Mississippi Coding Academies:
A non-traditional approach to computing education

Introduction

School districts in Mississippi (MS) must supplement state funding, which is consistently at a level below state law, with funds from local property taxes [1][2]. Population and property ownership differs among districts resulting in uneven funding. Counties with a large property tax base have more revenue for public schools than more rural areas with less dense populations. Students from smaller, less-funded school districts are often unprepared for college upon high school graduation, and may not see college as a feasible pathway [3]. For those that do attend college, the number of bachelor's degrees in computer science (CS) is less than in neighboring states. MS awarded 207 CS undergraduate degrees in 2017 compared to 350 in Arkansas and 614 in Alabama [4].

The challenges of attracting large scale, high-wage employers and retaining educated talent in the state of MS are well documented [5]. The state has seen some success in recruiting large manufacturers, but these opportunities are rare, expensive, and increasingly impacted by the trend toward greater automation. For the third consecutive year, MS ranked last in the nation in the 2017 State New Economy Index published by the Information Technology & Innovation Foundation [6]. For MS, the development of a more capable computing and technology-focused workforce promises more than just higher wages and greater employment. It represents a new pathway to greater economic development and homegrown innovation. Code.org reports there are 978 open computing jobs in MS [7], and workers in computing positions earn an average annual wage of $67,820, which is much higher than the average annual wage for all occupations of $38,910 [8].

Showing promise for enlarging the pool of technical talent in the state are the Mississippi Coding Academies (MCA), launched by Innovate Mississippi (InnovateMS), a non-profit service provider focused on growing the innovation economy in the state. The program provides a pathway for persons to enter the workforce and accelerate income opportunity. With 1,519 contact hours over 11 months, participants learn front-end to back-end software development with a diverse set of programming languages and frameworks [9].

The Program

The MCA program was initiated with the following goals:

- Prepare highly motivated high school graduates who are not on a college pathway for careers in technology,
- Reduce the shortage of available computing professionals in the state, and
- Establish Mississippi as a high growth area in technology.

Inspired by Base Camp Coding Academy in Water Valley, MS, MCA operates a tuition-free, 11-month training experience. Base Camp graduated classes in 2017 and 2018, with students

transitioning to developer jobs at companies such as FedEx, C Spire, and MTrade. Coding academies and 'boot camps' have been launched across the country, inspired by the shortage of computer programming and other technical talent needed to fill the 494,000 open computing jobs in the United States [10][11].

The MCA curriculum is designed to be responsive to the needs of employers in the state [9]. In the first three months, a thorough introduction to computing architecture, with topics such as binary representation and memory models, and core computer programming concepts, including object oriented, is presented. Students learn the model-view-controller (MVC) architectural pattern approach for developing graphical user interfaces, and learn hypertext markup language (HTML) and cascading style sheets (CSS). Database design, including normalization, and structured query language are taught, with a focus on relational database management systems. Specific programming languages and frameworks sometimes vary across the two campuses dependent on industry input, including but not limited to: Python, C#, Swift, .Net, and XCode.

Governance of MCA is managed by a board of directors consisting of industry and academic professionals. The board strives to maintain the following characteristics of the program:

- A rigorous student recruitment and selection program to ensure students accepted are motivated and have demonstrated outstanding work ethic,
- A high-touch approach, working closely with each student to achieve success,
- A strong connection to employers who assist in setting the curriculum and in screening, educating, and evaluating the progress of the students, and
- A close partnership with Mississippi PK-12 schools.

Students attend class during normal business hours, five days a week, and participate in an active learning environment. There is very little lecture, with most time spent on hands-on activities. In addition to technical content, students also receive guidance on professional development topics such as resume development, workplace communication, and interviewing skills. Service-based learning is a component of both academies with students giving back to their communities through a variety of activities. In 2018, students in the Golden Triangle campus, working with MSU students, co-hosted a mini-hackathon for local second grade students and a programming workshop for persons with low vision or blindness. They also visited elementary classrooms in another nearby school district to teach programming using Sphero and Finch robots, spending a total of two weeks in 2nd and 5th grade classrooms. The Jackson campus provided technical leadership to the Mayors Summer Jobs Coding Program. They taught the Swift programming language and Xcode development platform using Apple's Everyone Can Code curriculum to 30 public high school students over a month, for a total of 80 contact hours. They also coached the high school students during a one-month internship at three local companies where they wrote simple apps.

The Students

The Golden Triangle (GT) campus is an affiliate program of Mississippi State University, and is located adjacent to the main campus in Starkville MS. The Jackson MS (JXN) campus is co-located with InnovateMS' main office. The first cohorts entered the MCA in 2017. The second cohort started in 2018. 86% of students entering the MCA across cohorts 1 and 2 are African

American and 72% are female. Figure 1 depicts the educational backgrounds of participants prior to entering an MCA program.

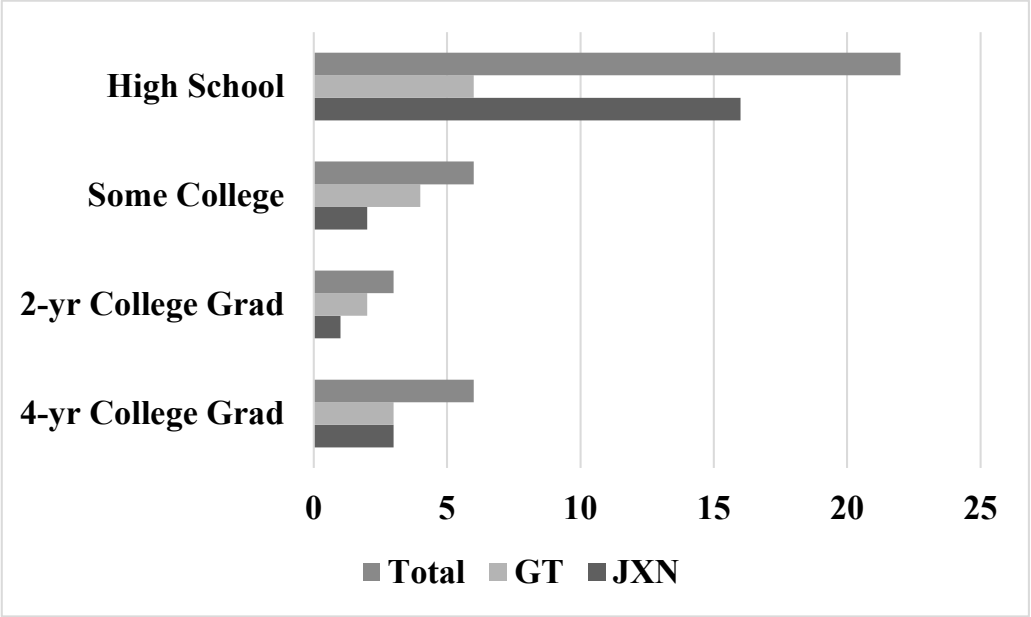

Figure 1. Pre-MCA educational status

Economic Impact

The total cost of the MCA in 2018 was $474,500. The cost per student averages $22,000. $1.1 million of funding has come from the W. K. Kellogg Foundation, the Appalachian Region Commission, and Mississippi State University. The State of Mississippi committed approximately $900,000 of workforce development funding for the first two years.

The starting salaries of graduates will have a significant impact on the individual and the gross domestic product (GDP) in Mississippi. Various economic development models suggest a GDP multiplier between 2 and 5, so both are included in Table 1 for illustrative purposes, demonstrating the potential output generated by the currently employed MCA graduates at one year and five years.

Table 1. Salary Impact to the State Economy

	First Year	Fifth Year	Cumulative
Jobs	14	14	14
Salary	$40,000	$75,000	$287,500
Income Before Program	$14,000	$14,000	$70,000
Increased Salary	$26,000	$61,000	$217,500
	State Direct Income and GDP Increase		
Income (Direct)	$364,000	$854,000	$3,045,000
GDP @ Multiplier of 2x	$728,000	$1,708,000	$6,090,000
GDP @ Multiplier of 5x	$1,820,000	$4,270,000	$15,225,000

Sixty-one percent of the trainees who complete the program have entered a technical job position to date. Based on data reported in exit surveys, the average starting salary for these is $40,000, an estimated increase of $26,000 over their incomes before entering the program. The salary estimate of $75,000 after five years is based on the average compensation noted by Code.org [5]. Not included are the students who entered college, military service, or non-technical jobs after leaving MCA. The increase in direct income is the aggregate wage increase, excluding those who returned to college.

Assessment

Exit surveys were conducted with cohort 1 at both campuses to assess their perceptions of the program and the quality of education they received. This information will be used for continual improvement to the curriculum and program structure. Completion of the survey was optional, and not all of the students completed it. Nine students graduated from the GT academy with 3 completing the survey, and 21 completed the Jackson program with 6 completing the survey. One reason for the low completion rate is that the survey was not distributed until after most students were no longer physically present on campus. In the future, the survey will be distributed before students exit the program. The quality of instruction and overall assessment of the program by the students who responded is shown in Figure 2. While this sample size from year one is small compared to the total number of students, it does provide a baseline for future assessment and quality improvement.

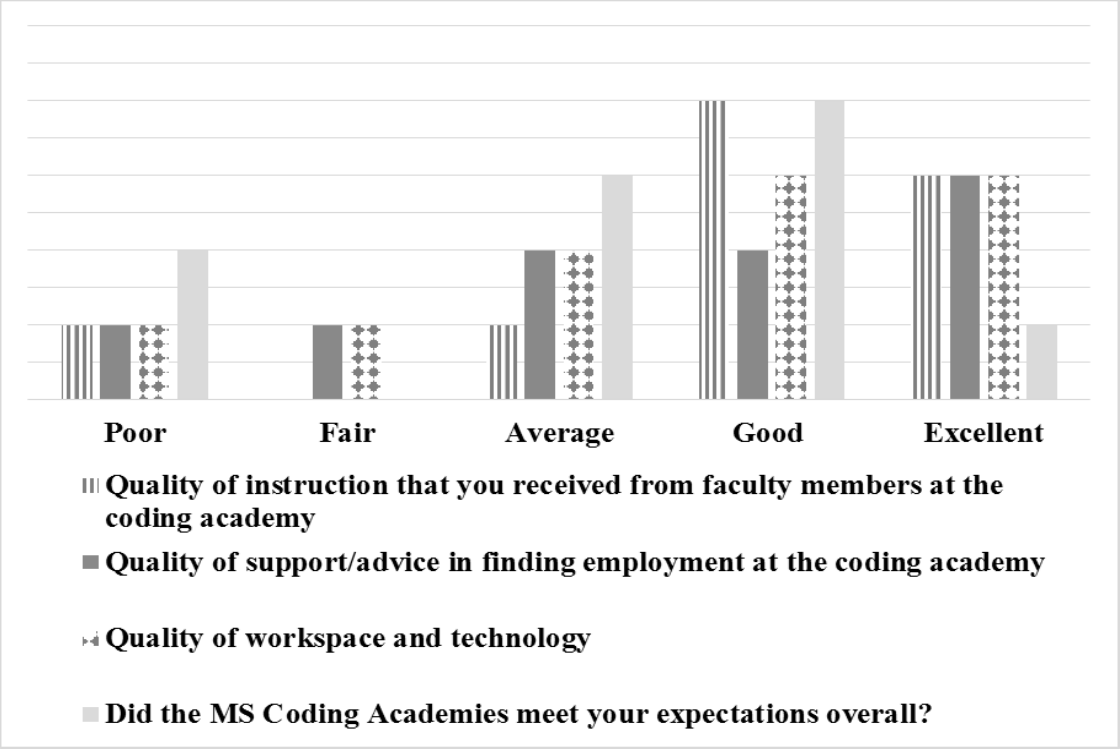

Figure 2. MCA year one exit survey results

Approximately 18 of the 39 students who entered the program did not obtain a certificate. Many of the students who leave voluntarily do so because they are not willing to invest the time and effort required to master the material. Some are asked to leave for this reason, which

manifests in high absenteeism. Longitudinal assessment will help identify the profile of students most successful in the program, and will inform the acceptance process and criteria. Future work includes determining the characteristics of individual students who successfully complete the program and enter the workforce to determine the type of student that MCA should target for recruitment.

Summary

Shortly after the first MCA class graduated, the Mississippi State Personnel Board changed the minimum requirements for 20 information technology job categories to include an MCA certification. Students in MCA have entered jobs at companies including BankTEL, Corelogic, C Spire, and defense contractors in addition to state agencies. These placements are encouraging as cohort two enters the second half of their MCA education.

Currently, MCA participants must attend class in person, during normal business hours, five days a week [9]. Excluded by life circumstances are persons who must work during those hours to support a family and those who have child and elder care responsibilities. Further, citizens with limited mobility are also excluded when regular class attendance creates a hardship. A distance-based learning model to complement the existing program will enable more equitable access to this non-traditional approach to computing education.

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