Expanding Computing Education Pathways (ECEP)
Maryland Core Group Members Meeting
Monday, September 21, 2015

UMBC Training Centers
6996 Columbia Gateway Dr.
Columbia, MD 21046

Meeting Participants

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Jan Plane, UMd -- College Park
Jennifer Smith, Digital Harbor High School, Baltimore City
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Invitees not present: Henry Johnson, MSDE; Heather Lageman, MSDE; Felicia Martin Latief, Prince George's County Public Schools; Christina Morris, Catonsville High School, Baltimore County; Sarah Spross, MSDE

Summary

Since enrollment of CS students has doubled in the last 8 years at the college level and numerous efforts have also occurred at the K-12 levels, it is important for CS education leaders across Maryland to unite and streamline all of our efforts. This NSF-supported ECEP Alliance minigrant provides support for statewide reform of CS education.

CS as a Technology Education credit

There has been a transition from the traditional technology/engineering courses that fulfilled the Tech Ed HS graduation requirement, leading to more options--including CS courses--that fulfill the requirement. However, there are three remaining challenges. First, some school systems are resisting a change away from the classes that traditionally filled this requirement, in part because the existing teachers are more well prepared to teach the older courses. To remedy this resistance, MSDE is looking to blend CS into these other courses and to build a new hybrid course. Some participants felt that such integration would be more appropriate at the middle school level rather than in high school courses, which should be more advanced and disciplinary (but in some universities, including College Park, there is a trend towards more integrated courses). A second, related challenge is teacher training. There are CS teacher training opportunities (including CS Matters and Code.org) in MD, but these opportunities may not meet allneeds over time as the demand for CS classes grows. Finally, students at the high school level need more CS options for advanced technology education credit. Working with higher education (UMCP and UMBC) and other organizations (Code.org, ITEEA, Lockheed Martin, etc.), we need to identify platforms and tools that are needed for students who enter the workforce.

CS as a Mathematics Credit

The regulations for a MD HS diploma prepare students for college and career. Mathematics is required in all four years of HS. Approximately 59,000 diplomas are earned across all MD public schools, with 79% of

students subsequently attending college. USM requires that the senior year mathematics course must be a "non-trivial algebra-based course" in order to enter any USM campus; since CS is not considered to be "algebra-based," it is not currently accepted as a senior-year math course (although AP CS A may be taken as a math course in the junior year). The "non-trivial mathematics" rationale is based on NCTM recommendations. The College Board supports CS as mathematics, and has shared data that students who took CS courses tended to perform better on the AP Calculus exam. The group discussed the possibility of creating a more broadly available computing-intensive mathematics course, such as discrete math with programming. In the longer term, many members felt that the "unitary credit" system is too constraining, and that it prevents the possibility of creating more integrated courses that offer "fractional" course content.

Relationship between CTE and Non-CTE Programs of Study

In order to have Perkins federal funding, schools must offer approved four-course completer sequences for technology education in MD. We need to consider what courses are best for students and create pathways that have flexibility. For example, PLTW students must take 5 classes to complete the pathway, but students can take the initial course as a technology education credit without completing the full pathway if they do not select the PLTW pathway. Another example is the Cisco Academies, of which there are currently 52 in MD; adding new CS courses has not taken students away from these academies. However, it is important for school administrators to follow financial rules and track graduation requirements and for guidance counselors to be aware and encourage students into different pathway options. A CS-oriented Advanced Technology Education pathway (e.g., to include AP CSP and AP CS A) might be appealing to some students -- but could have the side effect of pulling students off of the CTE completer pathway. There is a tension between offering more options for students and securing the federal funding for completer programs.

PreK-8 CS Curriculum

CS is offered across all grade levels in MD, but not in every school and at not at every level right now. The model for incorporating CS in elementary school (which tends to be done in standalone "specials" courses) is quite different from what might work best for middle school (integrating CS into science and math standards). Computing education--which includes computational thinking--needs to be integrated at all levels. There are few alternatives for developing K-8 computing standards -- at the moment, the only "game in town" is the CSTA 2011 K-8 standards. This is becoming a national area of focus: two new grants investigating learning progressions in CS were recently funded by NSF. The challenge in Maryland is determining how the conversation can best be structured, and how all stakeholders can ensure that any decision about P-12 standards is based on best practices and informed decision making.

Gender and Race Diversity in CS Programs

Nationally and in MD, there is a desire to increase the diversity in CS classes, with the ultimate goal of having more diversity in the CS workforce along several dimensions, including gender, racial/cultural, and socioeconomic. Diversity integration and exposure needs to occur from preK-12. Diversity issues involve curriculum, teaching style, guidance counselors, encouraging all students to try CS classes, and teacher training. Diversity also includes geographic diversity and equity across the state. Across the 24 MD school systems, there is a wide variation of CS classes offered at each level. In fact, there were 6 systems that did not have any students take the AP CS exam. (Note: This does not indicate that the course is not offered.) Several possible activities and goals were discussed, including improving pedagogical methods, reaching out to guidance counselors, and partnering with HBCUs.

Teacher Training

Teacher training attracts different types of teachers. Some teachers have content knowledge but not delivery skills. Other teachers are enthusiastic but need scaffolding to help them master the content. Still other teachers, who feel pressured to complete training but are not actually interested, simply disregard the training and "do their own thing" in their classroom. Teacher isolation also persists as an issue, and teachers need to have more administrative support in order to interact more regularly with colleagues. Online community building is an option; however, it needs to be with minimal time constraints for teachers. A challenge with CS in particular is that even after receiving training for a particular curriculum (such as CS Matters CSP), teachers are not always allowed to teach the class because of recruiting, enrollment, and

prioritization issues. There was broad agreement that administrator training is needed as well, with better explanatory materials for principals and guidance counselors to inform them about the nature and value of CS courses.

Teacher Certification

Several states in ECEP, including Maryland, are drafting a letter to ETS for an improved CS content Praxis II. Most students major in a different discipline with direct, clear pathways to certification in that area, and then later obtain an endorsement for CS. Currently that endorsement requires 30 credits in CS, but there is little clarity or consistency about the content that would qualify a course to be counted as CS. This group wants a rigorous and consistent course list for CS endorsement, including CS 1 (introductory programming), CS 2 (advanced programming), algorithms, discrete math, computer organization, operating systems, software engineering, and a course on computing in society (focusing on history, impact, and ethics). There is a need for more broadly available CS methods classes that emphasize modern pedagogies, including team-based learning, active learning, and inquiry-directed learning. UTeach may be a viable model, but thus far has not focused on CS, and has been incompatible with some efforts to create a non-UTeach pathway.

Physical Resource Issues

Many schools are resource-limited and do not have current hardware and software. The larger issue is identifying and providing the basic resources or computing experiences (hardware, platforms, app development, programming, problem solving, etc.) that students need for the workforce. When robots or specific tools are required, the expense to offer the course becomes a huge barrier. Maintenance and tech support for tools, hardware, software, and networking infrastructure add more costs over time. Some national programs have moved toward only using web and mobile-enabled platforms, but the question remains whether taking away specific hardware or software environments prepares them for college or industry.

Technology Education CS standards discussion

The 2005 technology education standards were based on ISTE standards. The new standards are being written this year. The first issue is how to integrate CS and whether CSTA standards can be used to guide the integration. The revision team consists of school districts who have been doing computer science and have added industry people (BGE, LM and medical community). The revised standards document is in draft form, and include computational thinking and CS as a fifth standard along with the four engineering-focused standards, which have been rewritten to apply more broadly. The team felt that this add-on approach should be revised to have CS as a more central component. The current intention is that all new courses must meet all five standards. The group felt strongly that both CS-focused courses and engineering-focused courses should be eligible for Tech Ed approval, so the question is whether the standards are in fact broad enough to permit more specialized courses to “count.” The core group is interested in providing more feedback about the standards this year and before they are finalized.

Defining ECEP MD Goals

A broad-ranging discussion by the group led to a series of increasingly ambitious goals that will culminate in a 15-year goal of offering computing-related content to every student throughout their P-12 education. "Computing" in this context includes not just digital literacy, but computational thinking and computer science, as appropriate for the students' age and developmental level. "Training" for teachers refers to comprehensive curricular and pedagogical training (such as the workshops offered by CS Matters in Maryland, Code.org, and Project Lead the Way).

- **1-year goals**
  - An ambitious P-12 CS standards framework has been defined and adopted in Maryland.
  - Teachers have been trained to teach AP CS Principles in at least half of the high schools in each public school system in Maryland.
  - Guidance counselors in at least half of the high schools in each Maryland public school system have received training about how to advise students on taking computing courses.
- **2-year goal**
  - AP CS Principles is listed in the course catalog, and has been approved as a Technology Education credit, in every public school system in Maryland.
  - AP CS Principles is actively taught in at least half of the high schools in each public school system in Maryland.
- **3-year goal**
  - The CS endorsement transcript review process has been improved and standardized across the state.
- **4-year goal**
  - Every public high school in Maryland has at least one teacher who has been trained to teach AP CS Principles, and at least one guidance counselor who has received training about computing course offerings.
- **5-year goals**
  - High-quality CS courses, including AP CS Principles, are offered in every high school in Maryland, and taught by well trained teachers.
  - There are at least three undergraduate and three graduate programs, all active and approved, that offer CS teacher certification in the state of Maryland.
  - All public school systems in Maryland have aligned their P-12 CS curriculum with the state P-12 curriculum standards framework.
  - An assessment framework and implementation guides for computing curricula have been created.
- **10-year goals**
  - Rigorous computing courses and content are offered in every public school in Maryland.
  - Every public high school student in Maryland takes at least one course with substantive computing content before graduation.
  - Every public school system in Maryland has encompassed all of the state P-12 computing standards.
- **15-year goals**
  - **Computing is offered to every student in Maryland throughout their P-12 education.**
  - Every secondary teacher who teaches CS classes has a solid CS certification or endorsement based on the new transcript standards and programs.