Providing Equitable Access to Computing Education in Mississippi

Sarah Lee
Bagley College of Engineering
Mississippi State University
Mississippi State, MS USA
sblee@cse.msstate.edu

Jessica Ivy
Annsley Frazier Thornton School of Education
Bellarmine Univeristy
Louisville, KY USA
jivy@bellarmine.edu

Andrew Stamps
Bagley College of Engineering
Mississippi State University
Mississipp State, MS USA
ass78@msstate.edu

***Abstract*— Computational thinking is becoming increasingly essential to the development of a competitive and innovative workforce. This study examines work by researchers and practitioners in Mississippi to provide pathways for learning that make computing education accessible for all citizens. Assessments from a K-12 teacher professional development program will be discussed, in addition to outcomes from one year of a workforce development program.**

Keywords—computer science, K-12, workforce development

I. INTRODUCTION

Researchers in the departments of Computer Science & Engineering (CSE) and Curriculum, Instruction and Special Education (CISE) at Mississippi State University (MSU) are taking the lead to bring equitable access to computing education to the state of Mississippi (MS), where historically minimal pathways have existed in a state heavily populated with groups that are under-represented in STEM and particularly in computer science (CS) and engineering. Out of 477,633 public school students in 2018-2019, 48.9% are female, 48% are African American (AA), and 25% of MS children were part of families receiving public assistance in 2017 [10] [11]. Currently, CS classes are few in the state. Computational thinking is not introduced equitably in MS public schools, yet it is a necessary skill in society.

The MS Adequate Education Program funds school districts below the funding level required by state law [1]. Districts supplement this state funding with funds from local property taxes [2], but the variability in population and property ownership by district leaves a very uneven funding model. Most of a county's revenue comes from property tax, which must meet additional needs besides funding for public schools [2]. Counties with a large property tax base have more revenue for public schools than more rural areas with less dense populations. For example, Madison county, with a population of 13,252, collects an average $1,204 property tax annually from property owners [3], and $67,140,303 of that revenue was directed at public schools in 2017 [4], approximately $5,000 per student. Amite County, with a public school population of 1,024, collects an average tax per property owner of $281 each year. The schools in Amite county received only $2,877,548 in 2017 [5], approximately $2,800 per student. These examples demonstrate the variability in funding across school districts. Students from smaller school districts are often unprepared for IHL upon high school graduation. Many of these students do not see college as a feasible pathway [6]. MS had 155 bachelor's degrees in CS awarded in 2015, compared to 328 in Arkansas (AR) and 1,363 in Alabama (AL).

Beyond K-12 and IHL, there is an economic need for workforce development in computing and technology. Code.org reports there are more than 1,000 open computing jobs in MS [7]. Those currently employed in computing positions in the state earn an average annual wage of $67,820, higher than the average annual wage for all occupations of $38,910 [8]. With MS ranked last in the 2017 State New Economy Index, the development of computing skills represents a new pathway to economic development and innovation [9].

II. PAVING PATHWAYS

A. K-12 Education

One approach to reaching the diverse population in MS is to engage public school teachers in the development of computational skills and the application of those concepts in their classrooms. MS continues to lag behind neighboring southern states in the number of CS AP exam takers. In 2017, AL reported 1520, AR - 870, and MS - 105 [7]. CSE and CISE researchers have developed and implemented a teacher professional development program, Attract-Inspire-Mentor (AIM), to make computing education more equitable [12]. AIM delivers a transdisciplinary approach to professional development, fostering collaboration of teachers across disciplines to integrate CS content into their classrooms. By introducing CS into multiple content areas, broader access and participation by students across gender and race is realized. Teachers are empowered to meet students where they are. In other words, students in a biology class that already are passionate about learning biology will learn how computing enhances this content area. Or, a student in biology who finds learning biology boring and is uninterested may become engaged by using data modeling to study biological data.

With AIM's transdisciplinary teacher development approach that integrates technical concepts with existing curriculum, a pathway towards CS-ready teachers is

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established [13]. Specific goals of AIM include: *Attract* teachers to CS learning by meeting them where they are in the comfort of their current content areas, enabling them to develop self-efficacy with computing as an extension of their current areas of expertise. *Inspire* teachers to pursue the use of computing concepts in their classrooms, with follow on activities that enable them to showcase their work and that of their students. *Mentor* teachers by providing an in-person and digital platform for knowledge sharing and mentoring among teachers, industry, and IHL faculty.

Pre and post assessments used include the Technological Pedagogical Content Knowledge (TPACK) Developmental Survey which measures changes in teachers' pedagogical content knowledge and the EQUIP Quality Review Protocol, validating that key components of exploration, implementation, and discussion are present in lesson plans that are developed. Another survey is administered six months after workshop completion to assess self-reported longitudinal impact. Data gathered in 2017 indicates participants do perceive some TPACK growth during the workshop, with the least in the Content Knowledge domain indicating more work is needed in that area. A large growth is the Pedagogical Knowledge domain suggests teachers benefit in their methods of practice [13]. Based on data and experience thus far, AIM is expected to demonstrate increased access, participation, and responsiveness to CS among teachers in the state.

B. *Workforce Development*

Responsive to state economic development challenges, a program that shows promise is the Mississippi Coding Academies (MCA). This non-profit program, consisting of a campus in the Golden Triangle region (GTR) and one in Jackson, provides a pathway for persons who want to retool for the digital economy and accelerate income opportunity. With 1,519 contact hours over 11 months, participants learn software development with a variety of programming languages and technical platforms. Students who successfully complete the program are entering technical support and software development entry level positions.

Curriculums differ slightly between campuses and are designed to be nimble and responsive to skill set demands of state industry. Students attend class during normal business hours, five days a week, in an active learning environment. There is minimal lecture, with most time spent on hands-on activities. In a simulated professional workplace environment, the experience is similar to an apprenticeship program. In addition to technical content, students also receive professional development such as resume writing, workplace communication, and interviewing. Service-based learning is a component, and recently students co-hosted a mini-hackathon for 80 second grade students and visited elementary classrooms to teach programming.

The MCA student population consists of 86% AA and 51% female. GTR cohort one finished the program in November 2018 with a 56% placement to date. Cohort one at Jackson had a slightly higher placement rate with others entering military service or IHL. The starting salaries, ranging from $33,000 to $50,000 have a significant impact on the individuals and the gross domestic product (GDP) in Mississippi. Employers include large and small corporations with a presence in Mississippi, including one government contractor.

III. FUTURE WORK

Through alignment with school district partners, AIM will be scaled to PK-12 teachers across the state. A longitudinal study is expected to show growth in self-efficacy in computing among the student populations that these teachers serve. Researchers will continue to study the students who apply to, enter, and complete the MCA programs, to develop a profile of the student that is most successful in this pathway.

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