes that every K-12 student in Arkansas deserves a premier computer science education that is suitable for his or her needs and can support his or her college and/or career aspirations.
- Arkansas believes that Arkansas will become and remain a national leader in computer technology careers through the implementation of a vertically articulated and comprehensive K-12 computer science education designed to support appropriate technological growth in all Arkansas students.
- Arkansas believes that, due to the nature of technology, computer science education development in Arkansas must be adaptable, dynamic, and ongoing and based on research by content area experts.
- Arkansas believes that professional development opportunities must be provided that meet the grade-band specific technological needs of educators in a modern society.
- Arkansas believes that Arkansas educators must provide their students with an education that will facilitate the advance of useful technological skills and promote their role as digital natives.
- Arkansas believes that appropriate and continued collaboration with stakeholders will lead to a sustainable computer science educational system that is beneficial to students and Arkansas.
- Arkansas believes that utilizing the wisdom of Arkansas educators who represent all grade levels, content areas, and regions of the state, in the development and periodic revisions of the K-12 Computer Science Standards is fundamental to ongoing successful implementation.
- Arkansas believes that Arkansas's current, potential, and future industries that use computer technology should play a vital role in the development, implementation, and evolution of computer science education in Arkansas.
- Arkansas believes that the Arkansas Department of Higher Education and Arkansas's institutions of postsecondary education are instrumental in establishing and adapting the goals of secondary computer science education in Arkansas.
- Arkansas believes that the Arkansas Department of Career Education has created a catalog of beneficial computer science courses that should evolve to become a component of this initiative and through which students can access additional areas of specialization.
- Arkansas believes that parents and other community members should be knowledgeable of the requirements of the Arkansas K-12 Computer Science Standards and be afforded the opportunity to provide feedback prior to adoption and revision of the standards.

National Perspective of Computer Science in Arkansas

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Code.org has identified the following 8 key policies that help to provide all students with access to computer science:

1. Define computer science and establish rigorous K-12 computer science standards,
2. Allocate funding for rigorous computer science professional development and course support,
3. Implement clear certification pathways for computer science teachers,
4. Create incentives at institutions of higher education to offer computer science to preservice teachers,
5. Establish dedicated computer science positions in State and Local Education Authorities,
6. Require that all secondary schools offer computer science with appropriate implementation timelines,
7. Allow computer science to count for a core mathematics or science graduation requirement, and
8. Allow computer science to count as a mathematics or science admission requirement at institutions of higher education.

In 2015, Arkansas had programs in place supporting numbers 2, 5, 6, 7, and 8. Since the 2015 initial report Code.org has recognized that Arkansas's efforts have, in addition, met the requirements of numbers 1 and 3. The state continues attempt to clarify the requirements of number 4 and research implementation possibilities.

Computer Science and Technology in Public School Task Force Activities, Findings, and Recommendations

CSTF Focus Areas

The CSTF identified the following six areas of focus crucial to the success of the Arkansas Computer Science Initiative:

1. the necessity for appropriate and continued communication about computer science and the, opportunities it presents for jobs and economic development in order to sustain momentum of the current progress,
2. the necessity to move from a disjunct system of courses and programs to a comprehensive systematic K-16 progression of courses,
3. the necessity to develop success-measurement criteria,
4. the necessity to increase the quantity and quality of computer science educators,
5. the necessity to identify resources that are most critical to the success of the initiative, and
6. the necessity for Arkansas-based industries to provide support of the initiative and guidance regarding their workforce needs.

CSTF Subcommittees

In order to further facilitate discussions regarding these areas of focus, the following five (5) subcommittees, with the listed chairs appointed by Dr. Hendren, were formed during the May 8, 2015 meeting:

- Awareness - Chair, Dave Wengel
- Curriculum - Chair, Carl Frank
- Metrics - Chair, Dr. Brett Powell
- Professional Development and Training - Chair, Andy Mayes
- Resources - Chair, Dr. Suzanne Mitchell

2015 General Recommendations

1. During the July 22, 2015 meeting, the CSTF voted unanimously to recommend:
   a. that the Commissioner of Education at ADE begin the development process for comprehensive K-12 Computer Science Standards, and
   b. that the ADE use the CSTA K-12 Standards as a guiding document for the state's standards development.
2. During the October 13, 2015 meeting, the CSTF voted unanimously to formally recommend that ETS begin the development of a multistate PRAXIS II for computer science based in modern standards as soon as possible.
3. The CSTF also strongly recommends that as schools are implementing first-year computer science courses/experiences that the students are engaged in actual programming as quickly as possible in the course work, instead of an extended recitation of theory before hands-on experience. This will allow for an early excitement for computer science via the feeling of accomplishment.

2015 General Recommendation Updates

1. The CSTF acknowledges and applauds the state's swift and comprehensive development and adoption of K-12 computer science standards and courses. The K-8 Computer Science Standards Development Committee, which developed and recommended the state's K-8 embedded computer science standards and Coding Block for Grades 7/8, was composed of K-8 classroom educators spanning multiple subject areas, business education teachers, secondary and post-secondary computer science educators, school administrators, an Arkansas Department of Career Education Specialist, ADE Curriculum and Instruction and Licensure Specialists, and computer science industry representatives. The State Board of Education (SBE) adopted the recommended standards and coding block, which can be accessed at www.arkansased.gov, during its January 2016 meeting.
   The 9-12 Computer Science Standards Development Committee, which developed and recommended the state's 9-12 Computer Science Standards and courses, was composed of approximately 35 teachers, curriculum specialists, higher education representatives, and industry specialists. The SBE adopted the recommended standards and courses, which can be accessed at www.arkansased.gov, during its August 2016 meeting.
   School level implementation of the standards and new courses adopted is to begin with the 2017-18.
2. The CSTF acknowledges that the Educational Testing Service (ETS) has began selecting individuals to serve on the Computer Science National Advisory Committee (NAC). Anthony Owen, ADE Coordinator of Computer Science, and Carl Frank, Task Force Member, have received and accepted invitations to serve on this NAC.
3. The CSTF extends this recommendation to include that ADE continues to recommend this practice to schools and PD providers evaluate PD proposals with this recommendation as part of the evaluation criteria.

2016 CSTF Agendas and Notes may be accessed at: https://goo.gl/bpILbq

Continued Subcommittee Recommendations

The following are the priority subcommittee recommendations forwarded by the CSTF:

Awareness Recommendations

The awareness committee recommends four key areas of focus to build broader awareness around:
1. the value of all K-12 students having exposure to computer programming opportunities,
2. a special emphasis on showing value to girls and minority communities,
3. working with leading colleges and universities in the state to advance the curriculum and help educate the next generation of computer science teachers, and
4. educating teachers, counselors, principals, superintendents, students, and parents on the opportunities in Arkansas for careers and high-paying jobs in computer science.

Quantifiable goals of #ARKidsCanCode include:
1. that within 5 years that at least 20% of all Arkansas public high school students take at least one high school computer science course by graduation,
2. that 100% of all Arkansas students are shown a promotional video in school each school year supporting the taking of a computer science course, and
3. that each year there are at least four events around the state with statewide and/or national partners similar to the successfully completed "Head of the Class Bash." These events should be focused on awareness building amongst four target groups: students and their families; private companies and foundations; educators/school districts; and media.

Metrics Recommendations

The metrics committee identified the following measurable state goals critical for the success of the initiative.

Primary Goal
By 2020, 20% of graduating seniors have enrolled in a high school computer science course.

The following courses* will be used to measure this goal in 2015-2016 and 2016-2017:
- Essentials of Computer Programming
- Computer Science and Mathematics
- Intro to Computer Science
- AP Computer Science Principles
- AP Computer Science A
- IB Computer Science (SL and HL)
- Intro to Mobile Applications Development
- Mobile Applications Development I and II
- Programming I and II
- Java I and II
- Object-Oriented Programming
- Computer Game Design
- any of the 2017-2018 SBE adopted courses that are implemented early by schools

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The following courses** will be used to measure this goal beginning in 2017-2018:
- High School Computer Science Levels 1-4 (all emphases)
- Mobile Application Development Levels 1-4
- Robotics

- Advanced Programming
- Game Design
- Advanced Networking
- Advanced Information Security
- AP Computer Science Principles
- AP Computer Science A
- IB Computer Science (SL and HL)
- Computer Science Independent Study
- Computer Science Internship

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Secondary Short-Term Goals
- Increase the number of schools offering computer science courses face-to-face in the school with a recommendation to provide incentives to school districts to encourage participation. Incentives should be available for certification costs to teachers, stipends to teachers, scholarships to students, and student loan forgiveness for computer science teachers.
- Increase the number of licensed or endorsed computer science teachers in the state qualified to teach the measured computer science courses.
- Increase the number of public/charter high schools with a licensed or endorsed computer science teacher qualified to teach the measured computer science courses to 95% by the 2020-2021 school year.
- Track changes in college and career readiness measures to determine whether math readiness is impacted. In 2015, public/charter high school graduates meeting the ACT college readiness benchmark in math was 35%. It is outside the scope of the task force to set goals around college readiness. Instead, the goal is to see no regression in this measure.

Secondary Long-Term Goals
- Increase total enrollments in all other high school level computer science courses
- Increase enrollments in concurrent computer science courses
- Increase the number of jobs in computer science within Arkansas as indicated by the following Standard Occupational Classification codes:
  - 15-1121 - Computer Systems Analysts
  - 15-1122 - Information Security Analysts
  - 15-1131 - Computer Programmers
  - 15-1132 - Computer Software Engineers, Applications
  - 15-1133 - Computer Software Engineers, Systems Software
  - 15-1164 - Web Developers
  - 15-1141 - Database Administrators
  - 15-1142 - Network and Computer Systems Administrators
  - 15-1143 - Computer Network Architects
  - 15-1151 - Computer Support Specialists
  - 15-1152 - Computer Network Support Specialists
  - 15-1199 - Computer Occupations, All Other

- Increase the number of students graduating from computer science certificate and degree programs at Arkansas colleges and universities. Graduate numbers will be measured based on the following computer science and related Classification of Instructional Programs (CIP) codes.

- ○ 11.01) Computer and Information Sciences, General
- ○ 11.02) Computer Programming
- ○ 11.03) Data Processing
- ○ 11.04) Information Science/Studies
- ○ 11.05) Computer Systems Analysis
- ○ 11.06) Data Entry/Microcomputer Applications
- ○ 11.07) Computer Science
- ○ 11.08) Computer Software and Media Applications
- ○ 11.09) Computer Systems Networking and Telecommunications
- ○ 11.10) Computer/Information Technology Administration and Management
- ○ 11.99) Computer and Information Sciences and Support Services, Other
- ○ 15.12) Computer Engineering Technologies/Technicians
- ○ 52.12) Management Information Systems and Services
- ○ 52.13) Management Sciences and Quantitative Methods

Curriculum, Professional Development, and Training Recommendations

Implementation summer 2015 and the 2015-2016 school year
1. ADE should continue working with STEM Centers, Educational Service Co-ops, ACE and other entities to identify and recommend Professional Development (PD) and curriculum options for teachers who would deliver the new ADE computer science courses (Code.org, Microsoft IT Academy, etc.).
2. ADE should start providing recommendations regarding programs/PD that are designed to help with Praxis preparation.
3. ADE should re-evaluate the Computer Science PRAXIS cut score and consider a more flexible range for current teachers attempting to gain certification this year and next (until further recommendations for test modifications are implemented).
4. ADE and ADHE should recommend that postsecondary institutions develop teacher specific computer science content programs as part of new teacher education.
5. ADE should request that Arkansas Higher Ed institutions develop summer instructional institutes for current teachers to prepare for the PRAXIS computer science exam.
6. ADE and ACE should work together closely in implementing computer science programs and recommendations of the CSTF.
7. ADE should include AP Computer Science Principles as a course that meets the school's Act 187 legislative requirement to offer a computer science course for the 2016-2017 school year.

Implementation summer 2016 and the 2016-2017 school year
1. ADE should allow districts to approve computer science PD hours that can count toward Alternate Licensing Plan (ALP) requirements for computer science certification. Determine an acceptable mix of contact hours and self-study w/ online resources (MOOCs, professional training services, summer institutes (see #5 above)).
2. Expand PD focus to include lower grade levels.
3. Develop resources and training to aid teachers in integrating computer science into K-8 curriculum as well as to prepare for the 9-12 courses.

4. ADE and ACE should solicit feedback from teachers who are currently teaching computer science in the state on the effectiveness of professional development opportunities and on what other resources are needed to prepare them to teach new courses in computer science.

Implementation within 5 years 2019-2020 school year
1. Align computer science education offered through ADE and ACE grades 9-12.
2. Provide PD resources based on the K-12 Computer Science Standards.
3. Develop a revised PRAXIS Computer Science exam and set a cut score appropriate for the new test.
4. Create and implement a teacher professional development program utilizing the state's post-secondary and other qualified institutions to provide appropriate, yet rigorous, computer science training for 3,000 K-12 educators per year for 5 years. These training programs should be based on a standard syllabus that was developed through research of best practices and include approximately 60 hours of professional development per educator.
5. Create and implement a workforce retraining plan for individuals already in the the workforce but needing/desiring addition computer science skills.
6. ADE, ACE, and ADHE work to align secondary and post-secondary standards to allow for continued growth of student transitioning from the K-12 to the post-secondary environment. This should include a reevaluation of post-secondary requirements and a push for K-12 schools to seek postsecondary credit opportunities for computer science work being completed in the K-12 environment.

Resource Recommendations

The following recommendations are those that were identified as the most critical needs for success of this initiative. The full list of recommendations with notes, can be found as Appendix A to this document.

Due to the need for ongoing funding, these recommendations are suggested for funding outside of the current $5 million biennium allocation:
- Increase in-service professional development opportunities provided by ADE/ACE; Education Service Cooperatives; STEM centers; Arkansas School for Mathematics, Sciences, and the Arts; local districts, and other interested parties
- Increase the number of public/charter high schools with a licensed or endorsed computer science teacher qualified to teach the measured computer science courses to 95% by the 2020-2021 school year with the following yearly benchmark goals:
  - 10% in 2016-2017
  - 20% in 2017-2018
  - 40% in 2018-2019
  - 60% in 2019-2020
  - 95% in 2020-2021
- Amend ADE Licensure Competencies to include computer science, based on the adopted K-12 Computer Science Standards.
- Modify all existing K-12 teacher education preparatory programs to include pre-service in computer science education.
- Employ a staff member, within each STEM center, designated to assist with computer science education.
- Encourage the Arkansas STEM Coalition to develop a job posting site either as part of their website or link to one that can focus on local STEM-oriented job opportunities for Arkansas students.

These recommendations are suggested for funding as part of the current $5 million biennium allocation:

- Develop a comprehensive set of K-12 Computer Science Standards.
- Assist in funding/expanding the annual Computer Science Summit.
- Provide up to $750,000.00 for teacher professional development educator scholarships payable to programs approved by ADE. Individual scholarships are not to exceed $2,500.00.
- Make available through a grant process, up to $375,000.00 for school curriculum development/purchase. Individual schools grants are not to exceed $2,500.00 and should not include the purchase of equipment.

Appendices

Appendix A: Additional Resource Subcommittee Recommendations

Recommendations for the State of Arkansas and State Agencies

ADE should investigate the potential impacts and benefits of changing the state's graduation requirements to include a high-school credit in computer science for all students and work with the Governor's office to determine if and when such a requirement change is warranted for Arkansas students.

ADE should continue employing a Computer Science Coordinator within the Commissioner's Office.

ADE should employ a curriculum specialist and professional development specialist highly qualified in computer science.

ADE should assign a teacher recruitment and retention specialist to focus primarily on computer science.

Arkansas Career Education (ACE) should continue employing a STEM Coordinator who is highly qualified in computer science.

Arkansas Department of Workforce Services and the Arkansas Department of Higher Education should each designate a contact within their agency who will field computer science inquiries and direct those inquiries to the ADE Computer Science Coordinator or other appropriate entity.

The state should continue efforts to expand availability and increase statewide speed of broadband internet services for educational institutions and Arkansas residents.

The state should actively work to attract nationally recognized coding competitions to Arkansas.

ADE should amend K-8 educator competencies to include computer science.

AETN should continue providing Arkansas educators with access to Lynda.com. Assessments required for teachers to gain recognized professional development hours should be developed.

The state should expand awareness opportunities and consider a professional public relations campaign.

The state should explore additional options, continue providing information on existing student loan forgiveness programs for computer science teachers, and expand the funding of student loan forgiveness programs for computer science teachers who are teaching in the classroom.

Computer science should be added as a critical shortage area at the state level.

Teacher Opportunity Program (TOP) funding should be made available for computer science education.

The regulations for state funded scholarships for students seeking STEM degrees, including computer science, should include a higher threshold for initial award, but increased flexibility to maintain the scholarship for students that continue STEM degree work.

Recommendations for Education Service Cooperatives (ESC), Post-secondary Institutions, and K-12 Districts

Each ESC should have an individual on staff designated to assist with computer science education within their region.

The Central Arkansas districts, that are not members of an ESC, should have an individual on staff designated to assist with computer science education within their region.

All post-secondary teacher preservice programs should include instruction in computer science education taught by a post-secondary computer science instructor.

Virtual Arkansas should continue providing computer science instruction; schools should be assessed the normal fee for services beginning once schools have had ample opportunity to improve teacher capacity in computer science. Beginning with the 2017-18 school year, any funding provided for Virtual Arkansas from the state and specific to computer science should only be provided to schools that either have a computer science licensed educator on staff instructing at least one section of computer science in a face-to-face model by the end of the school year.

Districts and schools should immediately begin the process of developing and/or selecting curriculum resources that will be used to implement the standards.

Arkansas districts and schools should regularly evaluate the computers, devices, and infrastructure to ensure it is adequate to meet teacher and student needs.

ESCs, STEM Centers, and districts should host coding competitions for the students in their area or district.

Recommendations for Business, Industry, or Other Entities

Arkansas industries/businesses should commit to integrating an internship/mentorship program for secondary and postsecondary students.

Arkansas Economic Development Commission should designate outreach personnel specifically employed to support Arkansas's Computer Science Initiative.

Arkansas businesses and industries should partner with local districts to provide students with opportunities and the support needed to elicit student solutions to real-world problems.

Arkansas businesses should provide internships in computer science disciplines.

Local entities should partner to provide after-school computing activities and coding workshops for students.

The Arkansas Computer Science Teacher's Association should continue its work to provide information to Arkansas computer science educators and provide suggestions to the proper entities to assist in the growth of the initiative.

Appendix B: Members of the Computer Science and Technology in Public School Task Force

Johnny Key, Department of Education, Commissioner of Education

Tom Chilton, Arkansas Economic Development Commission, Director of Technology Development

Dr. Charisse Childers, Department of Career Education, Director.

Dr. Brett Powell, Former Department of Higher Education, Director.

Daryl Bassett, Department of Workforce Services, Director.

Tim Atkinson, Arkansas Science & Technology Authority, President.

Carl Frank, Arkansas's Computer Science Teachers Association, President.

Gary Dowdy, Arkansas Academy of Computing, President.

Andy Mayes, Rogers. IT Solutions teacher, Bentonville High School. President of Arkansas Society for Technology in Education. A High School Computer Science Teacher.

Dr. Suzanne Mitchell, Little Rock. Executive Director, Arkansas STEM Coalition. Representative of the Arkansas STEM Coalition.

Rasesh Patel, Little Rock. Director of Product Development, Acxiom. Representative in the field of computer programming.

Dave Wengel, Little Rock. Founder and CEO, iDatafy. At-large member.

Dr. James Hendren, Technology Startup Consultant, Self Employed. Little Rock. At-large member.

Dr. David Hopkins, Clarksville. Superintendent, Clarksville School District. At-large member.

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