

# Securing the Future of Maryland: Computer Science Education for All



## ANNUAL REPORT 2020-2021

### Maryland Center for Computing Education

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# EXECUTIVE SUMMARY

The Maryland Center for Computing Education (MCCE) was formally established in statute and funded with the enactment of *Securing the Future: Computer Science Education for All* on July 1, 2018. The purpose of MCCE is to “expand access to high-quality computer science education in grades pre-kindergarten through 12 by strengthening the skills of educators and increasing the number of computer science teachers in elementary and secondary education (Maryland Code, § 12-118).” MCCE received an initial five million dollars in state funding and an additional one million dollars in state funding each year since 2018. The MCCE fund is a special, non-lapsing fund in which the balance remains with the center and is spent in accordance with the specifications in the law which governs the center.

This annual report provides the MCCE’s updated information. The purpose of this annual report is twofold. First, the report provides a descriptive analysis for how MCCE is in compliance with the law. Second, the report offers a detailed account for how MCCE is using state funds to assist each of the Maryland Local Education Agencies (LEAs) and the Institutions of Higher Education (IHEs) to strengthen the computing knowledge and skills of the Maryland teaching workforce. Through June 30, 2021, MCCE spent \$3,167,471.04 of the budget.

MCCE has provided state level professional development (PD) for a total of 1,022 educators from 595 schools across all of the Maryland LEAs. As of the 2019-2020 school year, 87% of the diploma granting high schools had at least one student enrolled in a high quality computing course. Of the 2020 Maryland public high school graduates, 26% took at least one high quality computing course while in high school with 59% of these graduates enrolling in college as a full-time student in the fall following graduation, and of these students, 19% declared a major related to computer science.

# IMPLEMENTATION PLAN

*Beginning in the 2021-2022 school year, each county board shall require each public high school in the county to offer at least one computer science course (Maryland Code, Education, § 4-111.4).*

The MCCE Advisory Committee has defined a high school as a diploma granting Maryland public high school. The metric toward compliance is to monitor that all diploma granting Maryland public high schools offer at least one high quality CS course each year beginning in the 2021-2022 school year. To monitor and provide data transparency, MCCE completed a research project with the Maryland Longitudinal Data System (MLDS) Center to review all of the computing education data since 2013. An outcome of this project is the published Maryland computing education dashboards. The [Dashboards: Participation in Maryland High Quality Computing Courses and Post-graduation Outcomes](#) were created using data from the MLDS (Garvin & Koerner, 2021). The online interactive dashboards provide stakeholders with data at the state, local school system, and local high school levels. As of the 2019-2020 school year, 87% of the diploma granting high schools offered and had enrollment of at least one student in a high quality computing course. There were 26% of 2020 Maryland public high school graduates who took at least one high quality computing course while in high school. Of these graduates, 59% enrolled in college as a full-time student in the fall semester following graduation, and of these students, 19% declared a major related to computer science.

Post High School Pathways of 2019 Participating Graduates

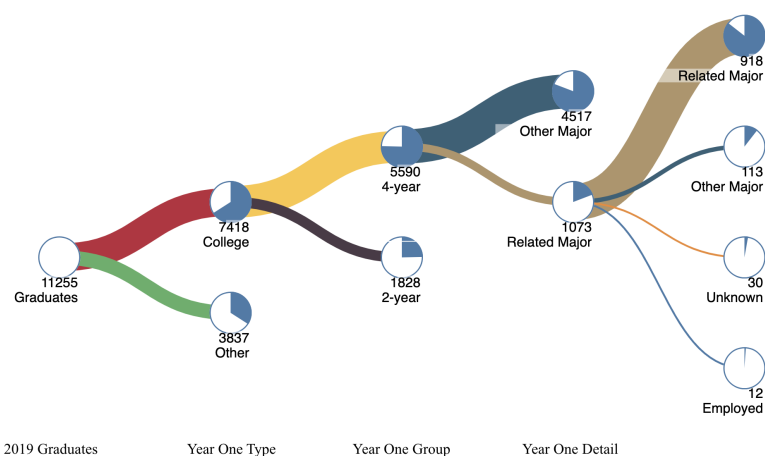


Figure 1: The post high school pathways of the 2019 Maryland public high school graduates.

The state details contain public high school graduate pathways beyond high school to higher education or workforce. (See Figure 1.) The 2019 Maryland public high school graduates who took at least one high quality computing course in high school attended a 4-year IHE more often than a 2-year IHE, and most of those graduates declared a major not related to computing. As the

number of graduates who take computing in high school continues to increase, we will continue to monitor the pathways these graduates take after graduation. With efforts to increase instruction at each education level from elementary through higher education, the number of students who obtain the necessary computing skills and content knowledge regardless of their intended college major or career will only strengthen the entire Maryland workforce and provide additional opportunities for all Maryland students to pursue more technologically advanced careers in their chosen fields.

*The computer science course shall be of high quality and meet or exceed the curriculum standards and requirements established by the State Board (Maryland Code, Education, § 4-111.4).*

The MCCE high quality CS workgroup identified high quality CS courses which meet or exceed the Maryland's K-12 Computer Science Standards. The list of courses will continue to be reviewed to account for any new computing courses. The specific high quality high school computing courses are listed in the data notes on the computing education dashboard.

*The county board shall make efforts to:*

- 1. Incorporate instruction in computer science in each public elementary and middle school in the county and;*
- 2. Increase the enrollment in middle and high school computer science courses of:*
  - I. Females*
  - II. Students with disabilities*
  - III. Students of ethnic, racial, and other demographic groups that are underrepresented in the field of computer science as identified by the U.S. Equal Employment Opportunity Commission (Maryland Code, Education, § 4 111.4).*

In order to monitor which students are taking computing courses, the dashboards provide multiple interactive visualizations to share with the public and interested stakeholders. At the state level, intersectional data is displayed and users are able to select which intersection variables to display. Kimberlé Crenshaw first used the term *intersectionality* in 1989 as she described the plight of Black women in the American legal system. Since then, intersectionality has been used to examine further the cumulative effect of an individual who

embodies multiple identities. Women of color in computing particularly have multiple identities which intersect and compound their oppression to the point that they can no longer determine if, in fact, they are at a disadvantage because they are women or because they are Black (Rankin & Thomas, 2020; Thomas, Joseph, Williams, & Burge, 2018). As shown in Figure 2, the intersection of gender and race/ethnicity provides insights into which student subgroups are taking a high quality computing course more often and which student subgroups are increasing in participation. While most student subgroups are

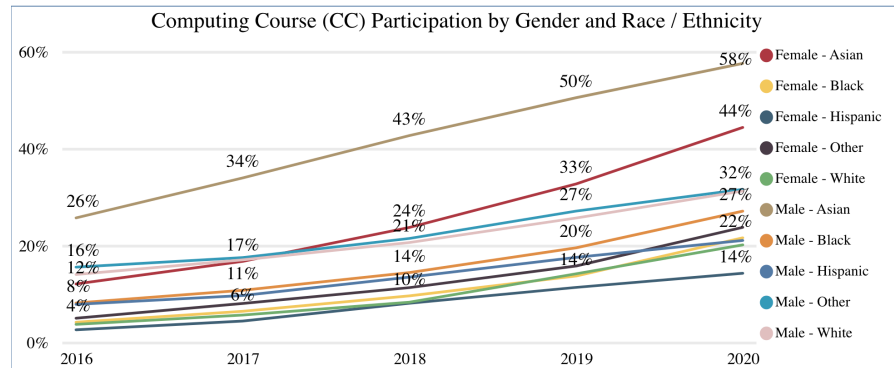


Figure 2: The percentages within the intersection of gender and race/ethnicity for each student subgroup from 2016 through 2020.

increasing, they are not all increasing at the same rates. The percentages listed are within each student subgroup and not an overall distribution of the student population. Both Asian males (58%) and Asian females (44%) took at least one high quality high school course more often than the lowest participating student subgroups (Hispanic Male at 21%, White females at 20%, and Hispanic females at 14%) in 2020. Additional intersectional options include students with disabilities and students who receive free or reduced meals which is a proxy measure for socioeconomic status.

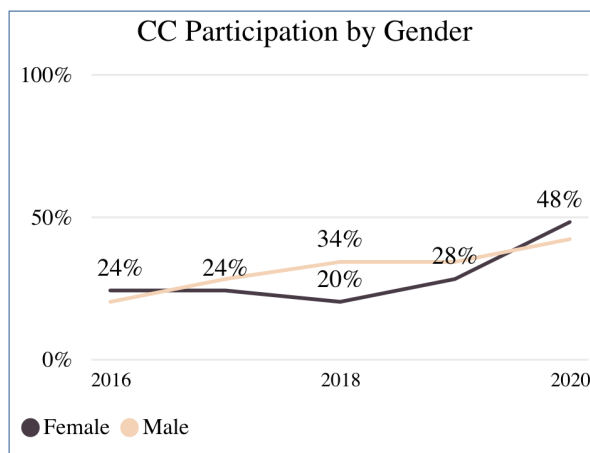


Figure 3: The percentages within each Garrett County Public Schools student subgroup by gender who participated in high quality computing high school courses from 2016 through 2020.

At the local level, the dashboards currently display data with each separate student subgroup due to suppression requirements. In order to maintain student anonymity, intersectionality is not able to be displayed. For example, Garrett County Public Schools, which is located in the Appalachian Mountains and has two public high schools, has continued to increase the number of high school graduates who took at least one high quality computing course. The overall percentage of high school graduates who took at least one high quality computing course doubled from 22%

in 2016 to 44% in 2020. As shown in Figure 3, Garrett County Public Schools student subgroups by gender who participated in high quality computing high school courses from 2016 through 2020 show fluctuation year over year. Even though both student subgroups doubled since 2016, the females (48%) surpassed the males (42%) in 2020 which had not occurred since 2016 when 24% of females and 20% of the males participated in a computing course.

The dashboards provide school level details for each Maryland diploma granting public high school. The school level dashboard provides a comprehensive analysis for computing course enrollment by year, graduates who took computing, the enrollment of graduates who took computing during the fall immediately after high school graduation, and the year over year list of computing courses

with enrollment at the high school. For example, Figure 4 shows the data for Gwynn Park High School in Prince George's County. Gwynn Park High School is a comprehensive high school located in Brandywine, Maryland

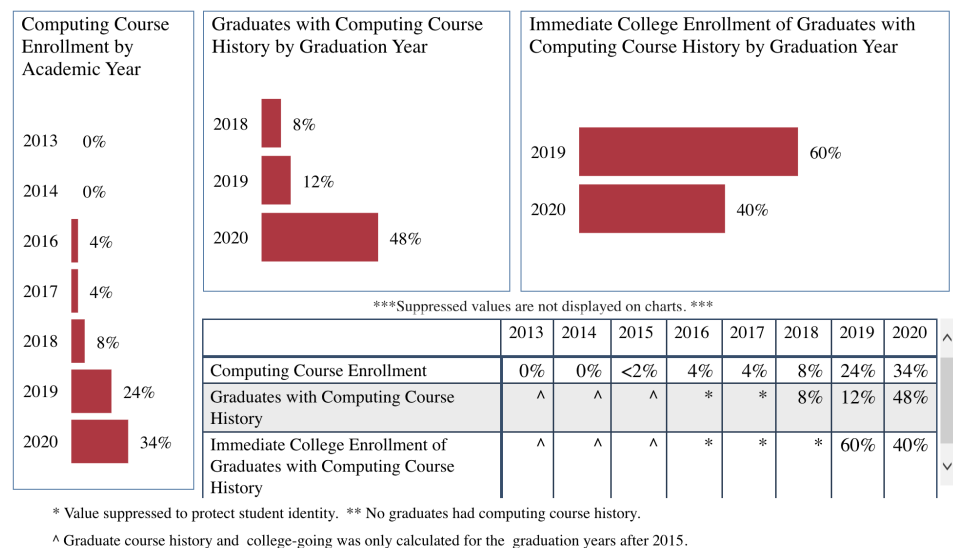


Figure 4: The school level computing dashboard for Gwynn Park High School in Prince George's County.

which is a suburban area outside of Washington, D.C. Gwynn Park High School did not have any students enrolled in a high quality computing course until 2016, and since 2016 the enrollment of students increased from 4% to 34%. Likewise, the percentage of Gwynn Park graduates who took at least one computing course increased from 8% of the graduates in the class of 2018 to 48% of the graduates in 2020. The courses with enrollment at Gwynn Park include Advanced Placement (AP) Computer Science A as an elective and AP Computer Science Principles and Foundations of Computer Science as a Career Technology Education (CTE) Pathway during the 2019-2020 school year.

When participation increases beyond the suppression requirements, the dashboards can be altered at the local levels. MCCE will continue to monitor student subgroups' participation in computing education annually.

### **Maryland Local Education Agencies' Computing Education Plans**

Each Maryland LEA created a pre-kindergarten through high school computing education vision and plan. The teams that developed these plans consisted of at least one representative from the central office administration, school-based administrators, and teachers. Each LEA gathered their own planning teams, and the team sizes varied from 4 to 18 planning team members. The plans provided insights into how the LEA intended to build the teacher capacity to offer high quality computing instruction from pre-kindergarten through high school. All of the LEAs are focused on providing computing education to all students with the purposeful intent to broaden participation in computing, particularly at the high school level when students have more freedom to select computing courses.

During the 2020-2021 school year, additional teams completed the research-based Strategic CSforAll Resource and Implementation Planning Tool (SCRIPT) to strengthen their CS visions and continue to make or revise both short-term and long-term plans. The SCRIPT tool and planning process is designed to empower all stakeholders including teachers. Building the capacity for LEAs to provide high quality K-12 CS instruction will take time, funding, and teacher professional development (PD). MCCE provides funds to LEAs through grants which were designated for each LEA to build a CS planning team consisting of at least one central office administrator, a school-based administrator, a teacher at the secondary level, and a teacher at the primary level. Each LEA team determined how to incorporate CS into the existing district structure and identified what, if any, changes need to be made, and developed two to four short-term CS goals (i.e. determine types of CS classes or units, select or create CS curricula, align curricula to the Maryland's K-12 CS Standards, or determine types of teacher PD).

LEA teams engage in focused workshops utilizing the SCRIPT research-based framework designed for school districts to expand CS to all students (DeLyser, Wright, Wortel-London, & Bora). This empowers each LEA to develop a vision for CS throughout each level of their district and to develop measurable goals in five key areas assessed by multiple rubrics in each area: (1) Leadership, (2) Teacher Capacity and Development, (3) Curriculum and



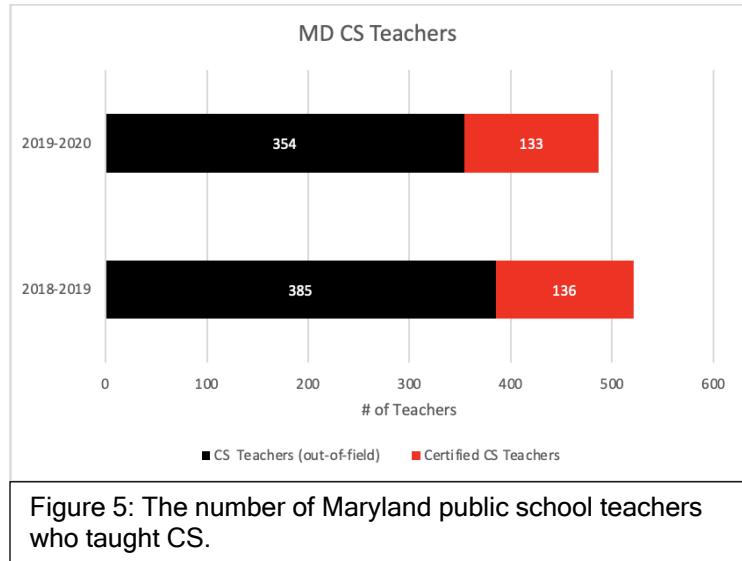
Materials Selection and Refinement, (4) Partners, and (5) Community (DeLyser & Wright, 2019). Each LEA planning team meets with MCCE and MSDE for an initial meeting and then follow-up meetings to review and refine goals at 3 months, 6 months and 1 year.

Funds were granted to allow LEA teams the time to meet, set goals, and take initial actions towards meeting those goals. LEAs vary in terms of where they each are in the development process. Additional awards have been made to the following LEAs which have provided local PD for their teachers: Anne Arundel County, Baltimore City, Charles County, Frederick County, Howard County, Montgomery County, Prince George's County, Washington County. (See Appendix C for the LEA Grant Totals.)

This year, there were a total of 95 educators listed as participants of a planning team. Of these planning team participants, 50 educators (20 central office, 26 teachers, and 4 school-based administrators) responded to the team planning survey. The teams from Prince George's County (7) and Montgomery County (6) counties had the most team members respond. Unlike the previous year, central office administrators and teachers both reported the same amount of team meetings. This suggests that teachers are included in these planning meetings more often. Only three LEAs (Baltimore City, Montgomery County, and Prince George's County) reported having six or more meetings. The most reported resources used by the planning teams were code.org materials followed by Maryland's K-12 CS Standards and the SCRIPT rubrics and workshop materials. Teacher respondents reported being most supported by other teachers, school-based administrators, and central office CS administrators. Teacher survey respondents also indicated lower confidence intervals for influencing decisions during CS team planning meetings, selecting CS curricula, and purchasing software. Both central office and school-based administrators felt the least confident with influencing the decision of which software is purchased. This suggests that teams need to include a representative from the Information Technology office for some of the planning meetings. The SCRIPT meetings were moved online due to the COVID-19 pandemic. There are still 11 LEAs which need to go through the full SCRIPT process.

## Maryland Computing Education Teachers

The efforts to train Maryland teachers to become CS teachers began prior to the establishment of MCCE. In fact, the successful recruitment and training of teachers from other content disciplines to teach CS is what motivated the advocates to work with the state to craft the legislation. The teachers who have been willing to learn CS and teach CS are celebrated in



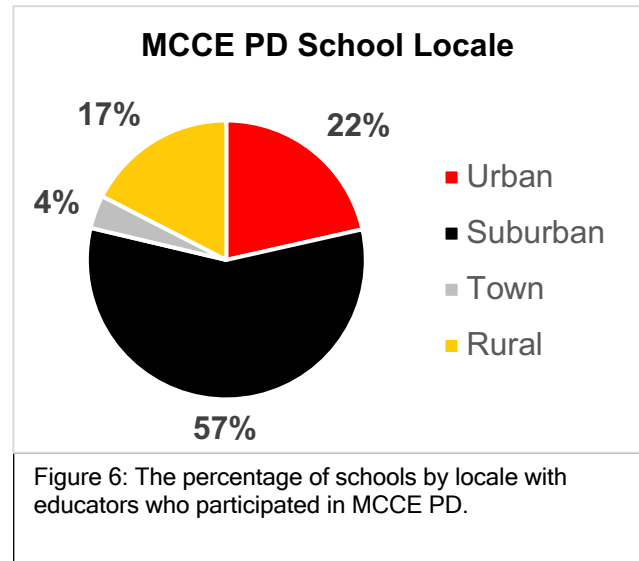
Maryland. According to MSDE, most of the teachers who are teaching CS are teaching out-of-field, which is exactly how Maryland has been able to increase the numbers of schools which offer CS and the number of teachers who teach CS. The total numbers of teachers who teach CS year to year will fluctuate due to a number of factors such as more teachers becoming CS certified which means that they can teach additional CS classes, some schools offering CS courses every other year, or attrition of teachers who previously taught CS classes.

## Maryland Computing Education Professional Development

MCCE provided extensive PD for pre-kindergarten through high school educators. The total state level PD attendance through June 30, 2021 is **1,022** educators. The MCCE and partner PD providers held a total of **128** days of PD for **32** workshops during the 2020 summer and 2020-2021 school year. All of the PD shifted to online synchronous and asynchronous workshops due to the Covid-19 pandemic.

Since 2018, MCCE provided state level PD for a total of 637 schools with **595 public schools**, which means that 41.6% of all Maryland public schools have had at least one educator attend state level computing PD. Of these schools, **36%** are **Title I** schools. Educators from 37 magnet schools, 13 charter schools, and 20 independent schools attended PD. Overall, the schools with participating educators included each type of school locale (22% urban, 57% suburban, 4% town, and 17% rural) as specified by the National Center for Education Statistics (NCES). (See Figure 6.)

Each Maryland LEA had educators participate in PD provided at the state level by MCCE and our partner PD providers. The total number of schools with educators who participated in computing education varied. (See Figure 7.) For example, Montgomery County Public Schools had a total of 122 schools with 230 educators who participated in PD while both Dorchester and Kent Counties had only one school represented each with 1 educator for Dorchester and 3 educators for Kent from those schools.



### MCCE PD Total Schools and Educators by LEA

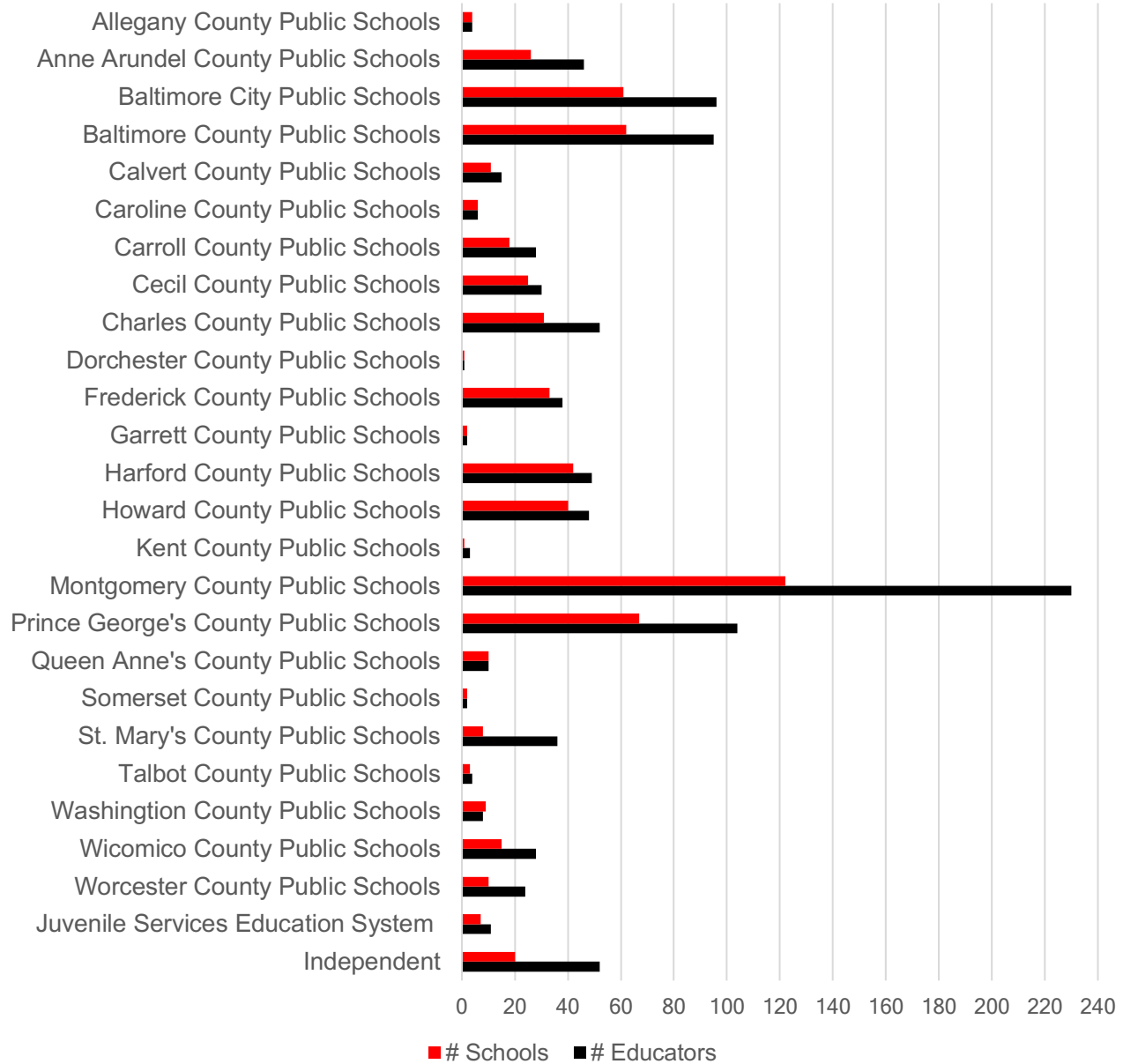


Figure 7: The total number of schools and educators who participated in MCCE PD per LEA in 2019.

Finally, the levels that the educators teach and the geographic locations of each school are shown in Figures 8 and 9. Figure 8 provides the location of each public high school and middle school which had at least one educator attend a state level CS PD. The PD provides teachers with the CS content and skills needed to teach CS courses and incorporate CS into other content disciplines.

### MCCE Secondary Professional Development Map by School

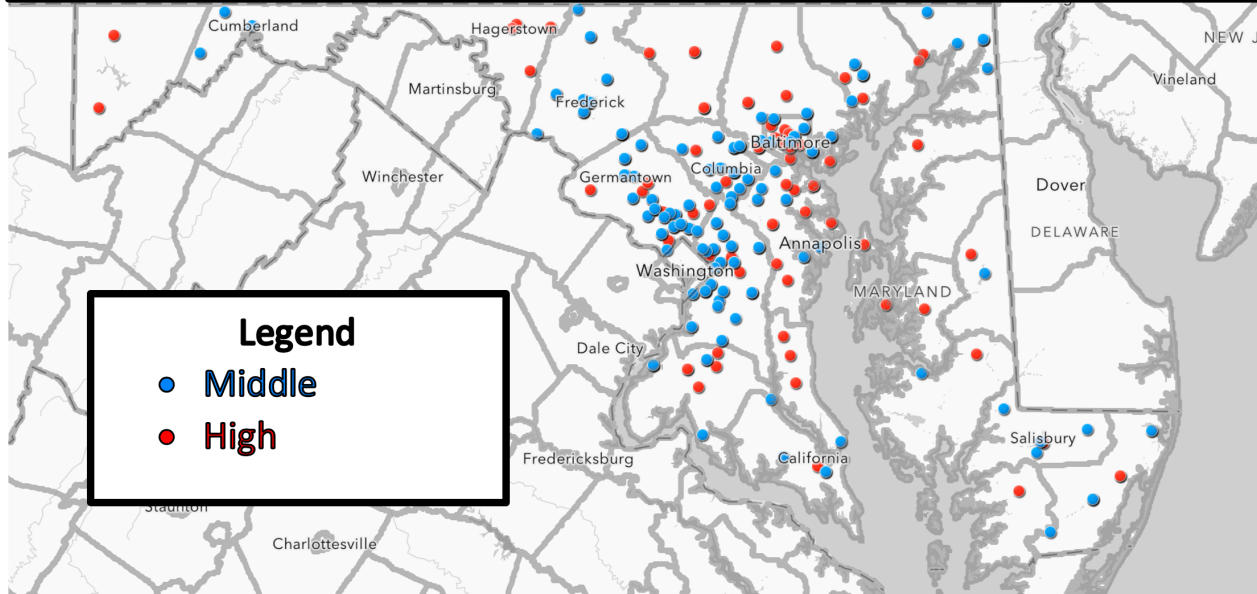


Figure 8: The MCCE map indicating the secondary education public schools which had educators participate in MCCE state level PD.

The number of LEAs which have invested in and sent their elementary teachers to state level PD has continued to grow as shown in Figure 9. The number of central office administrators who have also attended PD has increased. The Juvenile Services Education Services (JSES)

### MCCE Professional Development Map by School

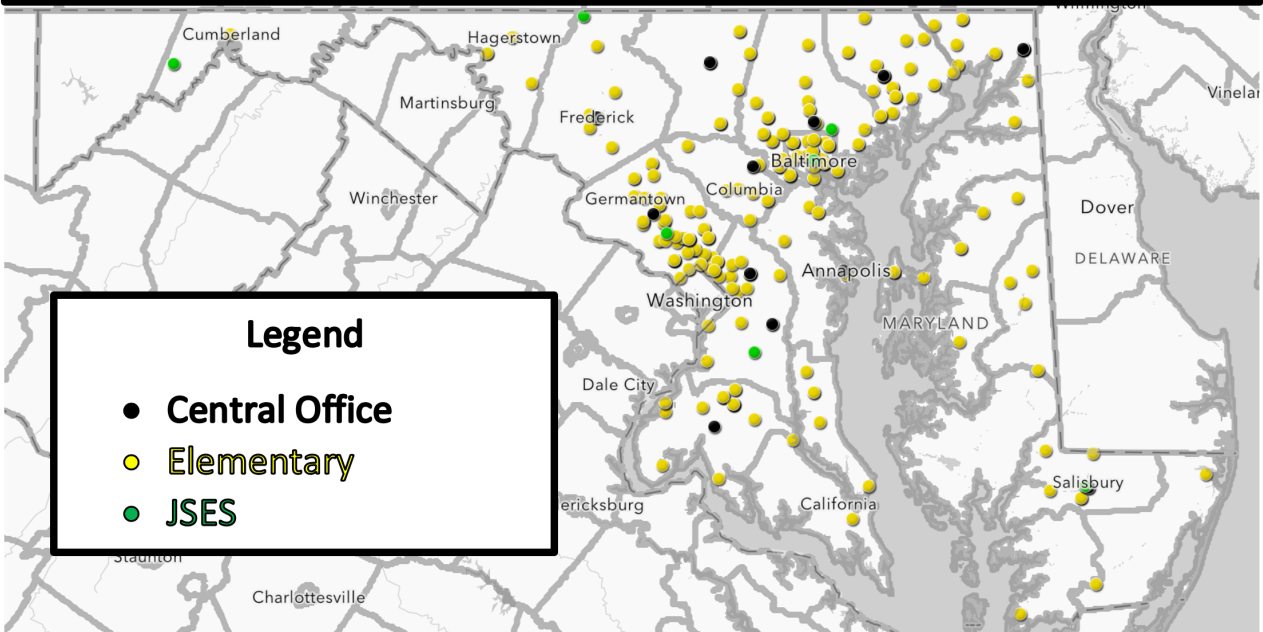


Figure 9: The MCCE map indicating the central offices, elementary schools, and JSES schools which had educators participate in MCCE state level PD.

schools across the state had educators attend CS PD enabling students in the JSES system have access to CS classes.

### **Maryland Cybersecurity Education**

Maryland and the Greater Washington, D.C. metropolitan area require cybersecurity across workforce sectors. Therefore, the K-12 cybersecurity education pipeline needs to be strengthened to provide meaningful lessons into K-12 classrooms and to broaden the participation of student subgroups to increase the number of qualified and interested professionals in the cybersecurity pipeline. The Maryland K-12 Computer Science standards include cybersecurity standards, and MCCE continues to work with partners to evaluate a variety of national resources which are aligned to our state CS standards. Working together with NIST, cyber.org, teachcyber.org, CompTia, GenCyber, and others to identify best practices in cyber education, MCCE continues to develop PD resources to build the foundational knowledge needed for teachers to deliver this content and to increase and broaden participation in cybersecurity.

MCCE designed and delivered a new series of creative K-12 workshops for Maryland educators to promote cybersecurity career understanding and exploration. Content for a micro-credential pathway in Cybersecurity Education has been developed for a broad audience. There have been 115 teachers and counselors from schools across the state who have attended 6 cybersecurity PD workshops. Each workshop provided an introduction to what teachers should know and understand about cybersecurity and the cybersecurity industry and how to communicate this information to students. These workshops connect to form a micro-credential stack that allows educators to learn, and then apply that learning in a way that is customized to the subjects and grade levels that they teach. Workshops provide hands-on activities and meaningful learning experiences for the teachers.

Topics covered in the micro-credential programs include cyber careers, threat modeling, securing digital information, encoding, encryption, authentication, and algorithmic functions. Additional workshops are now under development in system security and risk assessment. Participants in the workshops have curated quality resources and documented them for shared use in an online repository. These resources and the resulting activities will be incorporated into a series of 5 micro-credentials in cyber topics based on the national cyber framework. Presentations on these workshops have been given to national audiences.

## Maryland Elementary School CS Coaches' Program

The purpose of the Elementary CS Coaches' program is to develop a statewide cohort of elementary school leaders to be the experts and champions for CS. Elementary CS coaches will:

- Review and give feedback on curriculum resources and integrated lessons.
- Align instructional materials to Maryland's K-12 Computer Science Standards.
- Design and engage in CS instruction (for both integrated, as well as, stand-alone delivery).
- Customize resources for their LEA.
- Apply best practices in CS instructional methods.
- Share what they have learned with other coaches and their LEA.

MCCE conducted several PD events specifically for elementary CS coaches. The Coaches program kicked-off with a Summer Academy with our first cohort of coaches. The academy was a 3-day opportunity which built coach capacity in technology, pedagogy, and CS content. The work was led by the project manager with support from four regional facilitators. The first Cohort had 11 participants representing 7 LEAs. In January 2020, the second Cohort had 9 participants representing 5 new LEAs. This cohort attended a compressed version of the Academy. Both cohorts received a class set of floor robots and copies of three CS read-aloud titles. In February 2020, we brought together both cohorts for additional PD focused on gaining a deeper understanding of how to integrate CS with core-content instruction. Additionally, periodic virtual webinars were conducted to sustain learning. In the spring of 2021, we brought Cohort 3 onboard. Due to the pandemic, our PD was delivered virtually during evenings over the course of seven weeks. Cohort 3 had 14 participants representing 6 new LEAs. (See Table 1.)

The vision of the MD ES CS Coaches program is that CS is evolving rapidly, so the coaches need to be adaptable and have a propensity for learning as new advances emerge. This program provides the space for coaches to leverage quality instructional resources where they are readily available and supplement them with innovative resources to fill any identified gaps. Regional elementary coach facilitators led this work by drafting crosswalks between the

PD Event	Timeframe	Leadership Team	Cohort 1	Cohort 2	Cohort 3	Hours Each Person
# Teachers		4	11	9	14	
Academy - Cohort 1	06/2019	Yes	Yes			21
Periodic Webinars	09/2019 - 06/2020	Yes	Yes			4
Onboarding Cohort 2	01/2020	Yes	Yes			7.5
Retreat I	02/2020	Yes	Yes	Yes		7.5
Summer PD 2021	06/2020 - 09/2020	Yes	Yes	Yes		7.5 or 15
MCCE Mini-summit	10/2020	Yes	Yes	Yes		2
On-boarding Cohort 3	02/2021 - 04/2021	Yes			Yes	14
Retreat II	05/2021	Yes	Yes	Yes	Yes	7.5

**Table 1:** The Maryland Elementary School CS Coaches' Program session types and hours of PD.

CS standards and other core-content standards. All participants then curated quality resources and documented them for shared use in an online repository. Participants also wrote additional lessons which were made available in a crowd-sourced fashion in the repository. Presently, this repository has over 700 unique lessons. Each regional facilitator also developed a module (unit) of approximately 10 lessons with a cohesive scope and sequence. These modules are also housed within the repository.

The leadership team (project manager and regional facilitators) coordinate with LEAs, recruit participants, communicate expectations, and track the project (budget, costs, materials purchased, payments, and deadlines/obligations met). Coaches in the program are supported and mentored by their regional facilitators and the program manager. Coaches have opportunities to present best practices, share their challenges with their peers, collaborate on standards alignment, and explore ways to advocate for improved CS. The program launched with a budget of \$100,000 of which \$97,542.01 was spent in

Category	Total
Professional Development	\$ 16,384.30
Instructional Design	\$ 3,569.50
Mentoring and Collaboration	\$ 53.10
Oversight and Support	\$ 14,931.37
<b>Grand Total</b>	<b>\$ 46,794.32</b>

**Table 2:** The Maryland Elementary School CS Coaches' Program budget.



the first year. An additional \$46,794.32 was added for 2020-2021 as shown in Table 2.

### **Maryland's K-12 CS Standard Annotations**

In order for Maryland educators to utilize the Maryland's K-12 Computer Science Standards in local curricula and in daily lesson plans, annotations are being developed in collaboration with MSDE. To date, the annotations for the K-5 Maryland Computer Science standards were developed by and for elementary educators, administrators, and curriculum developers. Each annotation includes an explanation of the standard, essential vocabulary, skills and questions as well as sample lessons aligned with crosswalks to other content curricular standards. The review process included drafts sent to stakeholders, including members of the original CS standards development team, for review. A similar process will be used to develop the middle and high school standards.

### **ECSNet**

The law calls for MCCE to “maintain a clearinghouse with computer science education curricula and resources to support professional development in computer science education (MD § 4-111.4).” There emerged a need for this clearinghouse to specifically support elementary teachers who do not have the same type or quality CS materials which are readily available for secondary teachers. The [ECSNet](#) is an elementary CS lesson online repository. An intern initially curated quality resources and documented them for shared use. Then, search capability was enhanced to provide multiple ways (subject, grade level, CS concept, CS standard, other subject standard, and CS vocabulary) for teachers to search for lessons. Additionally, a new process for vetting resources and aligning lesson exemplars with the CS annotated standards as well as cross-walking with the other content discipline standards was implemented to add lessons to the repository. Finally, a cadre of University of Maryland students conducted a usability assessment resulting in numerous functionality improvements. Presently, ECSNet has over 700 individual lessons.

### **ESSA Computational Thinking/Learning Requirement**

MSDE included a requirement for all public middle school students to receive computational thinking/learning (CT/L) as part of a well-rounded middle school education within the Every Student Succeeds Act (ESSA) state plan. MSDE in collaboration with MCCE created a tool with which districts can align curricula to CT/L requirements. In recognition of the fact that we are just beginning to teach CT/L, the tool contains 3 levels (beginning, approaching, and

meeting the 8th grade standard) with examples at each level. Courses that have been found to be well aligned are Code.org CS Discoveries and StartUp Tech (an IB STEM course).

The listing of courses that align to the CT/L requirement was updated with a course called Integrated Computational Thinking. This allows districts to create courses where CT/L is integrated into other curricular content courses. The content should align to that curricular area's content standards as well as to the Computational Thinking tool. MSDE must approve the curriculum in advance of it being taught.

A survey was conducted in the fall of 2019, and all LEAs replied as did the Maryland School for the Blind (MSB) and the Maryland School for the Deaf (MSD). Of the respondents, ten LEAs and MSD taught Code.org courses and seven LEAs as well as MSB and MSD taught Scratch or another programming course. Fourteen LEAs had at least some of their middle school students enrolled in Project Lead the Way (PLTW) courses and seven LEAs and MSB had a robotics program. There are at least six LEAs that combine CS and engineering at the middle school level. The pandemic emergency school closures in March, 2020 were extremely difficult on districts; however, reports from the LEAs were that teachers continued teaching the CT/L. LEAs have done a remarkable job of shifting to equivalent CT/L online delivery when learning had to continue at home in mid-March through the end of the school year. Teachers delivered the content online, they found virtual robotics platforms that could substitute for in-person experiences, and schools attempted to provide unplugged activities where students were not able to connect online.

### **Teacher Certification Support Program for the Praxis II Exam**

The purpose of the Praxis study program is to provide Maryland CS teachers with support and resources to equip them to pass the CS Praxis 5652 Exam and earn the endorsement to teach CS in Maryland. MCCE currently accepts applications seasonally and cohorts meet for 5 weeks on Saturdays to review the 5 areas of the exam. A total of **182** teachers joined a study cohort and **51** teachers passed the exam. (Note: The exam became unavailable for 4 months during the COVID-19 pandemic). To incentivize teachers, we received a \$25,000 grant from Microsoft to offer a \$1,000 stipend for 25 teachers from underrepresented groups or who teach in a high need, rural, or urban district. Teachers who are not eligible for the Microsoft grant can apply to receive a \$1,000 stipend from the MCCE.

## Maryland Computing Education Convenings

Since 2016, Maryland has held an annual statewide computing education summit. The summit had been held in person in April at various locations. Unfortunately, the summit was not held in April 2020 and instead, it was shifted to an online format in October 2020. The keynote speakers were Dr. Jan Plane, Principal Lecturer in the Department of Computer Science, Director of the Iribe Initiative for Inclusion in Computing, Director of the Maryland Center for Women in Computing, and Associate Director of the ACES Honors Program at the University of Maryland, College Park and Tiara Booker-Dwyer, Assistant State Superintendent, Division of Career and College Readiness & Office of Leadership Development and School Improvement at the MSDE. The summit hosted 168 educators from across Maryland. The summit focus was on effective online CS education and equity. The agenda and details can be found on the [MCCE website](#).

The online format was a successful way to convene educators for the summit, so two additional convenings took place in the spring 2021. CS tends to spawn new and exciting topic areas to study, such as Artificial Intelligence (AI). AI enables computers to make predictions and solve problems in ways that are similar to human intelligence. Students are impacted by and interacting with AI systems in widely available technologies in their daily lives. The first Maryland Artificial Intelligence (AI) Symposium was held online on April 17, 2021 and attended by 43 Maryland educators. AI topics for pre-kindergarten through college levels of education were covered in sessions led by local teacher facilitators who shared resources, ideas, and experiences about teaching AI in the classroom. Additional information about the symposium can be found on the [MCCE website](#).

The MCCE Higher Education Summit was held online on April 16, 2021. The main purpose of this summit was to highlight and share IHE grant projects funded by the MCCE. Welcome remarks were given by USM Chancellor Dr. Jay Perman with reflections on completed projects. A total of 46 participants attended the sessions and recorded presentations are available at <https://cs4md.com/webinar>.

# STAKEHOLDER REPRESENTATION

*§12-118 Education Article, Annotated Code of Maryland*

*(1) There is a Maryland Center for Computing Education in the University System of Maryland.*

*(2) The purpose of the Center is to expand access to high-quality computer science education in grades prekindergarten through 12 by strengthening the skills of educators and increasing the number of computer science teachers in elementary and secondary education.*

*(3) In carrying out the powers and duties granted under this section, the Center shall work in consultation and collaboration with institutions of higher education in the State, including:*

- (I) Historically black colleges and universities;*
- (II) Other public senior higher education institutions;*
- (III) Independent institutions of higher education; and*
- (IV) Community colleges.*



MCCE has two stakeholder groups, the Maryland Computing Education Steering Committee and the MCCE Advisory Committee. Both groups provide valuable feedback and critical insights into the state of computing education in Maryland. The MCCE relies on the regular meetings and subcommittee workgroups to help set priorities.

## MCCE Steering Committee

The larger MD Computing Education Steering Committee, which precedes MCCE, has representation from government, K-12 LEAs including classroom teachers and administrators, non-profits, industry, community colleges, and public, private, and historically black four-year colleges and universities. (See Figure 10.) All committee members volunteer

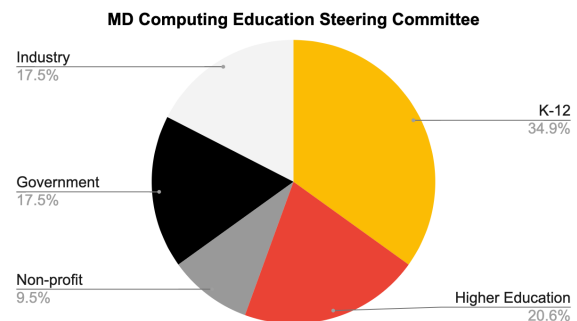


Figure 10: The percentages for members of each steering committee stakeholder group.

their time and expertise. (See Appendix A for the full membership.)

The MD Computing Education Steering Committee meets twice per year in the spring and fall as a full committee. In between these meetings, there are six workgroups including advocacy, cybersecurity, elementary, middle school, high school, and higher education. The workgroups then report back to the full committee.

### **MCCE Advisory Committee**

The MCCE Advisory Committee is co-chaired Dr. Nancy Shapiro, Associate Vice Chancellor for Education and Outreach Special Assistant to the Chancellor for P-20 Education at the University System of Maryland and Dr. Carol Williamson, Chief Academic Officer, Deputy State Superintendent, Office of Teaching and Learning at the Maryland State Department of Education (MSDE). The committee includes the following members:

- Dr. Daniel D. Curry, Superintendent, Calvert County Public Schools and President, Public School Superintendents' Association of Maryland (PSSAM),
- Alexandra Dorman, Senior Manager, Education Strategy at Microsoft, Microsoft,
- Jennifer Frank, Vice President of Academic Affairs, Maryland Independent College and University Association (MICUA),
- Dr. Lethia Jackson, Chair and Professor Department of Technology and Security, Bowie State University,
- Heather Lageman, Maryland Computing Education Steering Committee Chair and Executive Director of Leadership Development, Baltimore County Public Schools,
- Bryan Pawlicki, Principal, North Harford High School, Harford County Public Schools,
- Jennifer Smith, President, Computer Science Teachers' Association, Maryland Chapter and high school CS teacher,
- Michael Smith, Department Chair, Technology, Engineering, and Construction Department, Prince George's Community College, and
- Pat Yongpradit, Chief Academic Officer, Code.org.

# MCCE LEADERSHIP AND STAFF

The MCCE leadership includes a variety of education and computing expertise which strengthens the collaborative processes required to move computing education forward in Maryland. The collaborative processes occur within and between the levels of education as well as with our industry, government, and non-profit partnerships. Below are the MCCE leaders and their roles.

<p><b>Leadership</b>  <b>Dr. Nancy Shapiro (USM)</b>  <b>Dr. Carol Williamson (MSDE)</b>  <b>Dewayne Morgan (USM)</b>  <b>Advisory Committee</b></p>	<p><b>Guidance</b>  <b>Heather Lageman</b>  <b>Maryland Computing Education Steering Committee</b></p>
<p>Budget, equitable distribution, financial distribution, implementation plan, grant processes</p>	<p>Assess statewide needs, recommend next steps, engage stakeholders</p>
<p><b>Implementation</b>  <b>Dianne O’Grady-Cunniff, Director</b></p>	<p><b>Research</b>  <b>Dr. Megean Garvin, Director of Research and Assessment</b></p>
<p>District meetings, professional development, teacher support, resource appraisal, national connections</p>	<p>Data, reports, publications, grant writing, assessment, monitor statewide policy changes</p>
<p><b>Program Manager</b>  <b>Joelle Bennett</b></p>	<p><b>Coordinator of Career Programs, STEM, and Computer Science</b>  <b>Scott Nichols (MSDE)</b>  <b>Computer Science Specialist</b>  <b>Elissa Hozore (MSDE)</b></p>
<p>Manage facilitator accounts, submit and track grant funding and invoice payments, support for professional development workshops, track attendance, communications, and social media</p>	<p>District and teacher support, clarification of requirements and MD CS standards, collaboration with content area specialists and other state education personnel from MD and other states</p>

# MCCE GOALS AND METRICS

§12-118 Education Article, Annotated Code of Maryland

*The Plan shall identify:*

- (I) *Specific actions, resources, metrics, and benchmarks to create a long-term sustainable pipeline of computer science teachers.*

The MCCE Steering Committee created goals and metrics for computing education in Maryland in 2017. They were then further updated and approved by the steering committee in 2018 and revised again in 2020. These goals are also reflected in the *Securing the Future: Computer Science Education for All* Act. The ultimate goal is to have CS recognized as a content discipline in K-12 Maryland Public School classrooms with significant reduction in gaps among student subgroups who have access to and participate in CS classes.

	2021-2026 5-10 Years	2027-2030 11-14 Years	2031 Final 15 Year Goals
<b>Student Access and Participation</b>	High quality CS course offerings, including AP, taught by trained teachers in every high school. Gaps have been reduced by 50% from baseline. CT integrated from preK-8 <sup>th</sup> grade.	Rigorous computing courses and content offered in every P-12 school.	CS is offered to every student throughout their P-12 education. Gaps have been reduced by 90% from baseline.
<b>Professional Training</b>	At least three undergraduate and three graduate programs offering CS certification.	Training universally available. All P-12 pre-service programs require CS/CT integration into methods courses.	All full-time secondary CS teachers are certified in CS. Offerings are continually updated and micro-credentials are offered.
<b>Curriculum and Standards</b>	P-12 CS curriculum in every school system aligned with state CS standards.	Graduation requirements include CS. All P-12 CS standards implemented in all schools.	Review board established and in effect to continually update P-12 standards.

MCCE is on track or exceeds the milestones established by these goals. Working with our partners and aligning the resources across the state, computing education will be available to all Maryland public school students in every LEA. There are now 14 IHEs who are piloting how to incorporate computing education into pre-service programs to increase the likelihood of having at least three approved CS teacher programs in Maryland in the next two years.

# MCCE GRANTS

§12-118 Education Article, Annotated Code of Maryland

*(3) (I) The Center shall administer a grant program to support professional development in computer science education.*

*(II) The grant program shall:*

- 1. Be administered through an open and competitive process;*
- 2. Prioritize applications from county boards of education and institutions of higher education ; and*
- 3. Prioritize applications that focus on serving:*
  - A. Areas with high poverty;*
  - B. Rural areas; or*
  - C. Areas with large minority or diverse student populations including female students, students with disabilities, and students of ethnic, racial, or other demographic groups that are underrepresented in the field of computer science as identified by the U.S. Equal Employment Opportunity Commission.*

The MCCE administers two grant programs. The first grant process provides pilot study research for IHEs to update pre-service teacher education programs to include CS. The second grant process provides a series of grants to LEAs in order for each of the 25 Maryland public LEAs to reach full compliance with this law.

## **IHE Pre-service Teacher Education Program Grants**

The IHE Pre-service Teacher Education Program grants address the need for long-term solutions to prepare pre-service teachers at all levels of K-12 instruction to enter Maryland public school classrooms with CS knowledge and skills. Each pre-service teacher education program needs to incorporate the Maryland's K-12 CS Standards and CS pedagogy with an emphasis on equity, inclusion, and diversity. The grant requires faculty from CS and education to collaborate, IHEs to collaborate with LEAs, and for grant teams from across the institutions to collaborate and learn from each other. Initial grants were set at two levels, \$20,000 and \$50,000. The grantees determined which pre-service teacher program level (primary, secondary, or both) that they would begin with for the pilot study. Each IHE determined which level of funding to pursue and submitted a request for funding to MCCE. MCCE sent the solicitation to all IHEs in Maryland. There are 14 IHEs which applied and were



awarded grants. Both Frostburg State University and Hood College were awarded follow-up funding after the initial grant (See Appendix B.)

### **LEA Grants**

As CS builds into a K-12 content discipline, the infrastructure and support at each level (classroom, school, central office, and state) must also grow. MCCE is poised to assist in the growth process at all levels. MCCE offered regional meetings consisting of multiple LEAs and individual LEA planning meetings to clarify CS and CT/L, recommend appropriate resources, share best practices, develop district CS visions, and answer questions. These meetings leveraged expertise and provided the first step toward developing regional collaborations between LEAs and between LEAs and IHEs. Each LEAs now has a designated central office point of contact for CS. MSDE convenes regular meetings with all of the CS points of contacts and MCCE staff also attend these meetings. MCCE also assists with the CSTA, Maryland chapter in the development of CS educator communities of practice within each LEA and across LEAs. The Maryland chapter has continued to grow and the members are actively engaged during monthly meetings.

# PARTNERSHIPS

§12-118 Education Article, Annotated Code of Maryland

*The Plan shall identify:*

**(II)** *Activities to obtain and sustain public and private partnerships for funding, mentoring, and internships for teachers.*

MCCE has established and maintained partnerships with each of the 25 LEAs, numerous IHEs, non-profits, and industry representatives. In addition to the numerous members of the steering committee and advisory committees, MCCE has partnered with the following:

## Four-year IHEs

Bowie State University  
 Chesapeake College  
 College of Southern Maryland  
 Frostburg State University  
 Hood College  
 Johns Hopkins University  
 Morgan State University  
 Mount St. Mary's University  
 Salisbury University  
 St Mary's College of Maryland  
 Towson University  
 Clark Center for Cybersecurity  
 University of Maryland, College Park  
 University of Maryland, Global Campus  
 Washington College

## Two-year IHEs

Anne Arundel Community College  
 Hagerstown Community College  
 Montgomery College  
 Prince George's Community College

## Government

Maryland Governor's Workforce Development Board  
 Maryland Longitudinal Data System Center  
 National Aeronautics and Space Administration  
 National Security Agency

## Industry

Apple, Inc.  
 Microsoft Corporation  
 Microsoft TEALS

## Associations

Association for the Advancement of Artificial Intelligence  
 AI4K12 Working Group  
 Computer Science Teachers Association  
 CSforAll  
 Expanding Computing Education Pathways  
 International Society for Technology in Education  
 National Center for Women in Technology  
 National Center for Computer Science Education

## Non-Profit Organizations

Code in the Schools  
 Code.org  
 College Board  
 Digital Harbor Foundation  
 Family Code Night  
 Girls Who Code  
 Maryland MESA (Mathematics Engineering Science Achievement)  
 Maryland Public Libraries  
 Teach Cyber

We encourage our partners not only to work with us directly but to also work with the LEAs and IHEs directly. Some of the engaging events that have occurred include after school clubs and activities, family code nights, teacher PD workshops, mentoring of teachers, competitions, and contests.

# MCCE BUDGET

The overall MCCE budget reflects all funds spent through June 30, 2021. Due to the current regulation which limits the number of employees hired at the University System of Maryland (USM), the MCCE needed to partner with the University of Maryland, Baltimore County (UMBC) in order to hire both director positions and the Maryland State Department of Education (MSDE) CS Specialist position. A full-time program manager is employed at USM. Below is the budget overview including the basic budget categories: administrative operating costs, IHE grants, and LEA grants.

<b>Budget Overview</b>	
Administrative Operating Costs	\$903,039.28
MCCE State Level PD Costs	\$730,847.38
IHE Grants	\$593,204.43
LEA Grants	\$940,379.95
<b>Total</b>	<b>\$3,167,471.04</b>

The administrative operating costs include several categories. Salaries and fringe benefits are the most significant operating costs followed by the website design and maintenance, office supplies, and in-state travel. The MCCE state level PD costs include state-wide initiatives, such as computing teacher mentoring programs, PD workshops available to all teachers, regional SCRIPT meetings, and the state summit.

Both the IHE and LEA grants reflect the total funds spent through June 30, 2020. The IHE grant is currently capped at \$500,000 per the fiscal note; however, a portion of the additional three million is allocated toward this effort.

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# APPENDIX A: STEERING COMMITTEE

First Name	Last Name	Title	Organization
Quianna	Bannerman	Instructional Supervisor Information Technology/Computer Science/Transportation Technologies/Business Department of Career and Technical Education	PGCPS
Christine	Barrow	Dean of STEM	PGCC
Elizabeth	Bell	Information Technology Foundation Specialist	Montgomery County Public Schools
Kathy	Benson	Retired Elementary Teacher and STEM Integration Consultant	Immersive STEAM
Tiara	Booker- Dwyer	Assistant State Superintendent, Division of Career & College Readiness	MSDE
Dwight	Carr	JHU - APL STEM Program Manager	Johns Hopkins APL
Merijke	Coenraad	Ph.D. Student	UMD
Linda	Cooper	Associate Professor UTeach Co-Director	Towson University
Tara	Corona	Continuous Improvement Specialist	MSDE
Eric	Davis		BGE
Stacey	Davis	Coordinator of Media and Instructional Technology	Baltimore City Public Schools
Michael R.	DiGiacomo	Executive Director, Governor's Workforce Development Board (GWDB)	DLLR
Tim	Dixon	Elementary Teacher	PGCPS
Brian J.	Dulay	Executive Director	Maryland Business Roundtable for Education
Bill	Eckles	Supervisor of Career and Technical Education	Carroll County Public Schools
Val	Emrich	Director of Instructional Technology Instructional Technology, School Library Media, and Mathematics	MSDE
Michael	Flinn	Professor and Chair, Department of Computer Science & Information Technologies	Frostburg State University
Marquita	Friday	Career & Technology Education Lead Specialist	MSDE
Joe	Greenawalt	CS high school teacher	Charles County
Steve	Greenfield	Dean of Business, Information Technology and Safety with Workforce Development, MC	Montgomery College
Rafi	Guroian	Senior Systems Engineer	Apple
Courtney	Hodge	Program Manager, Inclusive Learning, Digital Inclusion and US Community Engagement	Microsoft
Elissa	Hozore	Education Specialist, Computer Science	MSDE
Nierria	Jones- Cooper	TEALS	Microsoft
Earl	Jefferson	TEALS	Microsoft
Deborah	Kariuki	Department of Education	UMBC
Ali	Keane	Policy Advisor	Office of Maryland Governor Larry Hogan
Diane	Ketelhut	Associate Professor Teaching & Learning, Policy & Leadership	UMD
Sharon	Kramer	Coordinator, Career and Technology Education	Howard County Public School System

Heather	Lageman	Executive Director of Leadership Development	Baltimore County Public Schools
Velma	Latson	Instructional Technology lecturer	Bowie State
Amanda	Lattimore	High School Teacher	Baltimore County Public Schools
Gretchen	LeGrand	Executive Director	Code in the Schools
Rob	Limpert	Supervisor of Magnet and CTE Programs	Harford County Public Schools
Kara	Lynch	Curriculum and Assessment	Baltimore County Public Schools
Richard W. (Bill)	MacDonald	High School Teacher	Roland Park Country School
Raquel	Marshall	Program Specialist Office of Education	NASA
Felicia	Martin Latief	STEM Supervisor	Prince George's County Public Schools
Bria	McElroy Barry	Regional Manager, MidAtlantic	<a href="http://Code.org">Code.org</a>
David	McGann	Cloud Migration Offering Leader - Federal CIC Delivery Excellence Leader - Rocket Center Senior Managing Consultant Global Business Services	IBM
Norm	McGaughey	Coordinator of Career & Technology Education	Frederick County Public Schools
Kim	Mentzell	Cybersecurity Program Manager	Maryland Department of Commerce
Christine	Newman	Assistant Dean, Engineering Education Outreach, Executive Director, Center for Educational Outreach, Whiting School of Engineering	Johns Hopkins University
Scott	Nichols	Coordinator of Career Programs, STEM, and Computer Science	MSDE
Loyce	Pailen	Professor	UMGC
Jan	Plane	Steering Committee Chair Principal Lecturer Department of CS	UMD
Alison	Procopio	Executive Director of Policy Implementation and Best Practices	College Board
Brandon	Riesett	Technology Accessibility Specialist	MSDE
Justin	Serota	CS Resource Teacher K-12	AACPS
Korbin	Shoemaker	CS Resource Teacher K-12	Frederick County Public Schools
Jennifer	Smith	CS Teacher Western High School	Baltimore City Public Schools
Erin	Sowa	Enterprise Key Account Manager-Mid-Atlantic/Northeast Region	Lego
Jackie	Smalls	Chief Programs Officer	<a href="http://Code.org">Code.org</a>
Diane	Stulz	Coordinator of Instruction	Worcester County Public Schools
Chuck	Trautwein	Technology Resource Teacher	Garrett County Public Schools
Carrie	Trudden	Instructional Technology Resource Teacher Office of Instructional Technology & Library Media	Howard County Public School System
Greg	Von Lehman	Advisor to the President of UMUC for Cybersecurity & CCEI Board Member	UMGC & CCEI
David	Weintrop	Assistant Professor Teaching & Learning, Policy & Leadership College of Education College of Information Studies	UMD

Lisa	Wenzel	Teacher	Montgomery County Public Schools
Tina	Williams	President and CEO	TCecure, LLC
Tracy	Woods	Azure Specialist, Education	Microsoft
Pat	Yongpradit	Chief Academic Officer	<a href="#">Code.org</a>
Eboni	Zook	CS Teacher, CSTA Equity Fellow	Baltimore City Public Schools

# APPENDIX B: IHE PRE-SERVICE TEACHER EDUCATION GRANTS

IHE	Total Grant Funding	Principal Investigators
Bowie State University	\$10,000.00	Hoda El-Sayed
Frostburg State University	\$76,013.00	Michael Flinn Jennifer Bishoff Jennifer Rankin
Hood College	\$92,775.17	Jennifer Cuddapah
Johns Hopkins University	\$9,859.00	
Loyola University	\$49,561.00	Kelly Keane Irene Bal
Morgan State University	\$34,350.00	Christian Anderson Edward Dillion Simone Gibson
Mount St. Mary's University	\$50,000.00	Laura Frazier Stacey Brown-Hobbs
Saint Mary's College of Maryland	\$48,306.57	Alan Jamieson Lindsay Jamieson
Salisbury University	\$49,956.00	Sophie Wang
Towson University	\$49,980.00	Linda Cooper
University of Maryland, Baltimore County	\$49,511.00	Patricia Young Deborah Kariuki
University of Maryland, Eastern Shore	\$10,000.00	Patricia Goslee
University of Maryland, College Park	\$39,799.69	Jan Plane David Weintrop
Washington College	\$23,955.00	Erin Counihan Shaun Ramsey
<b>Total</b>	<b>\$593,204.43</b>	



# APPENDIX C: LEA GRANTS

LEA	Total Grant Funding
Allegany	\$6,612.64
Anne Arundel County	\$58,275.39
Baltimore City	\$124,900.00
Baltimore County	\$5,000.00
Calvert County	\$40,364.62
Caroline County	\$6,225.00
Carroll County	\$56,536.43
Cecil County	\$35,884.00
Charles County	\$19,274.20
Dorchester County	\$4,712.04
Frederick County	\$62,934.78
Garrett County	\$17,474.00
Harford County	\$7,000.00
Howard County	\$70,494.57
Kent County	\$14,959.00
Montgomery County	\$55,885.46
Prince George's County	\$220,590.00
Queen Anne's County	\$5,534.10
Seed School County	\$0.00
Somerset County	\$4,475.00
St. Mary's County	\$18,800.00
Talbot County	\$562.97
Washington County	\$28,239.04
Wicomico County	\$29,401.53
Worcester County	\$41,245.18
MD School for the Blind	\$5,000.00
<b>Total</b>	<b>\$940,379.95</b>