Applied Research Paper

From Partnership to Prosperity: Challenges and Best Practices of Georgia Community Colleges on STEM Workforce Development

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Table of Contents

Ack	nowle	dgments2
Кеу	words	2
I.	Intro	oduction3
II.	Liter	ature Review6
	a.	Community college' challenges in federal and state context
	b.	Community college as a solution to STEM workforce shortage9
	c.	Community college as a local economic development accelerator
III.	Resea	arch Design12
IV.	Geor	gia Policy and Text Analysis Findings17
	a.	Funding formula17
	b.	Workforce development initiatives22
	c. l	Regulatory requirements24
V.	Case	Analysis and Interview Findings26
	a. (Ohio STEM Learning Network28
	b.	California Gaining Early Awareness and Readiness for Undergraduate Programs (GEAR UP)29
	c.	Kentucky Automobile Manufacturing Technical Education Collaborative (AMTEC) 31
	d.	Florida Seminole Community College (SCC) Center for Economic Development32
VI.	Rec	ommendations and limitations34
VII.	Bibl	liography
VIII.	Арр	pendix: Interview Guide and Questions41

Acknowledgments

I could not have finished this option paper without the many experiences and people I have encountered at Georgia Tech. In doing so, I owe immense gratitude to:

My advisor, Dr. Paige Clayton, whose teaching, revisions, and support were instrumental in

shaping my ideas and helping me to complete the tasks associated with this work.

The interviewees of this study – all thirteen- whose willingness to share their experiences and insights has been critical in shaping my research findings.

The Foreign Fulbright Program, Institute of International Education, and American Indonesian Exchange Foundation, who have provided me with the opportunity of a lifetime to pursue graduate education in the United States.

An immense thank you to my friends and family in Indonesia and the United States, whose unwavering support and encouragement have inspired me to persevere throughout my academic journey. *Terima kasih*.

Lastly, to Fajar Sumiarsa, for being the best cheerleader and partner I could ever ask for.

Keywords

workforce development, strategies, programs, STEM, partnerships, community college, Technical College System of Georgia

I. Introduction

Community colleges in the United States are powerful and potentially underutilized resources. Community colleges offer secondary education and career pathways with courses and financial flexibility. Most importantly, many community colleges offer a multitude of STEM education programs that are in demand by employers. Community colleges' involvement in closing the STEM worker shortage is important for several reasons, but mainly due to their unique position as a bridge for people unable to obtain a traditional four-year education.

Community colleges have a unique mission to develop essential technical skills that meet the needs of the current workforce. Therefore, STEM industries such as computer science and biotechnology often rely on partnering with community colleges to devise customized programs to supply the skilled workers they need to hire (Chen, 2013). Nearly half of the workers in the aerospace industry hold two-year degrees today. These skilled workers hold positions in large, well-known companies like Boeing and Lockheed Martin, working in maintenance, installation, and production department (Noonan, 2017). When industries are at a loss for skilled workers to fill their positions, they more frequently turn to community colleges as they produce a workforce with less time than a four-year institution. This habit is also because community colleges are more flexible in drafting curricula that suit an industry and even a specific company within the local community (Hagedorn and Purnamasari, 2012). Students focus on their field from their first day in the classroom and graduate from their twoyear or certificate program, ready to hit the professional ground running.

If we turn to Georgia, I find that the community colleges are severely underfunded. According to a report published by the Georgia Budget and Policy Institute, community colleges

in Georgia receive just 9% of the state's workforce development funding, despite serving nearly half of the state's undergraduate population. This disparity in funding is especially concerning when considering that community colleges are critical to developing a skilled workforce that can meet the demands of Georgia's growing STEM industries. It is also worth mentioning that Georgia's college students rely on federal need-based as the state is one of only two states in the country that lacks state need-based grants. These facts put Georgia community colleges at a disadvantage, especially since federal funding support students as financial aid, with very little flowing directly into schools (Lee, 2021).

Without adequate funding and support, community colleges and technical colleges will struggle to provide the high-quality education and training that Georgia's students need to succeed in STEM careers. It would be more challenging for Georgia to compete in the increasingly competitive global economy and meet the evolving needs of its STEM industries. Therefore, it is essential to address the underrepresentation and underfunding of community colleges in Georgia and ensure they receive the support they need to succeed.

Additionally, Georgia's Science and Technology Strategic Plan titled "Innovate Georgia 2025", last updated in 2015 and supposed to guide the state's science and technology policy, rarely mention community colleges or technical colleges. This underrepresentation is significant because community colleges and technical colleges are critical components of the state's STEM education system, especially if they are essential in meeting the workforce demands of Georgia's STEM industries.

Building a future-ready workforce to meet today's challenges requires comprehensive cooperation from policymakers, community organizations, educators, and business leaders.

When policymakers lead and provide a strong foundation for educators and the workforce – including underrepresented and marginalized communities – this foundation would inform future workforce to develop the necessary skills to be successful.

As such, this paper utilizes multiple primary and secondary sources to explore how roles of community colleges, technical colleges, and other associate degree-granting institutions (for conciseness, will be called "community colleges" unless otherwise noted) in Georgia could be leveraged to meet the state's regional STEM workforce needs with particular attention to different types of programs and partnerships efforts with external institutions outside the community college itself. The objectives of the research are to:

- Identify the biggest needs and challenges that Georgia community colleges face regarding the education of the STEM workforce using a policy lens and expenditure metrics,
- Assess current programs and partnerships that Georgia community colleges already implement,
- Compile and assess best practices of community college programs and partnerships efforts that have a similar emphasis on the STEM workforce, and
- 4. Use the lessons from the first three objectives to create a report with recommendations and best practices framework that would be helpful for Georgia community colleges in leveraging their role of producing a competitive STEM workforce.

The rest of the paper is structured through the following sections: (II) literature review of prior research on community colleges' challenges in general, its opportunity to shorten the nation's current STEM workforce shortage, and its capacity to form partnerships with external

institutions to support that goal, (III) research design and methods outline; (IV) landscape of STEM workforce development in Georgia and the issues it encounters, (V) discussion of the findings; (VI) policy implications along with recommendations for practitioners.

II. Literature Review

a. Community college' challenges in federal and state context

Community colleges play a crucial role in American higher education. They offer a low-cost alternative to a traditional four-year university by providing career and vocational training and pathways to a four-year university degree. These colleges are engines of opportunity that support social mobility and the economy, as they disproportionately serve low-income students and students of color. Community colleges have long granted associate degrees that typically take about two years of full-time study. These programs offer students the traditional collegelevel courses that lead to an associate degree and prepare the student for further study toward a bachelor's degree.

However, community colleges have also been providing career training through vocationoriented courses, leading to a certificate that proprietary schools and vocational institutions typically offer. This effort has increased the importance of community colleges, especially in rural areas where career training is difficult to obtain. As a result, community colleges have seen a surge in enrollments, outpacing the institutions offering bachelor's degrees (BLS, 2015).

Several challenges, including fiscal constraints, demographic shifts, and various other issues, threaten the community college's open-access mission. The American Association of Community Colleges stated in 2020 that despite such evident public support, student

enrollment has dipped since the early 2010s. College leaders have struggled to meet demand in the face of steep budget cuts, limited facilities, faculty turnover, rising technology costs, and an increasing number of students who need remedial work before they can take college-level classes." In other words, community colleges are asked to do more with less.

Community colleges also receive much less funding per student than public four-year institutions, even though they serve a greater proportion of underrepresented students in higher education and may need additional programs and supports to succeed (Edgecombe, 2022). Research shows that per-student spending by colleges is directly related to student outcomes and that a lack of resources impedes community college effectiveness (Deming and Walters, 2017). Better-resourced institutions have higher retention and attainment rates among Black and Latinx students (Weis, 2012; Gansemer-Topf & Schuh, 2006; Melguizo, 2008). But community colleges often lack the resources to implement reforms that research has shown lead to better and more equitable outcomes.

There is no single solution to uphold if we look at state policy contexts, governance structures, and funding mechanisms among community colleges nationwide. More than half of community colleges' public funding comes from state and local governments, and while federal funding has increased in recent decades, state funding has fallen (Stauffer et al., 2019). The large infusion of federal dollars during the pandemic and the debate over increasing the federal role has made effective federal funding policy even more critical.



Figure 1 Total Revenue for Community Colleges, by Source, Fiscal Year 2017. Source: Columbia College Research Center (2022).

Community colleges have substantially fewer core academic and student support resources than public four-year institutions. Despite their role in underrepresented communities, a typical US community college receives \$8,800 less in education revenue per student enrolled than their four-year institution's counterpart (Center for American Progress, 2020). The fact would translate as \$78 billion difference in revenue between the two institutions. This number is also nuanced as it did not consider federal research funding or auxiliary services such as dorms and dining halls. It also must be accounted for that four-year institutions can bring in more money by implementing much higher tuition and fees as well as auxiliary services in the form of dorms and dining halls, as well as receiving larger amounts of state appropriations.

COVID-19 relief funding has helped community colleges continue to operate during the pandemic, in which the funding formula has evolved to better support the population of predominantly studying at community colleges. Higher education institutions and their students received substantial help from the federal grant through the CARES Act (March 2020), the Coronavirus Response and Relief Supplemental Appropriations Act (December 2020), and the American Rescue Plan Act (March 2021), in which \$19.3 billion of this federal support has been allocated to public two-year colleges (where public four-year colleges receive \$34.7 billion). This time, the CARES Act funding formula used full-time-equivalent (FTE) students to measure the size of the student population (and low-income student population), depressing funding levels for community colleges relative to four-year colleges, as community colleges serve many more part-time students. This funding formula of attributing full- and part-time students has boosted funding for community colleges.

With the increase of STEM positions and the decline of undergraduate college enrollment due to student debt and companies emphasizing more experience rather than diplomas, community colleges have a chance to maintain, if not expand, their impact across the nation to secure a more equitable, skilled workforce.

b. Community college as a solution to STEM workforce shortage

The debate of the nation's STEM workforce has been a contentious issue among leaders in the public and private sectors. The US House Education and Workforce Committee (2013) asserts that although high-paying STEM jobs have grown rapidly, the supply of workers with the skills needed to fill these in-demand positions has fallen short. This result was also echoed by a report from the advocacy group New American Economy (2017), demonstrating the ongoing strength of belief in the STEM labor shortage that has worsened considerably during the

decade's first half. A growing body of labor force research disputes the claim of a general shortage across STEM occupations.

In some STEM fields, there are classic signs of adequate supply or even oversupply. For example, the median hourly wages in two computing-related professions (system software developers, computer information and research scientists) rose by an average of about 1.9% (BLS, 2017, Occupational Employment Statistics) between 2010 and 2017, which is barely above average annual inflation of about 1.7% for the same period. Further, Noonan (2017) reported that almost two-thirds of STEM undergraduates work in a field outside of STEM. Pay growth may be slowed by workers changing jobs and diverting into other high-skill occupations with better working conditions or better pay (National Science Board, 2015). The issue of adequate labor supply is further complicated by evolving workforce determinants that involve outsourcing STEM labor and automation.

Even then, workforce demand for STEM students spurs efforts at community colleges. With their high enrollments of minority and low-income students, community colleges are apparent places to recruit a diverse workforce thanks to their relative job security and higher wages. As concerns grow over impending workforce shortages in science and technology, educators are turning to community colleges to fill the gap. It is important to note that STEM does not mainly consist of research and other professionalized posts. However, it includes technicians and skilled workers in advanced manufacturing, welding, and other technology-driven industries.

Although STEM education has fomented much discussion, generated much concern, and is the topic of national debate, the exact nature of the country's STEM problem has been misunderstood. Hagedorn and Purnamasari (2019) contend that community college is an

important avenue to relieve the problem, but it is not to solve it. Community colleges have been "unfocused" by trying to be "all things to all people" without sufficient financial state support (Katsinas & Hardy, 2020). The question then asks for the most efficient way to train the next generation of STEM workers with limited resources and an obscure career path ahead.

c. Community college as a local economic development accelerator

Community colleges can play a critical role in local economic development by catalyzing job creation, industry partnerships, and entrepreneurial development. By providing targeted workforce training programs, fostering collaboration with local industries, and promoting entrepreneurship and innovation, community colleges can help to build a strong and sustainable local economy.

Research has shown that community colleges have the potential to drive economic growth by providing the necessary skills and training for the local workforce. A study by the Aspen Institute found that community colleges that focus on workforce training and align their programs with local industries' needs can help meet the labor market's demands and create new job opportunities (Aspen Institute, 2018). In addition, community colleges that offer certificate and degree programs in high-demand fields, such as healthcare, manufacturing, and information technology, can attract new businesses and industries to the area, further contributing to economic development (Bragg & Kyei-Blankson, 2011).

Furthermore, community colleges can foster collaboration with local industries by establishing partnerships and providing customized training programs. These partnerships can help to address skill gaps in the local workforce and provide businesses with the talent they need to grow and expand. A study by the National Association of Community College

Entrepreneurship (NACCE) found that community colleges that have established partnerships with local businesses and industry groups are better positioned to provide relevant training programs and support entrepreneurial development (NACCE, 2018).

In conclusion, community colleges have the potential to act as a local economic development accelerator by providing targeted workforce training programs, fostering collaboration with local industries, and promoting entrepreneurship and innovation. These efforts can help create new job opportunities, attract new businesses and industries, and build a strong and sustainable local economy. All three sections of this literature review reinforce that community colleges are powerful yet underutilized resources. Much of the workforce development pipeline discussions in Georgia focus more on other institutions outside of community colleges. As a growing state that often calls itself the technology hub of the South, there should be a better established, collective action to address a growing need for a skilled workforce that embraces a variety of stakeholders, especially community colleges. In the next section, I describe the research design by which the paper analyzes the current landscape of STEM workforce development in Georgia, the issues it encounters, and how we might address that by establishing better programs with better institutional partnerships.

III. Research Design

The aim of this research is to identify challenges and best practices for Georgia community colleges in regard to their STEM workforce development. To achieve this, a mixedmethod research approach is employed, consisting of a comprehensive analysis of policies and facts related to informing the landscape that Georgia community colleges currently operate in,

and second, analysis of informational interviews with stakeholders that participated in a community college partnership.

The first part of the research design involved a thorough assessment of existing findings and reports on community colleges in Georgia. This review includes an analysis of relevant policies, funding structures, and practices that impact the ability of community colleges to participate in STEM workforce development. A variety of sources are consulted, including government reports, academic articles, and policy documents. This part of the analysis aims to provide a comprehensive understanding of the landscape in which Georgia community colleges currently operate. The second part of the research design involved conducting informational interviews with stakeholders that were engaged in STEM workforce development efforts, including colleges across the state. The interviews were separated into two different parts. The first part of the interview had questions that were designed to inquire the questions I have about the policy environment that Georgia community colleges are currently in, while the second interview would be focusing more on examining successful case studies and how they could be implemented in Georgia community colleges. Before I started my interview, I obtained an IRB approval ¹ with the Georgia Tech Office of Research Integrity Assurance. Then, I selected a few names for an initial interview, before applying the snowball method to find the most relevant interviewees.

Table 1 Research	Question and	Methods.
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Research Methods	Research Question: How can community colleges be leveraged in future Georgia STEM
	workforce development?

¹ IRB number #H22435

	Q1: What are the biggest needs and challenges that community colleges face?	Q2: What programs can be developed and implemented at community colleges to support <u>Georgia's science</u> <u>and technology priority</u> <u>areas</u> ?	Q3: What partners do community colleges need to work with to achieve their education programs?
a. Conducting literature reviews	Reviewing policies and progr involvement of community c	ams that are/were applied in these olleges in addressing STEM workfo	e cities that addresses the rce development.
b. Determining relevant case studies	Identifying distinctive programs that discuss community colleges involvement, preferably with results or implementation plan	↓ Identifying four case studies from across the US that has distinctive typologies of partnership model applied on their community colleges.	 Drawing out and classifying types of partners that is involved in the programs.
c. Conducting interviews	Identify stakeholders from each cavegory (industries, research government entities, academia) for interview. Interview		
d. Generating recommendations	Collect quantitative characteristics that depict the current climate that Georgia community colleges are currently operating in.	Identify quantitative characteristics: - Years implemented. - Institutions involved. - Metrics of success (number students trained, number jobs created, etc)	Collect qualitative data that the interviewee has on their case studies
	Outlining challenges & be	est practices for leveraging commu workforce development strategies	nity college's role in STEM s

The interviewee names listed below were the interviews I deemed important to this paper's findings. I divided my interview group into two sections: Georgia context-interview and case studies interview. This distinction was made to achieve two separate goals: (1) learn more

about the local context of Georgia in which Georgia community colleges are operating in, and

(2) identify different partnerships that exist throughout the United States that followed

deCastro and Kemp (2019) 's community college-industry partnership typology. In the end, I

obtained thirteen interviews for this paper. All of the interviews were conducted either via

Zoom or phone call and lasted between thirty minutes to an hour.

Name	Title	Title (Case Study)	Type of Organization (Location)
Georgia context-inter	rview		
Anonymous	Middle level role	Technology Association of Georgia	State organization (Atlanta, GA)
Nathan Moon	Lead researcher	Georgia Tech Center for Advanced Communication Policy	Academia (Atlanta, GA)
Anonymous	Middle level role	Georgia Department of Education	State organization (Atlanta, GA)
Robin Roberts	Program Coordinator	Technical College System of Georgia	State organization (Atlanta, GA)
Steve Cromer	Program Director of Economic Development	West Georgia Technical College	Higher education institution (Waco, GA)
Case study interview			
LaCandice Ochoa	Program Manager	California's Community College Chancellor's Office (California GEAR UP)	State organization (Sacramento, CA)
Rob Evans	Strategic Partnerships & Communications Manager	Batelle (Ohio STEM Learning Network)	Private organization (Colombus, OH)
Anna Pyles	STEM Project Specialist	Batelle (Ohio STEM Learning Network)	Private organization (Colombus, OH)
Cadie Allen	Program Administrator	Ohio Department of Education	Government administration (Colombus, OH)
Mike Rodgers	Institutional Advancement Staff	Advanced Manufacturing Technical Education Collaborative (AMTEC)	Private organization (Owensboro, KY)
Jason Simons	Director	Advanced Manufacturing Technical Education Collaborative (AMTEC)	Private organization (Owensboro, KY)
Jonathan Cole	Faculty	Seminole State College of Florida	Higher education institution (Sanford, FL)
Gui Cunha	Administrator	Seminole County Economic Development Department	Government Administration (Lake Mary, FL)

Table 2 Informational interview participants. Source: Author.

The research design for this paper utilized a mixed-methods approach that includes both quantitative and qualitative data collection methods. The quantitative data would be collected from existing reports and statistical data related to community college funding, enrollment, and graduation rates in the form of a factsheet. The qualitative data will be collected through informational interviews and the analysis of policy documents. The data collected through both methods will be analyzed using a descriptive analysis approach to identify common themes and trends across the data.

Table 3 Identified case studies and institutions for each type of community college partnership typology.

	Goal	Possible outcomes	Sample activities	Identified case study
Curricular alignment and articulation	Alignment in curricular content, competencies, and course credits	 Pathways to and through various educational levels Coherent curricula and norms to allow for ease of student transfer 	 Articulation agreements Common course numbering 	Ohio Stem Learning Network
Academic and social support	Provide guidance and information to direct students toward educational and career success	 Accurate and helpful information for use in planning A common understanding of what students need to know and be able to do to be ready for college and career success 	 Intensive course advising Tutoring Workshops and student success courses Early warning assessments 	California Early Action Program
Professional development	Enhance staff and teacher preparation through sharing of information	 Promoting communication for collaboration Leveraging institutional expertise to improve instructional practice 	 Joint workshops Cross-sector professional mentoring 	Kentucky automobile manufacturing technical education collaborative
Resource- sharing	Generate new income streams and reduce costs	 Shared space, facilities, and equipment Lowered cost burden More efficient use of resources 	 Maximally used facilities Community-on-the-campus 	Florida Seminole Community College (SCC) Center for Economic Development

IV. Georgia Policy and Text Analysis Findings

The state of Georgia has several policies in place that impact the ability of community colleges to participate in STEM workforce development. The following section will discuss how the state's (1) funding formulas, (2) workforce development initiatives and (3) regulatory requirements can hinder the ability of these community colleges to fully engage in the state's workforce development.

a. Funding formula

As a state, Georgia's funding formula for community colleges may not prioritize STEM programs as highly as other states in the United States. Funding for Georgia community colleges is based on the number of credit hours generated, so programs with lower enrollment may not receive adequate funding. Georgia's funding formula for community colleges has stagnated since 1994 and has not kept pace with inflation (Georgia Budget and Policy Institute, 2019). As a result, community colleges in Georgia may struggle to provide high-quality programs and support services to students. The report also notes that Georgia's community college funding is significantly lower than the national average.

Top 10 states				Bottom 10 States for Per-Student Funding for		
			Community Colleges			
Rank	State	Amount	Rank	State	Amount	
1	Wyoming	\$8,620	50	Michigan	\$3,960	
2	Alaska	\$8,200	49	Kentucky	\$3,860	
3	Hawaii	\$7,760	48	Missouri	\$3,830	
4	North Dakota	\$7,390	47	Alabama	\$3,540	
5	Nebraska	\$6,980	46	Georgia	\$3,320	
6	New Mexico	\$6,950	45	South Carolina	\$3,290	
7	Montana	\$6,920	44	Arizona	\$3,190	
8	Louisiana	\$6,750	43	New Hampshire	\$3,090	
9	Idaho	\$6,710	42	Mississippi	\$3,030	
10	Colorado	\$6,540	41	New Jersey	\$2,800	
Nationa	l average: \$4,961	per FTE (full-time eq	uivalent)	student	•	

Table 4 US States Per-Student Funding for Community Colleges.

Source: Author, National Center for Education Statistics, Community College League of California (2021). It is important to note that these expenditures may include a combination of state appropriations, local funding, and other sources of revenue. Additionally, the funding allocated to each community college may vary based on factors such as enrollment, program offerings, and student demographics.

The table above shows the rankings of all 50 states in the United States based on perstudent funding for community colleges, as reported by the Century Foundation. The top 10 states in the ranking all provide significantly higher per-student funding than the national average of \$4,961 per FTE student, with Wyoming topping the list at \$8,620 per student. On the other hand, the bottom ten states in the ranking, with New Jersey providing the lowest perstudent funding at \$2,800 per student, all provide significantly lower funding than the national average. Georgia, which ranks 45th in the nation with per-student funding at \$3,320 per student, falls in the bottom ten states.



Figure 2t Funding sources and Dollar Values for Community College Funding Across US Tech Hub States

Source: U.S Department of Education (2019).

Table 5 Funding Sources f	or Community	Colleges in US	States with 1	ech Hubs
Tuble 3 Fulluling Sources I	or community	concecs in 05	States with	CCIT HUDS

State (Tech Hub)	State Appropriations	Local Property Taxes	Tuition/Fees	Federal Grants/Contracts	Other Sources	Total Funding
California (San Francisco)	\$2,229,851,000	\$1,294,127,000	\$3,447,091,000	\$290,883,000	\$498,171,000	\$7,760,123,000
New York (New York)	\$1,424,527,000	\$785,526,000	\$1,406,596,000	\$110,717,000	\$99,224,000	\$3,826,590,000
Washington (Seattle)	\$536,810,000	\$546,141,000	\$1,189,585,000	\$57,065,000	\$106,480,000	\$2,436,081,000
Texas (Austin)	\$1,410,280,000	\$1,016,358,000	\$1,820,409,000	\$121,479,000	\$293,186,000	\$4,661,712,000
Georgia (Atlanta)	\$390,782,000	\$219,962,000	\$1,086,151,000	\$35,825,000	\$99,078,000	\$1,831,798,000
Illinois (Chicago)	\$617,670,000	\$548,193,000	\$1,127,757,000	\$41,778,000	\$109,101,000	\$2,444,499,000

Source: National Center for Education Statistics (2019), Community College League of California (2021).

As the table shows, state appropriations and local property taxes are the two largest funding sources for community colleges in this sample of states with a growing tech population. However, tuition/fees are the largest sources of funding in Georgia, while in the other five states, it is the third largest source of funding. Federal grants, contracts, and other sources (such as lottery revenues or private donations) make up a smaller percentage of total funding across all states. It's also worth noting that the total funding amount varies greatly between these states, with California having the largest and Georgia having the smallest.

Several contributing factors could explain Georgia's low ranking in per-student funding for community colleges. As mentioned earlier, the Century Foundation report notes that Georgia's funding formula relies heavily on tuition revenue, which may create financial barriers for lowincome students and limit the resources available to community colleges. Georgia's community college funding is heavily reliant on revenue because the state of Georgia has chosen to rely on a funding model known as performance-based funding (PBF). Under PBF, community colleges and other higher education institutions are funded based on their performance in meeting certain metrics, such as graduation rates, transfer rates, and workforce development outcomes. The idea behind this funding model is to incentivize colleges to improve their performance in these areas, producing better outcomes for students and the state.

However, this also means that community colleges are heavily dependent on revenue. The more students they enroll and the more successful they are, the more funding they receive from the state. This can lead to a situation where community colleges focus more on revenuegenerating activities, such as recruiting more students and offering more courses, rather than providing students the best possible education. It is worth noting that other states often

considered tech hubs, such as California, New York, and Washington, are not in the top or bottom ten states in the ranking. This suggests that community college funding priorities may vary widely across different states, even those highly involved in the tech industry. Furthermore, a National Conference of State Legislatures report found that many states have implemented funding formulas that prioritize STEM programs or provide additional funding. However, it is unclear whether Georgia's funding formula provides similar incentives or resources for STEM education and workforce development.

Other states than Georgia have different funding formulas that prioritize STEM programs or consider other factors. For example, California's community college funding formula considers the number of low-income students, underrepresented students, and students who complete courses and degrees. This formula incentivizes colleges to serve disadvantaged students and focus on student success, which may include STEM education and workforce development. Similarly, Colorado's community college funding formula includes performance-based funding, which rewards colleges for meeting specific outcomes, such as completion rates, transfer rates, and workforce development outcomes. This formula incentivizes colleges to focus on workforce development and may prioritize STEM programs that lead to high-demand careers.

In conclusion, the state of Georgia could consider re-evaluating the funding formula to prioritize STEM programs, which would incentivize community colleges to offer more STEM courses and degree programs.

b. Workforce development initiatives

Workforce development initiatives in Georgia developed through various partnerships and collaborations between government agencies, community colleges, universities, and businesses. The state has recognized the need to develop a skilled workforce that can meet the needs of local businesses and industries and has implemented several initiatives to support workforce development. One key player in workforce development in Georgia is the Technical College System of Georgia (TCSG). The TCSG works closely with businesses and industries to develop customized education and training programs that prepare students for careers in high-demand fields. One of TCSG's flagship programs is the Georgia Quick Start program. This program provides customized training to new and expanding businesses in Georgia, helping them train their employees with the skills they need to succeed. Quick Start has been recognized as one of the best workforce development programs in the country and has helped to attract several major employers to the state.

Figure 3 Quick Start Program Steps



Source: Technical College System of Georgia (2020).

One of the strengths of the Quick Start program is its customized approach, where the program works closely with businesses to identify their specific training needs and develops customized training programs that meet those needs. This approach has helped to ensure that

businesses can quickly and effectively train their employees, helping them become productive members of the workforce more quickly.

Kia Motors Manufacturing Georgia (KMMG), which is located in West Point, Georgia, is one example of how the Quick Start program works with the industry in its partnership. When KMMG was preparing to open its plant in Georgia, the company turned to Quick Start for help in developing a training program for its employees. Quick Start worked closely with KMMG to identify the specific skills and knowledge needed for the plant's production processes. Based on this information, Quick Start developed a customized training program that provided KMMG employees with the necessary skills to operate the plant's machinery and equipment and other skills such as teamwork and problem-solving.

The results of this partnership have been impressive. According to a report by the University of Georgia's Selig Center for Economic Growth, KMMG's investment in training through Quick Start has resulted in significant economic benefits for the state. For example, the report found that in 2019 alone, KMMG's operations in Georgia resulted in \$2.5 billion in total economic output and \$1.5 billion in gross state product and supported more than 14,000 jobs in the state. Furthermore, the report found that the return on investment (ROI) for KMMG's investment in Quick Start was more than 3 to 1. This means that every dollar KMMG invested in training through Quick Start received a return of more than \$3 in economic output. This demonstrates that the Quick Start program is an effective way to train employees and a smart investment for businesses and industries looking to succeed in Georgia.

Another important initiative in Georgia is the Workforce Innovation and Opportunity Act (WIOA). This federal program provides funding to states to support workforce development

activities, including education and training programs, job placement services, and other workforce-related activities. Georgia has leveraged WIOA funding to support a range of workforce development programs, including apprenticeships, on-the-job training, and adult education programs.

However, there are also areas where both Quick Start and Workforce Innovation and Opportunity Act implementation in Georgia could be improved. An interview with a representative of TCSG mentions the need to expand the program to reach more businesses and industries. While both programs have successfully attracted major employers to the state, many smaller businesses and industries could benefit from customized training programs but may not be aware of the program or may not have the resources to participate.

Another area for improvement is the need to better align the program with other workforce development initiatives in the state. While the Quick Start program is an important part of Georgia's workforce development strategy, it should be viewed as one part of a larger system of education and training programs. By better integrating the Quick Start program with other initiatives, such as apprenticeships and adult education programs, Georgia can ensure that it is providing a comprehensive and coordinated approach to workforce development.

c. Regulatory requirements

The Technical College System of Georgia (TCSG) uses "Economic Development System Scorecard" performance metrics to ensure that each college meets workforce development needs and prepares students for careers. These metrics include six different parameters, as described in Table 4:

Placement Rate	Technical Skills Attainment	Program Completion Rate
This metric measures the	This metric measures the	This metric measures the
percentage of students who find	percentage of students who	percentage of students who
employment or continue their	achieve the technical skill	complete their program of study
education within six months of	competencies required for their	within 150% of the normal time
graduation. The TCSG has set a	program of study. The TCSG has set	frame. The TCSG has set a target
target placement rate of 70%.	a target technical skill attainment	program completion rate of 60%.
	rate of 70%.	
Credential Attachment	Employer Satisfaction	Student Satisfaction
This metric measures the	This metric measures the	This metric measures the
percentage of students who earn a	satisfaction of employers with the	satisfaction of students with their
certificate, diploma, or degree. The	TCSG graduates they employ. The	educational experience at TCSG
TCSG has set a target credential	TCSG has set a target employer	colleges. The TCSG has set a target
attainment rate of 60%.	satisfaction rate of 90%.	student satisfaction rate of 80%.

Table 6 TCSG Variables to Measure Community College's Workforce Development

Source: Technical College System of Georgia (2017).

While the TCSG's performance metrics provide insight into the success of Georgia community colleges in meeting workforce development needs and preparing students for STEM careers, I also identified several issues about the effectiveness about their effectiveness. First, the metrics primarily focus on quantitative measures, such as graduation rates and job placement rates, without necessarily capturing the qualitative aspects of student learning and development. For example, the metrics do not account for how well students are able to apply their knowledge and skills in real-world settings or how well they are prepared for lifelong learning and professional growth beyond their initial careers. Second, the metrics do not necessarily reflect the diverse needs and goals of different student populations, particularly

those from underrepresented backgrounds in STEM fields. For example, the metrics do not address issues of equity and inclusion, such as access to resources and support services or the development of cultural competence and global awareness.

Third, the metrics do not necessarily capture the STEM workforce's complex and dynamic nature, which constantly evolves in response to technological, social, and economic changes. For example, the metrics do not account for how well colleges adapt their curriculum and pedagogy to meet emerging workforce needs or how well they engage with industry partners to ensure that their programs are relevant and up-to-date. Finally, the metrics may incentivize colleges to prioritize short-term outcomes, such as graduation and job placement rates, over long-term outcomes, such as student retention, persistence, and career advancement. This may lead to a narrow and limited view of success, which does not necessarily reflect the complex and multifaceted nature of STEM careers and workforce development.

V. Case Analysis and Interview Findings

The previous sections detail a large amount of data and information on the current landscape in which Georgia community colleges are operating. To provide a stronger recommendation on areas for improvement, I identified several case studies that correspond to the four types of partnership typologies that community colleges have, according to research at the Community College Research Center for the Office of Vocational and Adult Education (deCastro and Karp, 2019). I interviewed thirteen individuals across four case studies that represent both community colleges' side and other stakeholders that are or were currently involved in the partnership program. This section reviews the findings from those interviews. Table 7 Case Analysis Description. Source: Author.

Case Study	Type of Partnership	Strength	Challenges
(Number of	and Description		
Interviews)			
Ohio STEM	Curricular alignment	1. Tailored professional development	1. Funding
Learning	and articulation	opportunities to stay up to date on the	2. Resistance to change
Network (OSLIN)		2 Industry partnerships with local	5. Resource constraints
		industries help inform the curricula and	
		provide students with opportunities in	
		the form of internships and other	
		experiential learning process	
		3. Clear articulation agreements that help	
		credits earned in community colleges	
		degree programs	
California	Academic and social	1. Early intervention for students in	1. Heavy reliance on state
Gaining Early	support	middle and high school who may be at	funding
Awareness and		risk of dropping out	2. Limited impact as it
Readiness for		2. Support for specifically	supports individual
Undergraduate		underrepresented students	students, but it does not
Programs (GEAR			address systemic issues
UP)			that contribute to
			challenges faced by
			community college
			students
Kentucky	Professional	1. Employer involvement since the	1. Lack of industry diversity
Automobile	development	program is supported by the state's	since it focuses solely on
Manufacturing	Professional	automotive manufacturers.	the automotive industry.
Technical	development activities	2. Industry-led curriculum	2. Limited geographic reach
Education	help staff and	3. Access to equipment	
(AMTEC)	improve students'		
	college preparation		
	and access.		
Florida Seminole	Resource-sharing	1. Increased efficiency since the	1. Dependency on other
Community	Involve cross-	community colleges share resources	institutions could limit
College (SCC)	institutional use of	with local businesses.	their independence and
Center for	facilities, funds, or	2. Different types of businesses are	ability to make decisions.
Economic	equipment. Such	present in a single building, which	2. The program was not able
Development	strong anneal for	anows students to get access to a variety of them before they graduate	in the region particularly
	colleges as they can	3. The program is staffed by experienced	those in rural or
	have an immediate	professionals with backgrounds in	underserved areas
	impact on	business and entrepreneurship	
	revenue by expanding		
	resources and sharing		
	costs		

A. Ohio STEM Learning Network

Table 8 Ohio STEM Learning Network Factsheet. Source: Ohio Stem Learning Network website and stakeholder interview.

Interviewee(s)	Rob Evans (Batelle), Anna Pyles (Batelle), Cadie Allen (Ohio Department of Education)
Partnership type	Curricular alignment and articulation
Website	https://osin.org/
Year founded	2008
Stakeholder(s)	 K-12 schools Higher education institutions (including community colleges) Businesses Non-profit organizations Government agencies Community organizations
Impact	 The network supports STEM education initiatives in Ohio by providing resources, training, and partnerships to educators and schools across the state. Since its inception, the Ohio STEM Learning Network has impacted over 100,000 students and engaged over 4,000 educators in STEM education. In the 2020-2021 academic year, the Ohio STEM Learning Network provided support to over 200 schools and community organizations across the state. Over 60,000 students participated in STEM programs and activities supported by the network during this academic year. The network's Ohio STEM Learning Network Designation Program has recognized over 70 schools and programs that have demonstrated a commitment to high-quality STEM education.

The Ohio STEM Learning Network (OSLN) is a statewide partnership to promote STEM education and career pathways in Ohio. One of the key strategies of OSLN is to promote curricular alignment and articulation in community colleges. OSLN works with community colleges to identify gaps and misalignments in STEM curricula across different colleges and then develops collaborative strategies to align and improve curricula. OSLN also supports community colleges in establishing articulation agreements with four-year institutions, which allows students to easily transfer credits and continue their education in STEM fields. The interviewee mentions the biggest strength of OSLN's approach is that it fosters and promotes collaboration

and communication between community colleges and four-year institutions, which can lead to more efficient and effective use of resources and better student outcomes.

Despite its strengths, OSLN also faces challenges in promoting curricular alignment and articulation in community colleges. One challenge is the lack of consistency in STEM curricula across different community colleges, making it difficult to align and standardize curricula. Additionally, community colleges often have limited resources and may struggle to implement new programs or update curricula. This can be particularly challenging in STEM fields, where new technologies and discoveries can quickly become outdated. OSLN's approach requires sustained commitment and investment from community colleges and other partners to achieve long-term success.

b. California Gaining Early Awareness and Readiness for Undergraduate Programs (GEAR UP)

Interviewee(s)	LaCandice Ochoa (California Community College Chancellor's Office)
Partnership type	Academic and social support
Website	https://castategearup.org/who-we-are/
Year founded	2001
Stakeholder(s)	 K-12 schools Community colleges Universities
Impact	 Until 2020, the GEAR UP program served over 104,000 students across the state. Facilitated over 1,600 outreach events, provided training to over 6,000 counselors and advisors, and distributed over 34,000 publications related to college readiness and financial aid. In the 2019-2020 academic year, 70% of the students served by the program were from low-income families, and 81% were from racial and ethnic groups that are traditionally underrepresented in higher education.

Table 9 California GEAR UP Program Factsheet. Source: Website and stakeholder interview.

The California Gaining Early Awareness and Readiness for Undergraduate Programs (GEAR UP) were founded in 2001 with the aim of providing academic and social support to students from underserved communities in California. The program collaborates with K-12 schools, community colleges, and universities to promote college readiness and encourage students to pursue higher education. CEAP offers various resources and services such as workshops, mentorship programs, financial aid guidance, and college application assistance to help students navigate the college admission. CEAP aims to reduce the achievement gap and increase college enrollment rates among low-income and first-generation students by providing early awareness and access to resources.

The interviewee, one of the program's stakeholders, mentions that the strength of GEAR UP is its focus on a comprehensive and integrated approach to college readiness that spans from pre-college to post-secondary education. Additionally, the program's emphasis on early awareness and access to resources has positively impacted student outcomes. According to a study conducted by the California Student Aid Commission in 2015, CEAP participation was associated with a 15% increase in college enrollment rates among participating schools.

However, CEAP also faces several challenges in promoting academic and social support in community colleges. One challenge is the limited resources available to the program. With a growing demand for college readiness services, CEAP may struggle to meet the needs of all students. Additionally, the program's effectiveness is hindered by a lack of coordination and communication among partner institutions, as suggested by the interviewee. One of the reasons for this is that some schools have struggled to fully engage with the program or to fully implement program components due to a lack of resources or high staff turnover. Students may not receive consistent and cohesive support throughout their educational journey without

effective and sustainable collaboration.

c. Kentucky Automobile Manufacturing Technical Education Collaborative (AMTEC)

Interviewee(s)	Mike Rodgers (AMTEC), Jason Simons (AMTEC)
Partnership type	Professional development
Website	https://amtecworkforce.org/
Year founded	2000
Stakeholder(s)	 Kentucky Community and Technical College System Automotive Manufacturing Industry in Kentucky (Toyota, Ford, General Motors) State of Kentucky
Impact	 Over 5,000 students have graduated from AMTEC programs since its founding. According to a report by the Center for Automotive Research, the automotive industry contributes over \$14 billion annually to Kentucky's economy.

Table 10 Kentucky AMTEC Program Factsheet. Source: Website and stakeholder interview.

The Kentucky Automobile Manufacturing Technical Education Collaborative (AMTEC) is an innovative partnership between industry and education designed to improve students' college preparation and access by exposing them to real-life working experiences. The initiative, launched in 2000, was created by the Kentucky Community and Technical College System (KCTCS) in collaboration with several major automobile manufacturers, including Toyota, Ford, and General Motors.

AMTEC is a type of professional development partnership in which industries help staff and teaching faculty improve students' college preparation and access by exposing them to real-life working experience. The partnership offers students a range of career opportunities

and provides industry partners with a pool of highly skilled workers. AMTEC's approach is unique in that it allows students to participate in a work-study program while earning a degree, allowing them to gain practical experience while earning college credit.

Through AMTEC, students gain a range of skills that employers, including technical skills, problem-solving skills, and team-building skills highly value. The program offers students hands-on training in areas such as electrical and mechanical systems, machining, and quality control. In addition, students are provided with access to state-of-the-art equipment and technology that is used in the industry. AMTEC also offers students the opportunity to participate in paid internships with partnering manufacturers. During these internships, students gain real-life experience in the automotive industry and have the opportunity to apply the skills they have learned in the classroom to real-world situations. Employers highly value these internships and often lead to full-time employment opportunities after graduation.

One interviewee mentioned that while AMTEC's partnership with major automobile manufacturers is beneficial, it is a narrow focus since it involves a single industry. This could result in a lack of diversity in the curriculum, potentially leading to an inability to respond to local or national workforce trends.

d. Florida Seminole Community College (SCC) Center for Economic Development

Interviewee(s)	Jonathan Cole (Seminole State College of Florida), Gui Cunha (Seminole
	County Economic Development Department)
Partnership type	Resource sharing
Website	https://www.seminolestate.edu/heathrow
Year founded	2014

Table 11 Florida SCC Center for Economic Development Factsheet. Source: Website and stakeholder interview.

Stakeholder(s)	 Florida Seminole Community College Seminole County Government Seminole County Economic Development Division Local businesses and organizations
Impact	 Assistance to over 500 businesses and organizations in the community Helped to create or retain over 1,000 jobs in the community. This is a significant impact, particularly given the challenging economic conditions that many businesses and organizations have faced in recent years (Florida Chamber of Commerce, 2019)

Community colleges can also engage in partnerships that focus on resource sharing. These involve cross-institutional use of facilities, funds, or equipment. Such collaborations hold strong appeal for colleges as they can immediately impact revenue by expanding resources and sharing costs. For example, colleges may partner with other institutions to make infrastructure. These types of collaborations may also include sharing physical space.

An example is Seminole Community College (SCC) Center for Economic Development in Florida, formed in 2005 to pool resources to create and deliver programs for economic productivity. Located in a new three-story building, the center houses several partners, including the Seminole Regional Chamber of Commerce, Seminole County Economic Development Department, Florida High Tech Corridor Council, SCC's Corporate Education Center, and Metro-Orlando Economic Development Commission.

Middle and early college high schools also exemplify space-sharing collaborations. These schools are housed on community college campuses and provide high school students with the opportunity to take both high school and college courses, leading to a high school diploma as well as, potentially, an associate degree upon graduation. Middle and early college high school students generally take their classes during the day—using college space that would otherwise go unused. Then, the same classrooms can be used for college classes in the evening. In this way, the use of these facilities is optimized.

VI. Recommendations and limitations

In recent years, community colleges have become increasingly important in addressing industries' skills gap and workforce needs. Especially in Georgia, when considering the state's rapidly growing STEM industries such as information technology, chemical manufacturing, and financial technology (Select Georgia, 2022). This paper reviewed policy documents to better understand the policy context that Georgia community colleges are currently in, as well as reviewed diverse partnership models between community colleges and companies. Although Georgia community college have also leveraged partnership models in the past: Chattahoochee Technical College with Cisco, Microsoft, and Oracle to offer certification programs in various IT fields; Lanier Technical College with Kubota Manufacturing of America to offer training programs for their employees – what I found is that they are typically focused on a singular activity of workforce training, that would make the partnership vulnerable since it depends only on how workforce training market and industry market in general, would operate.

As the case studies have shown, there are many innovations that could be implemented at community colleges that span more than one activity, such as:

- Alignment and articulation of curricular alignment of various community colleges across the state (Ohio Stem Learning Network)
- Student support services to promote motivation and disseminate information about colleges (California GEAR UP)

- Staff development to promote high quality training for teaching faculty, along with enhanced curriculum design (AMTEC)
- Resource sharing to maximize various institutional resources while minimizing cost (Seminole Community College Center for Economic Development)

To effectively develop and implement programs at community colleges to support Georgia's science and technology priority areas, it is important to approach it in phases. The first phase should involve establishing partnerships with industry leaders to define an industrydefined curriculum and skillset. Georgia community colleges have already established some partnerships with industries, but it is essential to expand these partnerships to a bigger statewide initiative to ensure that the curriculum and skillset are aligned with the needs of the entire industry, and not just a single company.

In the second phase, educators and business leaders should work together to effectively create a curriculum that will produce quality graduates with skill sets that are aligned to the needs of the industry. Industry leaders can provide real-life, work-based examples of how students can take what they have learned in the classroom and apply it to a future career. This collaboration can ensure that the graduates are well-prepared for the workforce, making them highly employable and contributing to the growth of the industry.

The third phase should involve aligning the qualifications needed for the science and technology industry workforce beyond the current company that is in partnership with the community college. These partnerships should extend to determining the educational pathways

offered to students in high school and post-secondary institutions, ensuring that these educational opportunities prepare students for the career opportunities of the industry.

State and federal policymakers can support the fourth phase by supporting facilitiesbased partnership activities. They can provide additional funding to support resource-sharing partnerships, which create economies of scale and cost-efficiencies but also incur additional costs such as safety and security. Policymakers can also conduct research on what types of agreements appear to lead to sustainable resource-sharing partnerships, which would help guide institutions seeking to share facilities and create partnerships that can persist under changing contexts and leaders.

Finally, it is important to acknowledge that industry partnerships should not be viewed as a replacement for federal funding. Instead, a balanced approach that combines the two is crucial for Georgia community colleges to achieve their mission of preparing students for success in the STEM workforce. The collaboration between community colleges and industry partners can help share resources and scale initiatives to a broader audience, addressing critical workforce challenges and contributing to the growth of the industry.

There are several limitations to consider in the research design of using policies and dollar value of community college expenditures to describe Georgia's current operation landscape and utilizing informational interviews to assess different types of community college partnerships, such as a lack of complete picture, potential bias and subjectivity, and limited sample of the study. A detailed description is provided below.

While policies and expenditures are important indicators of the operational landscape of community colleges, they may not provide a comprehensive understanding of these institutions' challenges and opportunities. Policies and expenditure value may not fully capture the daily experiences of students, faculty, and staff, such as the quality of instruction, the availability of support services, or the nature of the campus environment. These aspects of community college life can significantly impact student success, but they may not be reflected in budget documents or policy statements.

Furthermore, policies and expenditures may not fully capture the nuances of institutional culture and decision-making. Every community college's unique history, traditions, and values influence its governance structures and operational practices. These cultural factors can shape how colleges respond to challenges and opportunities, including their approach to partnerships with other institutions or organizations. Without a deep understanding of these cultural factors, designing effective partnership strategies that align with the college's mission and values may be challenging.

Relying solely on policies and expenditures may overlook the perspectives of stakeholders who are not directly involved in budgeting or policy-making processes. For example, community members, alumni, or employers may have valuable insights into the challenges and opportunities faced by community colleges, but their perspectives may not be reflected in budget or policy documents. This is why the research attempted to include informational interviews with a diverse range of stakeholders can provide a more holistic understanding of the operational landscape of community colleges and help identify potential areas for partnership and collaborations.

While the use informational interviews can provide valuable insights into community college partnerships, they are limited by their potential for bias and subjectivity. The

perspectives of the interviewees may be influenced by their own experiences and agendas and may not fully represent the views of other stakeholders or the broader community college landscape. For example, an interviewee who has had a positive experience with a particular partnership may be more likely to promote its benefits, while someone who has had a negative experience may be more critical.

Another limitation of this study is the sample size that may be limited by various factors, such as the availability of interviewees and the scope of the policies and expenditures analyzed. Out of all fifty-two potential interviewees that have been contacted, only thirty responded with an interest in the interview, and leaves with thirteen interviewees being conducted. Some of the case studies examples only covering one stakeholder (Battelle for Ohio STEM Learning Network, AMTEC for Kentucky AMTEC program). Therefore, it is important to recognize that the limitations of the sample size do not necessarily negate the value of the research findings. Rather, they suggest that the findings should be interpreted with caution and should not be taken as definitive or conclusive. Future research may seek to address these limitations by expanding the scope of the analysis and the number and diversity of interviewees. By doing so, the research may be better able to capture the full range of policies, expenditures, and partnerships that impact community college operations and challenges.

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VIII. Appendix: Interview Guide and Questions

Interviewee Name:

Date of Interview:

A. Interview Guide

My name is Nadya Pramaputri, a second year Master of City and Regional Planning student at Georgia Institute of Technology specializing in Economic Development. I am currently in the early stage of my master's thesis research study on how to leverage community college participation in current Georgia's STEM workforce development plans. My output will be a master's thesis research paper that outlines best practices from other STEM workforce development strategy case studies, as well as identifying the setbacks that prevent Georgia community colleges to do these practices.

The goal for our Interview today to get your perspective, insights, and experience on where Georgia is currently at with their workforce development strategies / the case study of (...)

You are free to ask me about the project at any time, and I want you to know that if I ask something you don't feel comfortable answering or unqualified to speak on, you can decline to respond, and we would move to another question.

To remind you of your disclosure option that is indicated in the consent form you have completed, the research study will omit (your name/your position/your organization) from your responses.

B. Interview Questions

(START OF INTERVIEW)

- a. "What" questions questions pertaining to the interviewee's background, the organization they are identified as a member of,
 - i. What is your current role? Could you describe your job description, and how long have you been in that role?
 - ii. What kind of work does your organization do?

- iii. How did your organization come to be involved in these STEM workforce development efforts? How long has the organization been doing this line of work?
- b. "So what" questions questions pertaining to the context that was set for the STEM workforce development strategy
 - i. What was the background in the inception of this document/strategy/policy (politically, economically, socially). The document mentions...
 - ii. What was the timeline of this document/strategy/policy? Did this document/strategy/policy start as a catalyst or as a response to another series of efforts?
 - iii. How does the document/strategy/policy align with other workforce development efforts in your area?
 - 1. Where is the other workforce development efforts currently at right now? Dormant/in process/making waves?
- c. "Now what" questions thought exercise and hypothetical questions
 - i. What do you think the role of community colleges should be in a workforce development setting?
 - 1. How does it interact with other education institutions such as R-1 universities, state universities, Pre-K to 12?
 - a. Has there been a working relationship established?
 - b. What are setbacks that prevent these conversations to take place?
 - 2. Any outstanding cases I should know about?
 - ii. (for Georgia respondents) Where do you think Georgia is going with their workforce development program?
 - Mention the current administration's interest in attracting external business, but it is not sustainable as citizens may not necessarily want to have a huge manufacturing plant in their backyard
 - Mention the mismatch with the previous administration where they revolve around human capital (HOPE scholarships, Georgia STEM Initiative)
 - 2. What is the biggest room for growth?
 - a. Effective partnerships
 - b. Transparency in information and data
 - c. Applied learning (making more room for non-class-based enriching activities such as internships and co-ops)

- d. Employability skills (employers need to translate what they are looking for in an employee to the school's curriculum)
- iii. What factors were most important in impeding or advancing community college's agenda of participating in the project/plan?
- d. Closing questions
 - i. Do you have any resources you can share?
 - I am looking to speak with people and organizations that were involved in the document/strategy/policy. Do you have anyone that you could recommend that I reach out to?

(END OF INTERVIEW)