

# Retraining the Gulf Coast through Information Technology Pathways: Final Impact Evaluation Report

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## TABLE OF CONTENTS

Introduction .....	1
Overview .....	1
Program design and implementation .....	2
Evaluation design .....	6
Evaluation questions.....	6
Methodology.....	6
Data sources .....	10
Gulf Coast IT Pathways program participants .....	14
Participation trends .....	14
Demographic characteristics .....	16
Outcomes of the Gulf Coast IT Pathways program .....	18
Outcome definitions .....	19
Outcome findings.....	20
Impacts of the Gulf Coast IT Pathways program .....	28
Impact analysis methodology .....	28
Program impact findings.....	32
Discussion.....	38
Overview .....	38
Summary of findings .....	38
Limitations of the evaluation .....	41
Conclusion.....	44
References .....	62

## LIST OF TABLES

Table 1. Consortium colleges .....	1
Table 2. IT pathways offered by colleges in the Consortium .....	3
Table 3. Original cohort groups for the DID impact analysis .....	8
Table 4. Revised cohort groups for the DID impact analysis .....	9
Table 5. Revised cohort groups for the retrospective impact analysis .....	10
Table 6. Data availability for impact analysis.....	12
Table 7. Demographic characteristics of Gulf Coast IT Pathways program participants .....	17
Table 8. Target outcomes for the grant.....	18
Table 9. Participants served.....	21
Table 10. Education outcomes for GCIT participants in for-credit programs .....	21
Table 11. Employment outcomes for all GCIT participants .....	22
Table 12. Education and employment outcomes by state .....	23
Table 13. Education and employment outcomes by IT specialty area .....	25
Table 14. Education and employment outcomes by IT specialty area .....	26
Table 15. Comparison of observable characteristics .....	30
Table 16. Comparison of outcomes .....	32
Table 17. Program impacts .....	33
Table 18. Program impacts by state .....	35
Table 19. Program impacts by IT specialty area .....	36

## LIST OF FIGURES

Figure 1. Gulf Coast IT Pathways program participation .....	14
Figure 2. Intake over time .....	15

## LIST OF APPENDICES

Appendix A. Intake form data elements .....	46
Appendix B. Academic variables requested by RMC .....	50
Appendix C. Target outcomes for the grant .....	51
Appendix D. Definitions for employment measures .....	52
Appendix E. Participant outcomes by college .....	53
Appendix F. Most common majors in the treatment group .....	54
Appendix G. Propensity Score Matching .....	56

# INTRODUCTION

## OVERVIEW

The Retraining the Gulf Coast Workforce through Information Technology (IT) Pathways Consortium project was a four-year project funded by the Department of Labor’s (DOL) Round Two Trade Adjustment Community College and Career Training (TAACCCT) grants program. The grant was awarded in September 2012 to Bossier Parish Community College (BPCC), which led a consortium of eight additional colleges (the Consortium) across the states of Louisiana and Mississippi (see Table 1) to implement the grant through March of 2016. In Louisiana, job losses in trade-affected industries such as auto manufacturing, shipbuilding, and furniture accelerated during the recession and its aftermath; in Mississippi, manufacturing was particularly hard hit by foreign competition. But amidst the tight economy and slow recovery, one of the few bright spots was the steady and growing demand in IT occupations. Responding to this need and opportunity, the project’s objective was to capitalize on the region’s growing IT sector and its increased demand for skilled labor by training almost 2,000 TAA eligible workers, veterans, and other individuals with basic skills needs for jobs.

Table 1. Consortium colleges

<b>Louisiana</b>
South Louisiana Community College
Bossier Parish Community College
Delgado Community College
Louisiana Delta Community College
<b>Mississippi</b>
Copiah-Lincoln Community College
Mississippi Delta Community College
Pearl River Community College
Meridian Community College
Northeast Mississippi Community College

The Aspen Institute Workforce Strategies Initiative (Aspen WSI), in collaboration with the Ray Marshall Center for the Study of Human Resources at the Lyndon B. Johnson School of Public Affairs at the University of Texas Austin (The Ray Marshall Center), conducted both an implementation study and a quasi-experimental impact analysis to assess the effectiveness of the project. The Ray Marshall Center (RMC) was the lead for the impact analysis and used a quasi-experimental approach to estimate the impact of the program on student outcomes.

## **PROGRAM DESIGN AND IMPLEMENTATION**

### ***Program goals***

The overall goal for the project was to train students across Mississippi and Louisiana for the growing regional demand for skilled labor in the IT sector. The Aspen Institute's 2016 survey of colleges found that there was some variation across the colleges in their stated primary reason for participating in the grant. Copiah-Lincoln Community College, Delgado Community College and Pearl River Community College reported that their main reason for participating in the grant was to *increase the number of adult education students transitioning into college academic or career and technical education programs*; Bossier Parish Community College and Louisiana Delta Community College reported that their main reason for participating in the grant was to *increase the number of students graduating from the college that have the skills that employers say they need*; Mississippi Delta Community College and Northeast Mississippi Community College reported that their main reason for participating in the grant was to *increase the employment opportunities for students with low basic skills and adult education students*; Meridian Community College reported that their main reason for participating in the grant was to *improve student access to support services in the community*; and, South Louisiana Community College reported that their main reason for participating in the grant was to *increase the earnings of students interested in pursuing the IT pathways offered*.

**Career pathway design**

In designing the project, the Consortium conducted an extensive labor market analysis to identify the sub-sectors and occupations that were most in demand in each college’s region and focused on three IT specialty areas: cyber security, health information technology, and industrial information IT. The Aspen Institute’s implementation evaluation found that all nine participating colleges implemented at least one pathway in the three IT specialty areas (see Table 2); in total, 21 pathways were in operation during the grant’s implementation (The Aspen Institute Workforce Strategies Initiative 2016).

Table 2. IT pathways offered by colleges in the Consortium

State	Institution	Cyber security	Health information	Industrial maintenance
Louisiana	South Louisiana Community College	✓		✓
	Bossier Parish Community College	✓	✓	✓
	Delgado Community College	✓	✓	✓
	Louisiana Delta Community College	✓	✓	
Mississippi	Copiah-Lincoln Community College	✓		✓
	Mississippi Delta Community College	✓	✓	✓
	Pearl River Community College		✓	
	Meridian Community College	✓	✓	
	Northeast Mississippi Community College	✓	✓	✓

Source: The Aspen Institute’s 2016 survey of colleges

Cyber security was the most popular pathway, offered at eight of the nine colleges, followed by health information technology, offered at eight of the nine colleges. Industrial maintenance was only offered at six colleges. The Aspen Institute’s implementation evaluation found that colleges considered several factors while selecting the pathways to implement (including, in some instances, working directly with area employers to select and design programs), but local labor market demand was the most important driving force. (The Aspen Institute Workforce Strategies Initiative 2015).



Seven of the nine Consortium colleges implemented pathways in which students could earn college credit and apply these credits towards a degree if they continued in a career pathway. The two exceptions – Meridian Community College and Northeast Mississippi Community College – chose to implement grant-funded programs as non-credit; the two colleges indicated that non-credit programs were more appropriate and responsive to student and employer needs (The Aspen Institute Workforce Strategies Initiative 2016).

### ***Program strategies***

The project included five inter-connected strategies intended to help build career pathways that allowed students to earn industry -recognized credentials and access in demand job opportunities in the three IT specialty areas. The strategies included:

1. Developing and institutionalizing an evidence-based, integrated IT career pathway design;
2. Offering a continuum of completion by stacking certificates and building a full career pathway leading to a variety of occupations;
3. Integrating hybrid and online learning and supports tailored to the needs of trade-impacted workers;
4. Building transferrable and portable credentials with degree articulation among consortium member colleges and with other institutions;
5. Aligning with a variety of partners and systems to support project implementation and ensure that the integrated career pathways developed meets the area's growing demand for skilled IT workers.

### ***Program implementation period***

The first official year of the grant was the 2012-2013 academic year, but the majority of that year was dedicated to setting up systems and contracts to implement the grant. With the exception of a few pilots, all colleges officially started program implementation

during the 2013-2014 academic year. Program implementation was to end on September 30, 2015, with the final year of the grant limited to gathering information and data for reporting outcome measures and completing the requirements for the third-party evaluation. However, the grant received permission from the U.S. Department of Labor to continue program implementation activities for an additional six months into the fourth year of the grant. Thus, program implementation ended on March 31, 2016, instead of the previous end date of September 30, 2015.

## EVALUATION DESIGN

### EVALUATION QUESTIONS

The goal of the impact evaluation was to determine the degree to which participating in the Gulf Coast IT Pathways program affected postsecondary and labor market outcomes for students. The research questions identified for the impact evaluation were: What impact did participating in the Gulf Coast IT Pathways program have on:

1. The rate at which students accumulate semester credit hours;
2. The likelihood that students persist beyond their first semester, and beyond their first year in the program;
3. The likelihood that students will earn a credential, or degree;
4. The likelihood that students who complete the Gulf Coast IT Pathways program will find employment;
5. The likelihood that students who complete the Gulf Coast IT Pathways program and find employment will be retained in employment; and
6. The likelihood that students who enter the Gulf Coast IT Pathways program experience a wage increase?

### METHODOLOGY

#### *Outcomes evaluation*

Documenting the outcomes of the Gulf Coast IT Pathways program relied on assembling data on education and labor market outcomes over the period of the evaluation. The Consortium included the National Strategic Planning & Analysis Research Center (NSPARC) as a data partner; NSPARC's role was to assemble education and employment data, both for grantee reporting and evaluation purposes, from institutional research data systems and state wage data systems in Louisiana and Mississippi. The Ray Marshall Center examined education outcomes, including credit hour accumulation,

persistence and credential attainment; and employment outcomes, including placement, retention and wage increase. The Ray Marshall Center examined outcomes for all Gulf Coast IT Pathways program participants, and also explored variation in outcomes by state and by IT specialty area.

### ***Impact evaluation***

The impact evaluation was designed to address the question: what impact did the Gulf Coast IT Pathways program have on student progress and outcomes in education and in the labor market, relative to comparison groups of students similar to the population in the Gulf Coast IT Pathways program but not participating in the program? The main goal of the impact evaluation was attribution – isolating the effect of the Gulf Coast IT Pathways program from other factors.

The main challenge of any impact evaluation is to determine what would have happened to the program participants if the program had not existed i.e. the counterfactual. Without information on the counterfactual, the next best alternative is to compare outcomes of program participants with those of a comparison group of non-participants. Successful impact evaluations hinge on finding a good comparison group (Khandker, Koolwal et al. 2010).

Recent research has demonstrated that, when carried out under the right conditions, quasi-experimental estimation produces impact estimates that are similar in direction and magnitude to those resulting from more expensive and intrusive experimental (random assignment) evaluation methods (Greenberg, Michalopoulos et al. 2006, Card, Kluve et al. 2010). At the beginning of this grant, the Ray Marshall Center carefully considered various methodological approaches, and selected the *difference-in-differences (DID)* approach as the quasi-experimental method for the impact analysis (Ray Marshall Center 2013). A key benefit of the DID approach is that it controls for differences over time, an important consideration in examining employment outcomes since the local economy and labor market demands can fluctuate over time.

The key to DID is selecting a comparison group for which data are available over the same time period as the treatment group, and which was likely to have experienced the

same exogenous factors but that did not experience the treatment. Although the treatment and comparison groups may differ significantly on both observed and unobserved characteristics, these potentially confounding influences are controlled for by measuring change in the outcome rather than the outcome itself. DID thus allows for unbiased estimates of the treatment effect even if the treatment and comparison groups are not identical.

In the original evaluation plan (Ray Marshall Center 2013), the Ray Marshall Center proposed that the comparison group would consist of students from non-Consortium colleges who enrolled in IT programs (see Table 3). But by the end of the first year of the grant, the Ray Marshall Center learned that the evaluation team would not have access to the data of students who attended non-Consortium colleges.

Table 3. Original cohort groups for the DID impact analysis

Time period	Academic Year	Comparison	Treatment
		(IT programs in non-Consortium Colleges)	(IT programs in Consortium Colleges)
Prior Year	2012-13	Group 1	Group 3
Program Implementation	2013-14 2014-15 2015-16	Group 2	Group 4

The evaluation team then modified their approach (Ray Marshall Center 2014) so that the comparison group could be drawn from students who enrolled in Consortium colleges, but did not enroll in one of the Gulf Coast IT Pathways programs (see Table 4). However, the first dataset sent to the evaluation team in November 2014, at the end of the second year of the four-year grant, only included a comparison group of students from one year prior to the Gulf Coast IT Pathways program implementation; the data did not include a comparison group of students from the years after the program was implemented. This crucial gap in the data was identified and highlighted in the evaluation team’s interim report (Patnaik 2015), and was to be addressed in the next data transfer.

Table 4. Revised cohort groups for the DID impact analysis

Time period	Academic Year	Comparison	Treatment
		(Other programs in Consortium Colleges)	(IT programs in Consortium Colleges)
Prior Year	2012-13	Group 1	Group 3
Program Implementation	2013-14 2014-15 2015-16	Group 2	Group 4

The second dataset sent to the evaluation team in July 2015, at the end of the third year of the four-year grant, still only included comparison students from one year prior to Gulf Coast IT Pathways program implementation, and did not include comparison students from the years after the Gulf Coast IT Pathways program was implemented. This prevented the Ray Marshall Center from implementing a difference-in-difference approach for the impact analysis, as originally planned. In consultation with partners from the Aspen Institute, the Ray Marshall Center decided to focus the Consortium’ efforts on addressing the other crucial data gaps related to education and employment outcomes for program participants. Instead of the difference-in-difference approach for the impact analysis, the Ray Marshall center instead elected to use a *retrospective cohort approach* (Patnaik 2015).

In this type of analysis (see Table 5), outcomes for the group that received the intervention during the program implementation period (i.e. the treatment group) are compared to the outcomes for a comparison group that did not receive the intervention from a time period prior to the program implementation period. The difference in the outcome between the two groups can be understood as the effect of the treatment. Although this design was the best approach considering the data that was available to the evaluation team, it should be noted that the retrospective cohort design is significantly less rigorous than the original DID approach. The Ray Marshall Center implemented the retrospective cohort analysis using:

- Gulf Coast IT Pathways program participants from the program implementation period (i.e. 2013-2016) as the *treatment group*; and,

- Students in similar programs from the year prior to program implementation (i.e. the 2012-2013 academic year) as the *comparison group pool*.

Table 5. Revised cohort groups for the retrospective impact analysis

Time period	Academic Year	Group assignment (IT programs in Consortium Colleges)
Prior Year	2012-13	Comparison
Program Implementation	2013-14 2014-15 2015-16	Treatment

The Ray Marshall Center then used *propensity score matching (PSM)* methods to estimate impacts from participation in the Gulf Coast IT Pathways program as a whole on key education and labor market outcomes. PSM was used to create comparison groups drawn from participants in each college who were as similar to Gulf Coast IT Pathways program participants as possible on a wide array of observed variables—e.g., age, gender, race, residency status, admission status and student level. Thus, estimated impacts captured the incremental value of the Gulf Coast IT Pathways program over and above services as traditionally delivered by the colleges in the consortium. Estimating impacts in this manner ensured that the impact of the treatment on the treated was measured, not simply the impact of the intent to treat (King and Heinrich 2011).

## DATA SOURCES

### *Intake forms*

A common intake form to collect information on participants enrolled in the Gulf Coast IT Pathways program was created by the nine colleges in the Consortium, with assistance from the National Strategic Planning & Analysis Research Center (NSPARC). The intake form collected a wealth of data on Gulf Coast IT Pathways program participants’

academic background, employment history, financial aid status, and other relevant information (see Appendix A). Intake forms were administered to all Gulf Coast IT Pathways program participants by student navigators and the data were entered into the NSPARC web portal.

Since the intake data was only collected on Gulf Coast IT Pathways program participants, and was not collected on non-participants, the utility of these data was limited for the purposes of the impact evaluation (which compares the treatment group of program participants to a matched comparison group of non-participants). However, the intake data was a rich dataset and was essential for understanding the population served by the Gulf Coast IT Pathways program, for providing context to participant outcomes, and for enhancing the implementation evaluation. The most recent intake dataset provided to the evaluation team in July 2016 included all individuals who entered the Gulf Coast IT Pathways program from project start in January 2013.

### ***Institutional Research (IR) data systems***

The primary data sources for the outcome and impact evaluation components were the institutional research (IR) data systems at each college in the Consortium. Data on participants' academic progress and education outcomes (including credential attainment) was compiled by each individual college and sent to NSPARC. NSPARC then combined the datasets, ensured consistency and accuracy, and performed quality checks before transferring the data to the evaluation team. Data was collected on a number of measures identified by the evaluation team during the first year of the grant (see Appendix B).

Originally, program implementation was to end on September 30, 2015, with the final year of the grant limited to gathering information and data for reporting outcome measures and completing the requirements for the third-party evaluation. However, the grant received permission from the U.S. Department of Labor to continue program implementation activities for an additional six months into the fourth year of the grant. Thus, program implementation ended on March 31, 2016, instead of the previous end date of September 30, 2015. However, no extension was granted for the evaluation, resulting in



a period of only six months between the end of program implementation and the writing of this final report. At the time this final evaluation report was being developed, academic data for the 2015-2016 academic year was still being processed and cleaned up in the colleges' data systems, and could not yet be accessed by the evaluation team. Thus, due to the lack of a sufficient follow-up period, education data was not available for the final 2015-2016 academic year, and the most recent semester of data available to the evaluation team was the Spring 2015 semester. As a result, outcomes and impacts could not be examined for program participants who entered in this final year; outcomes and impacts could also not be examined for program participants who may have exited in this final year. Thus, the outcomes and impact analysis presented in this report do not fully capture overall program outcomes and impacts.

Note also that data on many academic measures could not be collected for program participants enrolled in non-credit training programs as their information was not systematically recorded in the colleges' institutional data systems. As a result, the evaluation team was only able to examine limited outcomes for program participants in non-credit training programs. Note also that a suitable comparison group of individuals in non-credit training programs was not made available to the evaluation team; as a result, the Ray Marshall Center could not examine program impacts for participants in non-credit training programs (see Table 6).

Table 6. Data availability for impact analysis

Outcomes analysis	For-credit academic programs	Non-credit training programs
Education outcomes	✓	Limited
Employment outcomes	✓	✓
Impact analysis	For-credit academic programs	Non-credit training programs
Education outcomes	✓	✗
Employment outcomes	✗	✗

***Wage data***

Unemployment Insurance (UI) data was not made available directly to the evaluation team. Instead, UI data for program participants was extracted by LCTCS for Louisiana and by NSPARC for Mississippi. NSPARC then calculated the employment indicators following DOL guidelines, and the final computed measures were sent to the evaluation team. Note that UI data could only be extracted for program participants i.e. the treatment group. Since labor market outcomes for the comparison group were not made available to the evaluation team, the Ray Marshall Center could not examine the impact of the Gulf Coast IT Pathways program on employment outcomes (see Table 6).

## GULF COAST IT PATHWAYS PROGRAM PARTICIPANTS

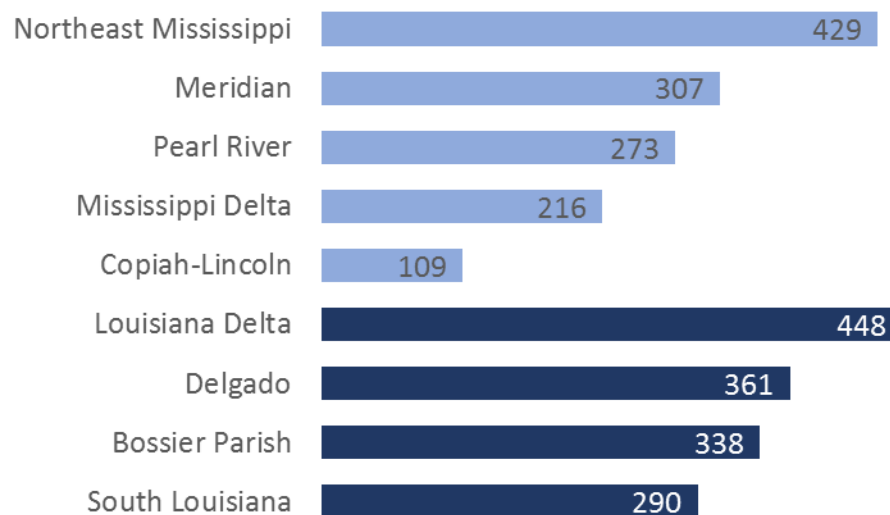
This chapter of the report describes the population served by the TAACCCT Gulf Coast IT Pathways program and examines participation patterns. The primary data source for the analyses presented in this chapter is the intake data.

### PARTICIPATION TRENDS

A total of 2,771 individuals participated in the TAACCCT Gulf Coast IT Pathways program. Participation was evenly split between the two states in the consortium, with Louisiana having a slightly higher number of program participants (52%). Northeast Mississippi Community College and Louisiana Delta Community College had the largest number of program participants while Copiah-Lincoln Community College had the smallest number of participants (see Figure 1). The Consortium met and exceeded their original target of serving a total of 1,954 unique participants by the end of the grant.

Figure 1. Gulf Coast IT Pathways program participation

#### MISSISSIPPI | LOUISIANA

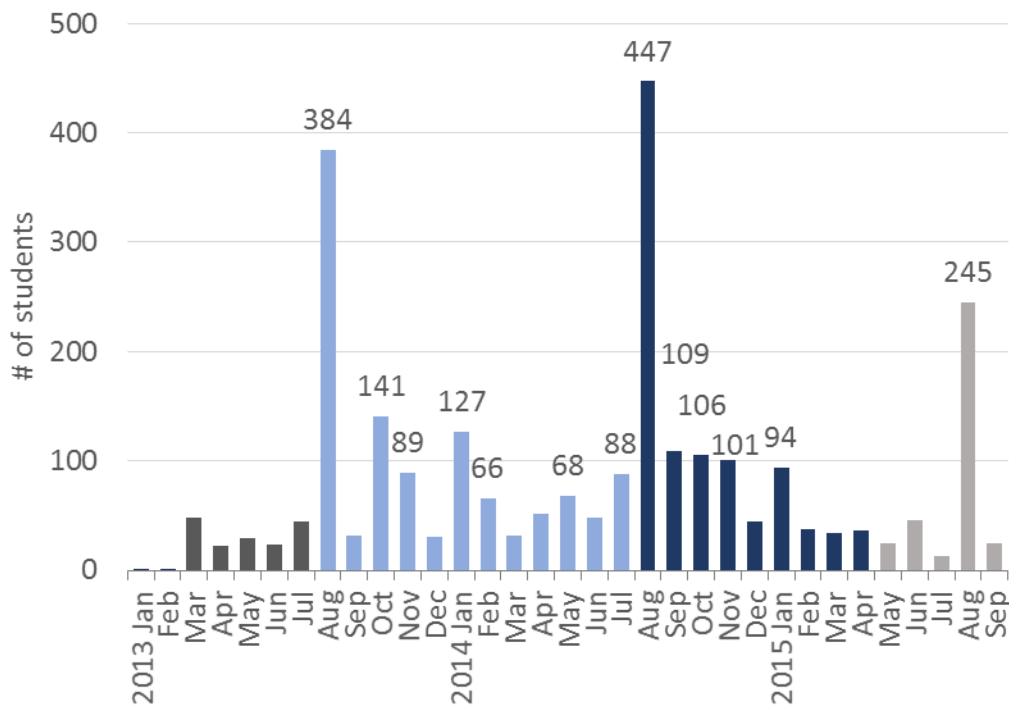


Participant intake over the grant implementation period is examined in Figure 2. Note that the first official year of the grant was the 2012-2013 academic year, but the majority of that year was dedicated to setting up systems and contracts to implement the

grant. With the exception of a few pilots, all colleges officially started program implementation during the 2013-2014 academic year. Students who completed intake prior to 2013 August either enrolled in these pilot programs or waited to enroll in the 2013 Fall semester.

Figure 2. Intake over time

GRANT YEAR 1 | [YEAR 2](#) | [YEAR 3](#) | [YEAR 4](#)



As expected, student intake was highest at the start of the fall semesters in August, with smaller peaks at the start of the spring semesters in January. The biggest peak was observed in August 2014, indicating that a large number of participants entered the program at the beginning of Year 3 of the grant. Small peaks are also observed mid-semester (for e.g. October 2013); these reflect enrollment in non-credit courses which varied in length and began at different points during the semester.

## DEMOGRAPHIC CHARACTERISTICS

Table 7 summarizes the demographic characteristics of participants in the Gulf Coast IT Pathways program. Program participants were about evenly split on gender. Program participants were mostly White (50%) or African American (38%)<sup>1</sup>. Only a very small proportion of participants were veterans (5%) or active duty military (1%). Nearly half (42%) of all program participants were employed at intake. Only a small proportion were UI claimants (2%), TAA eligible<sup>2</sup> (6%), or dislocated workers (4%).

A vast majority of GCIT participants (95%) were native English speakers. While only 16% of program participants had some post-secondary education, half of program participants (53%) had a high school diploma or GED and only a third of GCIT participants (30%) had completed 12th grade or lower. The intake form also collects information on participants' academic enrollment status at the time of intake. A majority of GCIT participants (66%) at intake had a high school diploma or GED and were already enrolled in a post-secondary school; the remaining were either individuals who were enrolled in an adult education program at intake (13%), or individuals who had a high school diploma or GED but were not enrolled in a post-secondary school at intake (17%).

Information on financial assistance receipt, academic needs, and career and academic goals was also collected through the intake forms. However, these fields were optional and hence data is unavailable for nearly half of the participants (see Appendix A); as a result, these data did not give us a full picture of participants. The limited data that was available on goals, needs and financial assistance indicated that working in health informatics, working in industrial technology, and pursuing further education appeared to be the most popular goals; improved math skills was the most common academic need, followed closely by improved computer skills, improved writing skills, and improved reading skills; and, Pell grants were the most common types of financial assistance received.

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<sup>1</sup> The race and ethnicity fields in the intake data were missing for about a third of participants. Hence, race and ethnicity are reported here using the academic data provided by NSPARC.

<sup>2</sup> The "TAA eligible" field in the intake form records if the participant indicates that he/she is eligible for Trade Adjustment Assistance (TAA) services.

Table 7. Demographic characteristics of Gulf Coast IT Pathways program participants

Demographic characteristics		Percent
Race	Black	37.8%
	White	49.5%
	Other	12.7%
Ethnicity	Hispanic	2.7%
Gender	Female	52.2%
Military status	Active duty military	0.8%
Veteran status	Veteran	4.7%
Offender status	Offender	2.7%
Disability status	Disabled	2.1%
Employment background	Employed	41.7%
	UI claimant	1.8%
	TAA eligible	5.8%
	Dislocated worker	4.4%
English proficiency	Native English speaker	95.4%
Highest level of education	Some post-secondary education	15.7%
	High school diploma or GED	52.7%
	12th grade or lower	29.8%
School status	In School - Adult Education	13.4%
	In School - Post-Secondary School	65.5%
	Not in School - High School Graduate	14.7%

## OUTCOMES OF THE GULF COAST IT PATHWAYS PROGRAM

This chapter of the report examines the outcomes of Gulf Coast IT Pathways program participants. Outcomes examined include education outcomes such as credit hour accumulation, persistence, credential attainment, and credential stacking; and employment outcomes such as placement, retention and wage increase. Outcomes are reported for all Gulf Coast IT Pathways program participants, and variations in subgroups are also examined. Table 8 lists the target outcomes identified by the grantee in the original grant proposal. Appendix C lists the target outcomes in greater detail.

Table 8. Target outcomes for the grant

Outcomes	Target
Total unique participants served	1954
Total number of participants who will have completed a TAACCCT-funded program	85%
Total number of participants completing credit hours (students who earn 1 or more credit hour)	60%
Total number of credentials earned (Aggregate number of degrees and certificates completed)	2988
Total number employed after program completion <sup>3</sup>	75%
Total number retained in employment after program completion <sup>4</sup>	68%
Total number employed at enrollment who receive a wage increase post-enrollment <sup>5</sup>	23%

As discussed earlier, due to the lack of a sufficient follow-up period, education data was not available for the final 2015-2016 academic year. Hence, the most recent semester of data available to the evaluation team was the Spring 2015 semester. As a result, outcomes and impacts could not be examined for program participants who entered in this

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<sup>3</sup> Defined as students entering employment within the first quarter after program completion.

<sup>4</sup> Defined as students employed in first, second, and third quarters after program completion.

<sup>5</sup> Defined as incumbent workers who receive a quarterly wage increase at any point in time post-enrollment.

final year; outcomes and impacts could also not be examined for program participants who may have exited in this final year. While the previous chapter presented demographic characteristics of all 2,771 GCIT participants, this chapter discusses outcomes for only those participants for whom outcome data were available in the 2013-2014 and 2015-2016 academic years: 1,774 participants in for-credit programs and 631 participants in non-credit programs. Thus, the outcomes analysis presented in this chapter do not fully capture overall program outcomes.

## **OUTCOME DEFINITIONS**

In the outcomes analysis, the evaluation team focused on outcomes similar to the participant outcomes reported by all TAACCCT grantees to DOL through the Annual Performance Report (U.S. DOL 2015).

- First, the total *number of participants served* is reported, and this number is broken down by participants in for-credit academic programs vs. participants in non-credit training programs.
- Next, the *average number of college credits earned per semester* is reported, calculated using the semester credit hours reported for Gulf Coast IT Pathways program participants. This measure is calculated and reported for participants in for-credit academic programs only.
- Next, persistence is measured and reported as the *percent of participants who persisted after their first semester in the program*. This measure can be calculated and reported only for for-credit participants who entered the program in the Fall 2013, Spring 2014 and Fall 2014 academic year, due to lack of follow-up data. This measure cannot be reported for participants in non-credit training programs as there is no semester recorded for these participants.<sup>6</sup>

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<sup>6</sup> Originally, the evaluation team had planned to examine first year persistence, measured as the percent of participants who persisted after their first year in the program. However, since (a) programs varied considerably in length and (b) this measure could not be computed for students who entered in the final year of the grant, the evaluation team decided to drop this measure from the final analysis.



- Next, credential receipt is examined and reported, including: the *percent of participants who earned any credential* (includes certificates and degrees of all types); the *percent of participants who earned any certificate or diploma* (includes 1-year and 2-year certificates); and, the *percent of participants who earned any degree* (includes Associate's or Bachelor's degrees). For participants in non-credit programs, the *percent of participants who earned any certification* is reported.
- Next, credential stacking is examined and reported as the *percent of participants who earned more than one credential* (includes certificates and degrees of all types).
- Finally, employment outcomes are examined, including: the *percent of participants who entered employment*; the *percent of participants who were retained in employment*; and, the *percent of participants who had a wage increase*. Recall that employment data were not directly made available to the Ray Marshall Center. Instead, NSPARC calculated the employment indicators following DOL guidelines, and the final computed measures were sent to the evaluation team. Definitions for NSPARC's wage calculations can be found in Appendix D.

## **OUTCOME FINDINGS**

First, the evaluation team examined the number of participants served (see Table 9). The Gulf Coast IT Pathways program served a total of 1,774 participants in for-credit academic programs; while 1,138 participants entered the program in the 2013-2014 academic year, just over half that number entered the program in the 2014-2015 academic year. The Gulf Coast IT Pathways program served a total of 631 participants in non-credit training programs; 294 participants entered the program in the 2013-2014 academic year, while 337 participants entered the program in the 2014-2015 academic year.

Next, education outcomes were examined (see Table 10). Program participants in for-credit academic programs earned an average of 12 college credits per semester. A vast majority of all program participants in for-credit academic programs (83%) persisted beyond their first semester. About a quarter of program participants in for-credit academic programs (26%) earned any credential; 18% earned a certificate/diploma while 14% earned

an Associate degree. Less than a tenth of program participants in for-credit academic programs earned more than one credential. Two-thirds of Gulf Coast IT Pathways program participants in non-credit training programs earned a certification, while about a third earned more than one certification.

Table 9. Participants served

Participants served	For-credit	Non-credit
Total Number of participants	1,774	631
Participants entering in 2013-2014 academic year	1,138	294
Fall 2013	946	n/a
Spring 2014	192	n/a
Participants entering in 2014-2015 academic year	636	337
Fall 2014	491	n/a
Spring 2015	145	n/a

Table 10. Education outcomes for GCIT participants in for-credit programs

Education outcomes	For-credit
College credits earned per semester (Mean)	12.0
Persisted after first semester (%)	83.2%
Earned any credential (%)	25.6%
Earned any certificate (%)	18.0%
Earned any degree (%)	14.1%
Earned more than one credential (%)	7.9%
Education outcomes	Non-credit
Earned any certification (%)	64.8%
Earned more than one certification (%)	32.5%

Finally, the evaluation team examined employment outcomes (see Table 11), and found that overall, just 7% of program participants entered employment, 3% were retained in employment and 12% experienced a wage increase. Note that these findings about

employment should be interpreted with caution due to the lack of a sufficient follow-up period for the evaluation. Recall that while the grant received an extension from DOL to continue program implementation activities for an additional six months into the fourth year of the grant (with program implementation ending on March 31, 2016), no such extension was granted for the evaluation, resulting in a period of only six months between the end of program implementation and the writing of this final report. Thus, employment outcomes could only be examined for a portion of the total participants served.

Table 11. Employment outcomes for all GCIT participants

Employment outcomes	%
Placed in employment	7.3%
Retained employment	2.9%
Had wage increase	12.0%

***Participant outcomes by state***

The evaluation team examined variations in outcomes by state and found that both states were similar in first-semester persistence rates (see Table 12). Credit hour accumulation was stronger in Mississippi than in Louisiana, with program participants in Mississippi earning an average of 14 college credits per semester, compared to an average of 11 college credits per semester for participants in Louisiana.

Overall credential attainment was similar in both states, with about a quarter of Gulf Coast IT Pathways program participants earning a credential. Program participants in Louisiana had stronger certificate attainment outcomes: 23% of participants in Louisiana earned a certificate/diploma compared to 9% of participants in Mississippi. However, program participants in Mississippi had stronger degree attainment outcomes: 20% of participants in Mississippi earned an Associate degree compared to 11% of participants in Louisiana. Credential stacking rates appeared to be stronger in Louisiana, where about a

tenth of program participants in Louisiana earned more than one credential, compared to just 4% of participants in Mississippi.

Overall, employment outcomes for Gulf Coast IT Pathways program participants were low. However, program participants in Mississippi appeared to have stronger employment outcomes than program participants in Louisiana. A tenth of Mississippi participants entered employment and 16% had a wage increase; in comparison, only 5% of Louisiana participants entered employment and 8% had a wage increase. Note again that these findings about employment should be interpreted with caution since employment outcomes could only be examined for a portion of the total participants served, due to the lack of a sufficient follow-up period for the evaluation.

Table 12. Education and employment outcomes by state

LOW - HIGH

Education outcomes	Louisiana	Mississippi
Number of participants	1,192	582
College credits earned per semester (Mean)	10.9	14.1
Persisted after first semester (%)	82.3%	84.9%
Earned any credential (%)	25.7%	25.4%
Earned any certificate (%)	22.5%	8.9%
Earned any degree (%)	11.2%	19.9%
Earned more than one credential (%)	10.0%	3.6%

Note: Education outcomes above are reported for participants in for-credit academic programs only

Employment outcomes	Louisiana	Mississippi
Number of participants	1,437	1,334
Entered employment (%)	4.8%	10.0%
Retained employment (%)	1.5%	4.3%
Had wage increase (%)	8.0%	16.3%

Note: Employment outcomes above are reported for all participants (for-credit and non-credit).

The evaluation team also examined participant outcomes by college, documented in Appendix E. Variations in education and employment outcomes were observed across all colleges. This is unsurprising since each college implemented the grant slightly differently; these variations are explored in greater detail in The Aspen Institute’s implementation evaluation report (The Aspen Institute Workforce Strategies Initiative 2016).

### ***Participant outcomes by IT specialty area***

The evaluation team also examined outcomes broken down by IT specialty area. Using the participants’ declared majors, the evaluation team was only able to group about half of all program participants into the three IT specialty areas: cyber security, health information technology and industrial information technology (see Table 13). Since this subgroup analysis includes only half of all program participants, findings in this section should be interpreted with caution.

Across the three specialty areas, program participants had similar strong credit hour accumulation rates and persistence rates. Program participants in the industrial information technology programs and health information technology programs had the strongest credential attainment outcomes: 39% of participants in industrial information technology programs earned a credential (34% earned a certificate/diploma and 8% earned an Associate degree) while 30% of participants in health information technology programs earned a credential (13% earned a certificate/diploma and 17% earned an Associate degree). In comparison, participants in the cyber security programs had more modest outcomes: 16% earned a credential (7% earned a certificate/diploma and 12% earned an Associate degree). Evidence of credential stacking was strongest in the industrial information technology programs, where 7% of participants earned more than one credential.

Employment outcomes were strongest for participants in the health information technology field, with 24% placed in employment, 9% retained in employment and 15% having a wage increase. Employment outcomes were more modest for participants in the

industrial information technology field, with 7% placed in employment and 1% retained in employment. Employment outcomes were weakest for participants in the cyber security field, with only 5% placed in employment and 2% retained in employment.

Table 13. Education and employment outcomes by IT specialty area

LOW - HIGH

Education outcomes	Cybersecurity	Health	Industrial
Number of participants	444	226	317
College credits earned per semester (Mean)	12	13.6	13.6
Persisted after first semester (%)	88.6%	85.3%	86.7%
Earned any credential (%)	16.4%	29.6%	38.5%
Earned any certificate (%)	7.4%	13.3%	33.8%
Earned any degree (%)	11.5%	17.3%	7.9%
Earned more than one credential (%)	3.8%	1.3%	6.9%
Employment outcomes	Cybersecurity	Health	Industrial
Number of participants	444	226	317
Entered employment (%)	4.7%	23.9%	6.6%
Retained employment (%)	1.8%	8.8%	1.3%
Had wage increase (%)	6.3%	15.0%	10.7%

Note: Education and employment outcomes above are reported for participants in for-credit academic programs only

### ***Participant outcomes by program entry***

Finally, the evaluation team examined outcomes broken down by program entry, comparing participants who entered the GCIT program in the 2013-2014 academic year to participants who entered the GCIT program in the 2014-2015 academic year (see Table 14). While credit hour accumulation and first semester persistence were similar across both groups for participants in for-credit programs, credential attainment and credential stacking appeared to be stronger among participants who entered the program in the first year of program implementation. Of the 1,138 participants who entered in the 2013-2014

academic year, a third earned a credential (32%) while 12% earned more than one credential. In contrast, of the 636 participants who entered the program in the 2014-2015 academic year, just over a tenth earned a credential (14%), while a tiny fraction earned more than one credential (1%).

Table 14. Education and employment outcomes by IT specialty area

LOW - HIGH

Education outcomes (for-credit programs)	Entered in 2013-2014 academic year	Entered in 2014-2015 academic year
Number of participants	1,138	636
College credits earned per semester (Mean)	12.1	11.7
Persisted after first semester (%)	88.6%	85.3%
Earned any credential (%)	32.3%	13.5%
Earned any certificate (%)	21.3%	12.3%
Earned any degree (%)	21.0%	1.7%
Earned more than one credential (%)	12.0%	0.5%
Education outcomes (non-credit programs)	Entered in 2013-2014 academic year	Entered in 2014-2015 academic year
Number of participants	294	337
Earned any certification (%)	45.9%	81.3%
Earned more than one certification (%)	18.0%	45.1%
Employment outcomes	Entered in 2013-2014 academic year	Entered in 2014-2015 academic year
Number of participants	1,138	636
Entered employment (%)	10.8%	3.3%
Retained employment (%)	4.0%	0.5%
Had wage increase (%)	8.3%	10.8%

Employment outcomes also appear to be stronger for participants who entered the program in the first year of program implementation: 11% were placed in employment and 4% were retained in employment. In contrast, among participants who entered the program

in the 2014-2015 year, only 3% were placed in employment and 0% were retained in employment. The weaker education outcomes and weaker employment outcomes for participants who entered later in the program can likely be partially attributed to the lack of follow up data: academic data including credential attainment for the 2015-2016 academic year were not available to the evaluation team, due to lack of a sufficient follow-up time period.

However, for non-credit programs, participants who entered in the second year of program implementation appear to fare better, with a majority earning a certification (81%), and nearly half earning more than one certification (45%). In comparison, less than half of students who entered in the first year of program implementation earned a certification (46%), and less than a fifth earned more than one certification (18%). This may potentially be a result of the colleges improving and refining their implementation strategies over the course of the grant implementation. Although this improvement would also have occurred for the for-credit programs, the effects on credential attainment in for-credit programs may not be visible because of the lack of a sufficient follow-up time period.



## IMPACTS OF THE GULF COAST IT PATHWAYS PROGRAM

The previous chapter examined and reported outcomes for Gulf Coast IT Pathways program participants i.e. the treatment group. This chapter focuses on understanding the impact of the Gulf Coast IT Pathways program using rigorous impact evaluation methods. The impact evaluation is designed to address the research question: what impact did the Gulf Coast IT Pathways program have on student progress and outcomes in education and in the labor market relative to comparison groups of individuals similar to the population in the Gulf Coast IT Pathways program but not participating in the program?

### IMPACT ANALYSIS METHODOLOGY

The Ray Marshall Center implemented a *retrospective cohort analysis* approach using Gulf Coast IT Pathways program participants as the treatment group, and individuals in similar programs from the year prior to program implementation (i.e. the 2012-2013 academic year) as the comparison group pool. The Ray Marshall Center then used *propensity score matching (PSM)* methods to estimate impacts from participation in the Gulf Coast IT Pathways program as a whole on key education and employment outcomes.

Originally, the evaluation team had planned to estimate program impacts on labor market outcomes. However, NSPARC required a program end date for each individual in order to construct the employment outcome measures for the evaluation team. Program end dates could only be clearly identified by the grantee for the treatment group, but not the comparison group. Hence NSPARC could only construct employment outcome measures for the treatment group, but not the comparison group. As a result, the Ray Marshall Center could not examine program impacts on labor market outcomes.

As noted earlier, a suitable comparison group of individuals in non-credit training programs was not available to the evaluation team; as a result, the Ray Marshall Center could not examine program impacts for participants in non-credit training programs. Also, due to the lack of a sufficient follow-up period, education data was not available for the 2015-2016 academic year; the most recent semester of data available to the evaluation team is the Spring 2015 semester. As a result, impacts could not be examined for program

participants who entered in this final year; impacts could also not be examined for program participants who may have exited in this final year. Thus, the impact analysis presented in this chapter does not fully capture overall program impacts, whether to the program's benefit or detriment.

### ***Selection of comparison group pool***

The comparison group pool comprised of individuals in similar IT programs from the year prior to Gulf Coast IT Pathways program implementation. The evaluation team began by identifying the most common major fields of study (see Appendix F) declared by the treatment group (i.e. GCIT participants). The evaluation team then selected individuals at the nine consortium colleges from the year prior to program implementation (the 2012-2013 academic year) who had declared the same major fields of study; these individuals formed the comparison group pool<sup>7</sup>. Note that these majors span the three IT specialty areas identified by the consortium in their proposal: health information technology, cyber security, and industrial information IT.

### ***Comparison of observable characteristics***

Next, the differences between the treatment group (i.e. Gulf Coast IT Pathways program participants) and the comparison group pool (i.e. non-Gulf Coast IT Pathways program participants in IT programs) on a wide range of observable characteristics were examined. These characteristics were not only potential correlates of participation in the Gulf Coast IT Pathways program, but were also likely to be related to the education and employment outcomes of interest. Table 15 lists these characteristics in detail, documenting the differences between the treatment and comparison group.

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<sup>7</sup> A student may change their major field of study, as identified by the program CIP code. The evaluation team identified the most recent semester of data available for each student (in both the treatment and comparison groups), and extracted the student's major field of study for that most recent semester.

Table 15. Comparison of observable characteristics

Observable Characteristics	Comparison Group Pool	Treatment Group
Number of participants	5,017	1,774
State: Louisiana	82.0%	67.2%
State: Mississippi	18.0%	32.8%
Age (median)	25.0	23.0
Female	37.1%	48.5%
Race: Other	16.6%	15.0%
Race: White	43.6%	47.1%
Race: Black	39.8%	37.9%
Ethnicity: Hispanic	5.9%	2.9%
U.S. Citizen	98.3%	99.7%
In-State Resident	97.9%	96.7%
Freshman	52.4%	60.5%
Sophomore	29.8%	23.6%
Other Undergraduate	17.8%	15.8%
Pursuing associate's degree	63.0%	45.7%
Pursuing certificate	18.0%	6.7%
Pursuing diploma	4.3%	12.8%
Non-degree seeking student	1.3%	9.0%
GPA (median)	2.7	2.7

In some ways, Gulf Coast IT Pathways program participants appeared to be relatively similar to non-Gulf Coast IT Pathways program participants in IT programs. There were, however, differences worth noting. The treatment group was slightly younger in age, with a median age of 23, compared to the comparison group with a median age of 25. The treatment group had about an even distribution of gender, while nearly two-thirds of the comparison group were male. The two groups had similar racial compositions; nearly half were White while about two-fifths were Black. The comparison group had a slightly higher

proportion of Hispanic students (6%), compared to the treatment group (3%). Similar to the treatment group, the comparison group was almost exclusively U.S. citizens and in-state residents.

In the comparison group, about half of the students were freshmen (52%) and a third were sophomores (30%); in contrast, nearly two-thirds of the treatment group were freshmen (61%), and only about a quarter were sophomores (24%). The comparison and treatment group also differed greatly on the degrees pursued; nearly two-thirds of the comparison group (63%) was trying to earn an Associate degree, compared to less than half of the treatment group (46%). More than a third of students in the treatment group were trying to earn a certificate (35%), compared to only 17% of the comparison group. Given these large documented differences between the treatment group and the comparison group pool on the observable characteristics, it is necessary to account for them as well as possible in order to attribute outcome differences to the treatment (i.e. Gulf Coast IT Pathways program participation).

### ***Comparison of outcomes***

Next, education outcomes were compared across the two groups. Overall, education outcomes for the treatment group appear robust, and stronger than the comparison group (see Table 16). The treatment group earned on average 12 credit hours per semester, compared to an average of 11 credit hours per semester for the comparison group. A quarter of the treatment group (26%) earned a credential, compared to a fifth of the comparison group (21%). Credential stacking appears to be lower in the treatment group, with just 8% earning more than one credential, compared to 10% of the comparison group.

However, these results are descriptive in nature and do not control for differences among individuals in these groups. Given the differences documented in Table 15 between the treatment group and the comparison group pool on the observable characteristics, it is necessary to account for them as well as possible in order to attribute these outcome differences to the treatment (i.e. Gulf Coast IT Pathways program participation).

Table 16. Comparison of outcomes

LOW - HIGH

Outcomes	Comparison	Treatment
College credits earned per semester (Mean)	11.3	12
Earned any credential (%)	20.7%	25.6%
Earned any certificate (%)	11.9%	18.0%
Earned any degree (%)	11.1%	14.1%
Earned more than one credential (%)	10%	8%

***Propensity Score Matching (PSM)***

The evaluation team used the propensity score matching (PSM) approach to account for differences on the observable characteristics between the treatment group and the comparison group pool. See for a detailed description of the application of this method. Gulf Coast IT Pathways program participants in the treatment group were matched to individuals from the comparison group pool. The single nearest-neighbor technique was used; this technique involves finding for each treated individual that non-treated individual with the most similar propensity score and so, the most similar characteristics. The evaluation team assessed and confirmed that this matching approach achieved satisfactory balance in all observables characteristics (see Appendix F). Thus, the evaluation team can be quite confident that genuinely comparable individuals are being compared in the estimates of the causal impact of the Gulf Coast IT Pathways program on education outcomes.

**PROGRAM IMPACT FINDINGS**

***Overall program impacts***

After matching, the evaluation team estimated the impacts of participation in the Gulf Coast IT Pathways program on education outcomes (see Table 17). Overall, the matched comparisons tend to confirm the unmatched comparisons quite closely, despite the differences in observable characteristics discussed earlier. The evaluation team found

that participation in the Gulf Coast IT Pathways program had a significant impact on both credit hour accumulation and credential attainment, but no impact on credential stacking.

Table 17. Program impacts

SIGNIFICANT POSITIVE IMPACT | SIGNIFICANT NEGATIVE IMPACT

Outcome	Matched Comparison Group Mean	Treatment Group Mean	Difference	Abadie Imbens Robust S.E.	P> z
All		(n=1,770)			
College credits earned per semester (Mean)	11.3	12.0	0.7	0.18	0.000
Earned any credential (%)	17.7%	25.5%	7.9%	0.02	0.000
Earned any certificate (%)	11.1%	18.0%	6.8%	0.01	0.000
Earned any degree (%)	8.6%	14.1%	5.5%	0.01	0.000
Earned more than one credential (%)	8.6%	7.9%	-0.7%	0.01	0.510

Column 4 of Table 17 indicates the propensity score matching estimates of the differences in education outcomes between the treatment group and the matched comparison group. PSM models found that the Gulf Coast IT Pathways program had a significant positive impact, albeit small, on credential attainment: the average number of credits earned by Gulf Coast IT Pathways program participants in a semester was 12, compared to an average of 11.3 for the matched comparison group – a difference of about half a credit per semester. The Gulf Coast IT Pathways program also had a significant positive impact on credential attainment: 26% of Gulf Coast IT Pathways program participants earned a credential, compared to 18% for the matched comparison group – an 8 percentage point difference; 18% of Gulf Coast IT Pathways program participants earned a certificate, compared to 11% for the matched comparison group; and, 14% of Gulf Coast IT Pathways program participants earned a degree, compared to 9% for the matched comparison group.

### ***Program impacts by state***

The evaluation team also examined program impacts broken down by state (see Table 18). In Louisiana, the PSM models found that the Gulf Coast IT Pathways program had a significant positive impact, albeit small, on credential attainment: the average number of credits earned by Gulf Coast IT Pathways program participants in Louisiana in a semester was 10.9, compared to an average of 10.4 for the matched comparison group – a difference of about half a credit per semester. The Gulf Coast IT Pathways program also had a significant positive impact on credential attainment in Louisiana: 26% of Gulf Coast IT Pathways program participants in Louisiana earned a credential, compared to 18% for the matched comparison group from Louisiana – an 8 percentage point difference; 22% of Gulf Coast IT Pathways program participants in Louisiana earned a certificate, compared to 13% for the matched comparison group; and, 11% of Gulf Coast IT Pathways program participants in Louisiana earned a degree, compared to 7% for the matched comparison group. The PSM models found no program impact on credential stacking in Louisiana.

In Mississippi, the PSM models found that the Gulf Coast IT Pathways program had a significant negative impact, albeit small, on credit hour accumulation: the average number of credits earned by Gulf Coast IT Pathways program participants in Mississippi in a semester was 14.1, compared to an average of 14.9 for the matched comparison group – a difference of about one credit per semester. However, the Gulf Coast IT Pathways program had a significant positive impact on credential attainment in Mississippi: 25 percent of Gulf Coast IT Pathways program participants in Mississippi earned a credential, compared to 18% for the matched comparison group – a 7 percentage point difference; 9 percent of Gulf Coast IT Pathways program participants in Mississippi earned a certificate, compared to 5% for the matched comparison group; and, 20 percent of Gulf Coast IT Pathways program participants in Mississippi earned a degree, compared to 13% for the matched comparison group. In Mississippi, the PSM models found that the Gulf Coast IT Pathways program had a significant positive impact on credential stacking: 4 percent of Gulf Coast IT Pathways program participants in Mississippi earned more than one credential, compared to 0% for the matched comparison group – a 4 percentage point difference.

Table 18. Program impacts by state

SIGNIFICANT POSITIVE IMPACT | SIGNIFICANT NEGATIVE IMPACT

Outcome	Matched Comparison Group Mean	Treatment Group Mean	Difference	Abadie Imbens Robust S.E.	P> z
Louisiana		(n=1188)			
College credits earned per semester (Mean)	10.4	10.9	0.5	0.16	0.005
Earned any credential (%)	17.7%	25.6%	7.9%	0.02	0.000
Earned any certificate (%)	12.7%	22.4%	9.7%	0.02	0.000
Earned any degree (%)	7.4%	11.3%	3.9%	0.01	0.000
Earned more than one credential (%)	11.3%	10.0%	-1.3%	0.01	0.373
Mississippi		(n=582)			
College credits earned per semester (Mean)	14.9	14.1	-0.8	0.37	0.033
Earned any credential (%)	18.0%	25.4%	7.4%	0.03	0.005
Earned any certificate (%)	4.7%	8.9%	4.2%	0.02	0.012
Earned any degree (%)	13.3%	19.9%	6.6%	0.02	0.006
Earned more than one credential (%)	0.0%	3.6%	3.6%	0.01	0.000

**Program impacts by IT specialty area**

Finally, the evaluation team examined program impacts broken down by IT specialty area (see Table 19). Recall that the specialty area could only be identified for half of all program participants; thus, findings in this section should be interpreted with caution. For Gulf Coast IT Pathways program participants in cyber security programs, the PSM models found no significant impacts on credit hour accumulation or credential attainment. However, the PSM models did find a significant negative impact on credential stacking: 4 percent of Gulf Coast IT Pathways program participants in cyber security programs earned more than one credential, compared to 8% for the matched comparison group – a 4 percentage point difference.



Table 19. Program impacts by IT specialty area

SIGNIFICANT POSITIVE IMPACT | SIGNIFICANT NEGATIVE IMPACT

Outcome	Matched Comparison Group Mean	Treatment Group Mean	Difference	Abadie Imbens Robust S.E.	P> z
Cyber security		(n=442)			
College credits earned per semester (Mean)	11.6	11.9	0.3	0.31	0.310
Earned any credential (%)	13.9%	16.3%	2.4%	0.03	0.358
Earned any certificate (%)	8.6%	7.2%	-1.4%	0.02	0.520
Earned any degree (%)	8.0%	11.5%	2.8%	0.02	0.165
Earned more than one credential (%)	8.0%	3.8%	-4.1%	0.02	0.021
Health IT		(n=228)			
College credits earned per semester (Mean)	11.4	13.6	2.2	0.50	0.000
Earned any credential (%)	20.1%	29.3%	9.2%	0.04	0.034
Earned any certificate (%)	7.8%	12.9%	5.1%	0.03	0.079
Earned any degree (%)	12.3%	17.3%	5.0%	0.04	0.154
Earned more than one credential (%)	6.3%	1.3%	-4.9%	0.02	0.018
Industrial IT		(n=312)			
College credits earned per semester (Mean)	12.8	13.6	0.8	0.29	0.004
Earned any credential (%)	32.0%	38.5%	6.5%	0.03	0.050
Earned any certificate (%)	22.0%	33.8%	11.7%	0.04	0.004
Earned any degree (%)	10.3%	7.9%	-2.4%	0.03	0.401
Earned more than one credential (%)	16.6%	6.9%	-9.6%	0.03	0.004

For Gulf Coast IT Pathways program participants in health information technology, the PSM models found a significant positive impact on credit hour accumulation: Gulf Coast IT Pathways program participants in health information technology programs earned an average of 13.6 credits, compared to an average of 11.4 credits for the matched comparison group – a difference of more than two credits per semester. The PSM models also found a significant positive impact on overall credential attainment: 29% of Gulf Coast IT Pathways

program participants in health information technology programs earned a credential, compared to 20% for the matched comparison group – a 9 percentage point difference. However, the PSM models found no significant impact on certificate attainment or degree attainment rates. Finally, the PSM models found a significant negative impact on credential stacking: 1 percent of Gulf Coast IT Pathways program participants in health information technology programs earned more than one credential, compared to 6% for the matched comparison group – a 5 percentage point difference.

For Gulf Coast IT Pathways program participants in industrial information technology programs, the PSM models found a significant positive impact on credit hour accumulation: Gulf Coast IT Pathways program participants in industrial information technology programs earned an average of 13.6 credits, compared to an average of 12.8 credits for the matched comparison group – a difference of about one credit per semester. The PSM models found no program impacts on overall credential attainment and degree attainment, but did find a significant positive impact on certificate attainment: 34% of Gulf Coast IT Pathways program participants in industrial information technology earned a credential, compared to 22% for the matched comparison group – a 12 percentage point difference. Finally, the PSM models found a significant negative impact on credential stacking: 7 percent of Gulf Coast IT Pathways program participants in industrial information technology programs earned more than one credential, compared to 17% for the matched comparison group – a 10 percentage point difference.

## DISCUSSION

### OVERVIEW

This report analyzed the outcomes of Gulf Coast IT Pathways program participants and estimated the impacts of the Gulf Coast IT Pathways program on postsecondary outcomes. Since being awarded the grant in 2012, the Gulf Coast IT Pathways program has met and exceeded its original goal of serving 1,954 participants by serving a total of 2,771 individuals. The Gulf Coast IT Pathways program has trained students for jobs in the region's IT sector through strategies that help students complete programs of study and find employment. This report sought to understand the outcomes of students enrolled in the Gulf Coast IT Pathways program through descriptive data, as well as through rigorous statistical analyses conducted with available data to understand educational and employment outcomes. Results presented in this report were both descriptive and inferential to provide a comprehensive picture of student outcomes and program impacts.

### SUMMARY OF FINDINGS

#### *Findings from the outcomes analysis*

The outcomes analysis conducted by the Ray Marshall Center found strong credit hour accumulation and persistence rates overall, as well as robust credential attainment rates, but found employment outcomes to be weak<sup>8</sup>. Variations in outcomes were noted across the two states. First-semester persistence and credential attainment were similar in both states. While credential stacking appeared to be stronger in Louisiana, credit hour accumulation appeared to be stronger in Mississippi. Employment outcomes also appeared to be stronger in Mississippi.

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<sup>8</sup> Note that employment outcomes should be interpreted with care since employment outcomes could only be examined for a portion of the total participants served, due to the lack of a sufficient follow-up period for the evaluation. These limitations are discussed at length at the end of this chapter.

Variations in outcomes were also noted across the three IT specialty areas.<sup>9</sup> Credit hour accumulation rates and first-semester persistence rates were strong across all three IT specialty areas. However, participants in the industrial information technology programs had the strongest credential attainment outcomes, with 39% earning a credential, followed closely by participants in health information technology programs, with 30% earning a credential. Evidence of credential stacking was modest across all three specialty areas, ranging from 1% for participants in health information technology programs to 7% for participants in industrial information technology programs. Employment outcomes were strongest for participants in the health information technology field, with 24% placed in employment, but much weaker for participants in the industrial information technology programs and cyber security programs.

The outcomes analysis also found that credential attainment, credential stacking and employment placement appeared to be stronger among participants in for-credit programs who entered the program in the first year of program implementation, compared to participants who entered the program in the second year of program implementation. The weaker education outcomes and weaker employment outcomes for participants who entered later can likely be partially attributed to the lack of follow up data: academic data including credential attainment for the 2015-2016 academic year were not available to the evaluation team, due to lack of a sufficient follow-up time period.

The outcomes analysis also found that participants in non-credit programs who entered in the second year of program implementation appear to fare better than those who entered in the first year of program implementation. This could potentially be attributed to these colleges improving and refining their implementation strategies over the course of the grant implementation.

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<sup>9</sup> Recall that findings about variations by IT specialty areas should be interpreted with caution, since the IT specialty area could only be identified for half of all program participants.

### ***Findings from the impact analysis***

The Ray Marshall Center also conducted an impact analysis to study the impacts of the Gulf Coast IT Pathways program on education and labor market outcomes. Since an experimental design was not feasible, the Ray Marshall Center selected a quasi-experimental design for the impact analysis: propensity score matching using a retrospective cohort. The treatment group comprised Gulf Coast IT Pathways program participants from the program implementation period (i.e. 2013-2016) and the comparison group pool comprised individuals in similar programs from the year prior to program implementation (i.e. the 2012-2013 academic year); the strength of this design was that it controlled for differences in local conditions across geography.

The impact evaluation found that overall, the Gulf Coast IT Pathways program had significant positive impacts on credit hour accumulation and credential achievement, including both certificate attainment and degree attainment; however, the program had no impact on credential stacking. Variations in program impacts were noted across the two states. The impact evaluation found that while the program had a significant positive impact on credit hour accumulation in Louisiana, the program had a significant *negative* impact on credit hour accumulation in Mississippi. However, the impact evaluation found that the program had significant positive impacts on credential attainment (including both certificate attainment and degree attainment) in both states. However, the impact evaluation found that the program had no impact on credential stacking in Louisiana, but had a significant positive impact on credential stacking in Mississippi.

Variations in program impacts were also noted across the three IT specialty areas.<sup>10</sup> Notably, the impact evaluation found that the program had no impact on credit hour accumulation or credential attainment for participants in cyber security programs. However, the impact evaluation found that the program had significant positive impacts on credential attainment for participants in the health information technology and industrial information technology programs. The impact evaluation also found that the program had

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<sup>10</sup> Recall that findings about variations by IT specialty areas should be interpreted with caution, since the IT specialty area could only be identified for half of all program participants.

significant *negative* impacts on credential stacking for participants in all three specialty areas. These findings about the Gulf Coast IT Pathways program's impacts on education outcomes should be interpreted with caution, keeping in consideration the many limitations of the evaluation design, discussed in the next section. The evaluation team's findings of the impact of the Gulf Coast IT Pathways program on education outcomes should be interpreted as suggestive estimates, rather than conclusive findings.

Although the evaluation found significant program impacts on education outcomes, the evaluation was unable to study program impacts on labor market outcomes – employment placement, employment retention and wage increase – that are key outcomes for the TAACCCT grants. No inferences about impacts on employment outcomes should be drawn from the positive impacts on education outcomes. Some evaluations of training programs have found positive impacts on postsecondary outcomes but no impacts on labor market outcomes. For example, a recent evaluation of the National Information Security & Geospatial Technology Consortium (NISGTC) that was funded with a Round One TAACCCT grant found that students “who earned credentials were no more likely than those who did not earn credentials to be employed”, and “those who earned a credential did not have wages significantly different than those without a credential”(Bridges, Bishop et al. 2015).

## **LIMITATIONS OF THE EVALUATION**

The impact analysis is clearly limited by its non-experimental design. While propensity core matching (PSM) controls for observed differences between the treatment group (Gulf Coast IT Pathways program participants) and the comparison group, it cannot control for selection bias that may be due to unobserved differences between the groups, although there is evidence this may well be an overrated problem (Dehejia and Wahba 1998, Heckman, Ichimura et al. 1998, Dehejia and Wahba 1999). As with all PSM approaches, the degree to which unmeasured sources of bias affect the comparability of groups is unknown.

The evaluation team made efforts to incorporate all available and important characteristics such as age, gender, race, residency status, and admission status and student level. However, some important characteristics such as prior education, prior labor market

experience, household size and family characteristics could not be included in the analysis, since data on these characteristics was not available to the evaluation team.<sup>11</sup> PSM does not correct for selection bias that might be caused by characteristics not observed or measured; this remains a significant limitation of this study.

The impact evaluation also faced significant challenges in data collection over the grant period. As noted earlier, NSPARC served as the data partner for the consortium and was tasked with collecting data across all nine colleges in the consortium; compiling the data; cleaning the data to ensure consistency and accuracy; and, delivering the data to the third-party evaluation team. The evaluation team received the first dataset very late in the grant period - in November 2014, at the end of the second year of the four-year grant. The evaluation team immediately identified significant swathes of missing data and documented these missing data challenges in the interim report, published in January 2015 (Patnaik 2015). Missing data challenges included: missing data for specific variables such as high school GPA; no data collected for students in non-credit programs; no credential attainment data reported for all students; and, no employment outcomes collected for all students. Over the next year, the evaluation team worked closely with the consortium to address the missing data challenges. The evaluation team also adapted the evaluation design to the realities of data availability; as noted earlier, the evaluation team was forced to step down in rigor from a difference-in-differences approach to a retrospective comparison cohort approach.

Later data sets received by the evaluation team included more complete data; however, inconsistencies and gaps in data persisted, including in the final dataset that was sent to the evaluation team in June 2016. This final dataset was returned to NSPARC for a more thorough data cleaning to address data quality issues. A final clean dataset was received by the evaluation team on August 29, 2016, a mere five weeks prior to the publication of this report. Although many gaps in the data were addressed over the course

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<sup>11</sup> Note that while rich data on additional characteristics were available for the treatment group (Gulf Coast IT Pathways program participants) from the intake data, no data on these characteristics were available in the administrative data for the comparison group. Thus, these additional characteristics could not be incorporated in the impact analysis.

of the grant period, some significant gaps still remained and pose limitations to the impact evaluation, including:

**1. Missing data on prior labor market experience**

Due to lack of access to data, the evaluation team was unable to include prior labor market experiences for the treatment and matched comparison group in the impact analysis. This is significant, since prior labor market experience is an important characteristic in considering selection bias; evaluations of job training programs in the US have found the employment histories of individuals to be good predictors of program participation (Friedlander and Robins 1995, Friedlander, Greenberg et al. 1997). Prior unemployment and earnings are important when using propensity score matching because they are important predictors of program entry and employment outcomes; they also help capture otherwise unobservable characteristics, such as motivation, which can also influence participation and outcomes (Bryson, Dorsett et al. 2002).

**2. Missing data for participants in non-credit training programs**

As noted earlier, data on many academic measures could not be collected for program participants in non-credit training programs as their information was not systematically recorded in the colleges' institutional data systems; as a result, the evaluation team was only able to examine limited outcomes for program participants in non-credit training programs.

Additionally, a suitable comparison group of individuals in non-credit training programs was not made available to the evaluation team; as a result, the Ray Marshall Center could not examine program impacts for participants in non-credit training programs.

**3. Missing data on labor market outcomes for the comparison group**

As noted earlier, UI data could only be extracted by NSPARC for program participants i.e. the treatment group. Since labor market outcomes for the comparison group were not made available to the evaluation team, the Ray Marshall



Center was unable to examine the impact of the Gulf Coast IT Pathways program on employment outcomes.

#### **4. Missing data for Year 4**

As noted earlier, the grant received permission from DOL to continue program implementation activities for an additional six months into the fourth year of the grant, with program implementation ending on March 31, 2016, instead of the previous end date of September 30, 2015. However, no extension was granted for the evaluation, resulting in a period of only six months between the end of program implementation and the writing of this final report.

At the time this final evaluation report was being developed, academic data for the 2015-2016 academic year was still being processed and cleaned up in the colleges' data systems, and could not yet be accessed by the evaluation team. Thus, due to the lack of a sufficient follow-up period, education data was not available for the final 2015-2016 academic year, and the most recent semester of data available to the evaluation team was the Spring 2015 semester. As a result, outcomes and impacts could not be examined for program participants who entered in this final year; outcomes and impacts could also not be examined for program participants who may have exited in this final year. Thus, the outcomes and impact analysis presented in this report do not fully capture overall program outcomes and impacts.

## **CONCLUSION**

Considering all the results together, it appears that the Gulf Coast IT Pathways program had success in reaching their overall goal of training students across Mississippi and Louisiana for the growing regional demand for skilled labor in the IT sector. Evidence shows that students in the Gulf Coast IT Pathways program had strong education outcomes, including credit hour accumulation, persistence, credential attainment, and credential stacking. Evidence also suggests that students participating in the program had stronger education outcomes, compared to a carefully matched comparison group of similar

students in IT programs. However, as noted above, the program's impact on employment outcomes could not be studied in this evaluation.

These findings about the program's outcomes and impacts should be carefully considered in conjunction with the findings from The Aspen Institute's implementation evaluation. Specifically, the variations in the program's outcomes and impacts should be considered in conjunction with the variations in program implementation to identify successful strategies.

## APPENDIX A. INTAKE FORM DATA ELEMENTS

Intake form field	Optional/ Required
<b>Section I: Individual information</b>	
Last Name	R
First Name	R
Middle Initial	O
Address Line 1	R
Address Line 2	O
City	R
State	O
Province / Region	O
Zip Code	O
Postal Code	O
Country	R
Primary Phone	R
Secondary Phone	O
Email	R
Date of Birth	R
Place of Birth	O
Gender	R
Ethnicity Hispanic/ Latino	R
American Indian or Alaska Native	R
Asian	R
Black or African American	R
Native Hawaiian or other Pacific Islander	R
White	R
Active Duty Military	R
Eligible Veteran Status	R
Offender	R

Individual With a Disability	O
<b>Section II: Financial assistance</b>	
Financial Assistance: Pell Grant	O
Financial Assistance: VA	O
Financial Assistance: Vocational Rehabilitation	O
Financial Assistance: Scholarships	O
Financial Assistance: Loans	O
Financial Assistance: Other	O
Financial Assistance: Debt	O
<b>Section III: Employment</b>	
Employment Status at Participation	R
Current or Previous Employer	O
Unemployment Insurance Claimant	R
TAA Eligible	R
Dislocated Worker	R
Incumbent Worker Status	R
<b>Section IV: Education</b>	
English Language Proficiency	R
Highest Grade Completed	R
Year Completed Highest Grade	O
School Status at Participation	R
Course Load	R
<b>Section V: Academic needs</b>	
Academic Needs: Writing Skills	O
Academic Needs: Listening Skills	O
Academic Needs: Test Taking Skills	O
Academic Needs: Computer Skills	O
Academic Needs: Math Skills	O
Academic Needs: Communication Skills	O

Academic Needs: Memorization Skills	O
Academic Needs: Time Management Skills	O
Academic Needs: Reading Skills	O
Academic Needs: Concentration Skills	O
Academic Needs: Typing Skills	O
Academic Needs: Note-Taking Skills	O
<b>Section VI: Program of study</b>	
Career and Academic Goals: Accelerating Opportunities	O
Career and Academic Goals: Work in Cyber Security/Networking	O
Career and Academic Goals: Work in Health Informatics	O
Career and Academic Goals: Work in Industrial Technology	O
Career and Academic Goals: Work in Digital Gaming	O
Career and Academic Goals: Pursue Further Education	O
<b>Section VII: Staff</b>	
Application Date	R
Interview Date	R
FAFSA Application Date	R
Placement Testing Date	O
Follow up Date	O
College Application Date	O
Host College Student ID	R
Intake Remarks	O
<b>Section VIII: Follow up</b>	
Date of Enrollment	O
Date of Program Completion	O
Continued Enrollment in Grant-Funded Program	
Continued Enrollment in Other Education	
Number of Credit Hours Completed	
Total Number of Earned Credentials	

Earned Certificate in Less Than One Year

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Earned Certificate in More Than One Year

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Earned Degree

---

Entered Another Education Program

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Date of Placement Into Employment.

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Entered Employment

---

Retained in Employment

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Wage Increase for Incumbent Workers

## APPENDIX B. ACADEMIC VARIABLES REQUESTED BY RMC

Academic Date	Institution Common Identification Number
Academic Year Begin	Cumulative Hours Earned
Academic Term	Attended Summer Session
Institution Code	Student Course Information
Student Identification Number	Enrolled at Census Date
Student Race	Developmental Course Flag
Student Ethnicity	Contact Hour Course Flag
Student Gender	Course Abbreviation
Fee Residence	Course Classification (CIP)
Citizenship	Course Number
Parish/State/Country	Section Number
Birth Date	Course Credit/Contact Hours
Birth Month	Course Grade
Birth Year	Credential receipt
Admission Status	Level of credential (certificate, associate's, bachelor's, etc.)
Student Type/Level	Subject/major of credential
Program Classification	Date of receipt
CIP Code	FICE or other institution code of granting institution
Degree Level Code	
High School Graduation Year/Date	
High School Grade Point Average	
High School Class Percentile Rank	
Admission Test (type and scores)	
Current Term Grade Point Average	
Cumulative Overall Grade Point Average	
Academic Standing at End of Term	
Total Student Credit Hours Scheduled	
Total Student Contact Hours Scheduled	

### APPENDIX C. TARGET OUTCOMES FOR THE GRANT

Outcomes	Year 1	Year 2	Year 3	Year 4	Total
Total unique participants served	460	613	881	0	1954
Total number of participants who will have completed a TAACCCT-funded program	295	506	859	0	1660
Total number still retained in their program of study or another TAACCCT-funded program	208	355	496	0	1059
Total number of participants completing credit hours (students who earn 1 or more credit hr.)	250	717	792	0	1174
Total number credentials earned (Aggregate number of degrees and certificates completed)	747	1000	1241	0	2988
Total number enrolled in further education after grant funded program completion	166	244	249	90	749
Total number employed after completion (students entering employment within the first quarter after program completion)	226	514	640	95	1475
Total number retained in employment after program of study completion	203	463	576	86	1328
Total number employed at enrollment (incumbent workers) who receive a wage increase post-enrollment	93	179	269	56	459



## APPENDIX D. DEFINITIONS FOR EMPLOYMENT MEASURES

NPSARC calculated the wage measures for the evaluation team, using the following DOL definitions:

Field Name	Data Type /Field Length	Field Name Definitions/Instructions	Code Value
Employed	numeric(1)	Employment status for students who meet the following criteria: are non-incumbent workers, complete a grant-funded program of study, and exited the college. Employment status is determined one quarter after exit from the college.	Blank = Not qualified to be considered or not found in wage data 0 = False 1 = True
Retained	numeric(1)	Employment retention status for students who meet the following criteria: are non-incumbent workers, complete a grant-funded program of study, and exited the college. Retention status is determined if the student is employed in first, second, and third quarters after exit from the college.	Blank = Not qualified to be considered or not found in wage data 0 = False 1 = True
Wage Increase	numeric(1)	Wage increase are determined for students who identified as an incumbent worker and receive a quarterly wage increase at any point in time post-enrollment.	Blank = Not qualified to be considered or not found in wage data 0 = False 1 = True

## APPENDIX E. PARTICIPANT OUTCOMES BY COLLEGE

Education outcomes (for-credit programs)	Louisiana Delta	Delgado	Bossier Parish	South Louisiana	Pearl River	Mississippi Delta	Copiah- Lincoln	Meridian	Northeast Mississippi
Number of participants	405	263	282	242	211	160	109	102	
Credits earned per semester (Mean)	11.8	7.6	11.1	12.8	13.1	14.6	14.3	15.4	
Persisted after first semester (%)	91.1%	60.9%	83.4%	85.5%	81.8%	85.3%	87.9%	87.3%	
Earned any credential (%)	34.3%	3.4%	15.6%	47.1%	30.3%	35.6%	24.8%	0.0%	
Earned any certificate (%)	29.6%	3.4%	9.2%	46.7%	6.6%	21.3%	3.7%	0.0%	
Earned any degree (%)	23.7%	0.0%	11.3%	2.5%	28.0%	21.3%	21.1%	0.0%	
Earned more than one credential (%)	19.8%	2.3%	5.0%	7.9%	4.7%	6.9%	0.0%	0.0%	
Education outcomes (non-credit programs)	Louisiana Delta	Delgado	Bossier Parish	South Louisiana	Pearl River	Mississippi Delta	Copiah- Lincoln	Meridian	Northeast Mississippi
Number of participants								218	413
Earned any certification (%)								26.1%	85.2%
Earned more than one certification (%)								2.8%	48.2%
Employment outcomes (for-credit and non-credit)	Louisiana Delta	Delgado	Bossier Parish	South Louisiana	Pearl River	Mississippi Delta	Copiah- Lincoln	Meridian	Northeast Mississippi
Number of participants	448	361	338	290	273	216	109	307	429
Entered employment (%)	10.7%	0.3%	0.0%	6.9%	4.8%	13.4%	5.5%	17.6%	7.5%
Retained employment (%)	3.8%	0.0%	0.0%	1.4%	2.2%	2.3%	0.0%	9.4%	4.2%
Had wage increase (%)	6.7%	7.5%	0.3%	19.7%	18.7%	0.5%	21.1%	16.6%	21.4%

## APPENDIX F. MOST COMMON MAJORS IN THE TREATMENT GROUP

CIP	Major field of study
110101	Computer and Information Sciences, General
110201	Computer Programming/Programmer, General
110299	Computer Programming, Other
110301	Data Processing and Data Processing Technology/Technician
110401	Information Science/Studies
110901	Computer Systems Networking and Telecommunications
111001	Network and System Administration/Administrator
111002	System, Networking, and LAN/WAN Management/Manager
111003	Computer and Information Systems Security/Information Assurance
111004	Web/Multimedia Management and Webmaster
111099	Computer/Information Technology Services Administration and Management, Other
119999	Computer and Information Sciences and Support Services, Other
510702	Hospital and Health Care Facilities Administration/Management
510707	Health Information/Medical Records Technology/Technician
510799	Health and Medical Administrative Services, Other
510801	Medical/Clinical Assistant
150101	Architectural Engineering Technology/Technician
150303	Electrical, Electronic and Communications Engineering Technology/Technician

150401	Biomedical Technology/Technician
150612	Industrial Technology/Technician
150613	Manufacturing Engineering Technology/Technician
150699	Industrial Production Technologies/Technicians, Other
150903	Petroleum Technology/Technician
151001	Construction Engineering Technology/Technician
151301	Drafting and Design Technology/Technician, General
460302	Electrician
470101	Electrical/Electronics Equipment Installation and Repair, General
470105	Industrial Electronics Technology/Technician
470201	Heating, Air Conditioning, Ventilation and Refrigeration Maintenance Technology/Technician
470303	Industrial Mechanics and Maintenance Technology
470604	Automobile/Automotive Mechanics Technology/Technician
470615	Engine Machinist
480501	Machine Tool Technology/Machinist
480503	Machine Shop Technology/Assistant
480508	Welding Technology/Welder
490202	Construction/Heavy Equipment/Earthmoving Equipment Operation

## **APPENDIX G. PROPENSITY SCORE MATCHING**

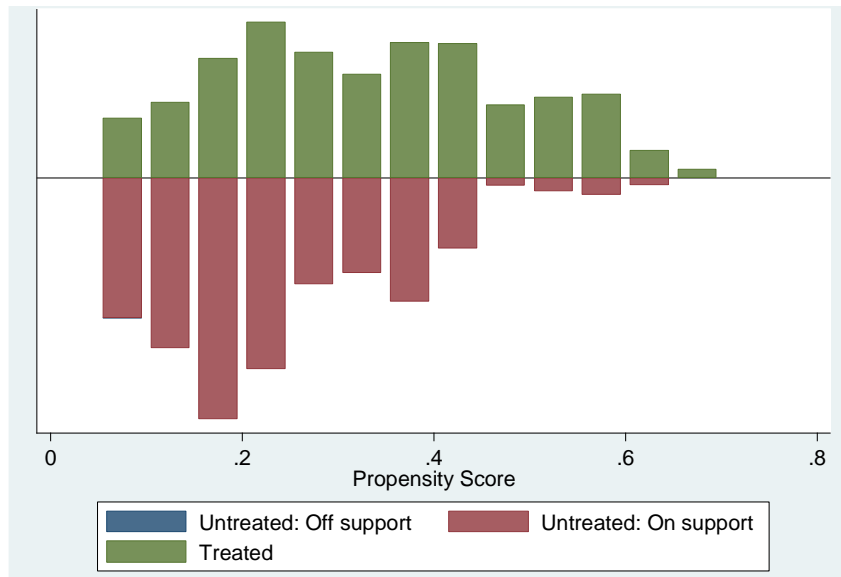
The Ray Marshall Center used the propensity score matching approach to account for differences on the observable characteristics between the treatment group and the comparison group pool. The aim of propensity score matching is to construct a balanced sample of treatment and comparison students who both participated in IT pathway programs, but are distinct only in their participation in the Gulf Coast IT Pathways program. The PSCORE, PSMATCH2 and TEFFECTS modules in the Stata statistical software package were utilized (Garrido, Kelley et al. 2014).

### **STEP 1: PROPENSITY SCORE ESTIMATION**

First, a propensity score was constructed for each individual (in both the treatment group and the comparison group pool) that estimated the likelihood of participating in the Gulf Coast IT Pathways program, using all the observable characteristics. This was done by using the *pscore* procedure in Stata (Becker and Ichino 2002) to perform a probit regression of the treatment dummy variable on all available covariates that, in the evaluation team's judgment, had the potential to influence the chances of being treated.

Overlap in the range of propensity scores across the treatment and comparison groups, called "common support", was ensured. This is important because no inferences about treatment effects can be made for a treated individual for whom there is not a comparison individual with a similar propensity score. Common support was subjectively assessed by examining a graph of propensity scores across treatment and comparison groups (Figure B-1).

Figure B-1. Common Support



## STEP 2: MATCHING

Next, individuals in the treatment group were matched to individuals from the comparison group pool, using the *psmatch2* procedure in Stata (Leuven and Sianesi 2014). Each treatment group individual can be matched to one or many comparison group individuals. When matching at the individual level, the first match is always best and will lead to the least biased estimates, but the decrease in bias from fewer matches needs to be weighed against the lower efficiency of the estimate that will occur with fewer observations. A broader one-to-many match will increase sample size and efficiency but can also result in greater bias from matches that are not as close as the initial match (Caliendo and Kopeinig 2008). The evaluation team selected to use the single nearest-neighbor technique was used; this technique involves finding for each treated individual that non-treated individual with the most similar propensity score and so, the most similar characteristics.

Matching with replacement was also used, which allows each comparison group individual to be used as a match more than once; matching with replacement improves the performance of the match and produces matches of higher quality than matching without replacement by increasing the set of possible matches (Dehejia and Wahba 1998, Abadie

and Imbens 2006). Matching with replacement is also less demanding of the data than permitting comparison group individuals to be used only once. “Essentially, it avoids the problem of the non-treatment group being ‘used up’. Should a certain type of individual be common in the treatment group but relatively uncommon in the comparator group, the pool of comparators able to provide a close match would become exhausted were non treatment group members used only once” (Bryson, Dorsett et al. 2002). Also, if two or more observations had the same propensity score and were thus tied for "nearest neighbor", all ties were used for the match; including all the ties provides a more precise estimator (Abadie, Drukker et al. 2004).

Next, the evaluation team assessed if balance in the observable characteristics had been achieved, using the *pstest* procedure in Stata. Propensity score matching can only lead to viable estimates of the causal effects of treatment, if the desired balancing of observable covariates is achieved. The evaluation team found that covariate balance had been successfully achieved. Table B-1 lists overall measures of covariate balance and Table B-2 lists individual measures of covariate balance for the propensity score model examining impacts on employment placement.

Table B-1 Overall Balance

Sample	Ps R2	LR chi2	p>chi2	Mean Bias	Med Bias	B	R	%Var
Unmatched	0.08	623.87	0.000	22.3	18.6	70.4*	1.2	0.0
Matched	0.00	12.01	0.151	3.7	3.8	11.7	1.1	100.0

After matching, the measures indicate good covariate balance: (1) standardized bias<sup>12</sup> for all covariates is less than 5%, (2) t-tests for all covariates are non-significant, (3)

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<sup>12</sup> The standardized bias is the % difference of the sample means in the treated and non-treated (full or matched) sub-samples as a percentage of the square root of the average of the sample variances in the treated and non-treated groups Rosenbaum, P. R. and D. B. Rubin (1985). "Constructing a control group using multivariate matched sampling methods that incorporate the propensity score." *The American Statistician* 39(1): 33-38..

the pseudo-R<sup>2</sup> is very low<sup>13</sup>, (4) the likelihood-ratio test<sup>14</sup> is non-significant, (5) the mean and median absolute bias are less than 5%, (6) Rubin's B<sup>15</sup> is close to 0, and (7) Rubin's R<sup>16</sup> is close to 1. Figure B-2 shows the distribution of the standardized percentage bias across covariates using a histogram. Figure B-3 shows the standardized percentage bias for each covariate using a dot chart.

Thus, while the differences between the treatment group and the comparison group pool in observable characteristics were documented in Table 15 to be substantial in the unmatched sample, the evaluation team's matching approach (nearest neighbor matching with replacement) achieved satisfactory balance in all observable characteristics. The evaluation team can be quite confident that in the estimates of the causal impact of the Gulf Coast IT Pathways program on outcomes, genuinely comparable students are being compared.

### **STEP 3: TREATMENT EFFECT ESTIMATION**

Finally, the average treatment effect on the treated (ATT) is estimated, which is the average difference on an outcome of interest between the matched treated and untreated observations. The ATT is the average effect of the treatment on the sort of person who participates in the program. The effectiveness of PSM is, in part, a function of having enough relevant information about the cases to accurately estimate the propensity score, and thus accurately estimate the ATT using the matching process that uses this score. The *teffects psmatch* procedure in Stata (StataCorp) calculates the treatment effect along with the Abadie Imbens corrected standard error calculation (Abadie and Imbens 2012).

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<sup>13</sup> The pseudo-R<sup>2</sup> indicates how well the regressors X explain the participation probability.

<sup>14</sup> the likelihood-ratio test of the joint insignificance of all the regressors

<sup>15</sup> Rubin's B is the standardized difference in mean of the linear prediction of the propensity score before and after matching

<sup>16</sup> Rubin's R is the ratio of variance of the treated and comparison group for the linear prediction of the propensity score.



Table B-2 Covariate Balance

Observable Characteristics		Mean		% bias	% reduct  bias	t-test	
		Treatment	Comparison			t	p> t
Age (log)	Unmatched	3.25	3.29	-13.50		-4.91	0.000***
	Matched	3.25	3.24	3.90	71%	1.19	0.234
Gender: Female	Unmatched	0.49	0.37	23.30		8.51	0.000***
	Matched	0.48	0.51	-5.60	76%	-1.62	0.105
Race : White	Unmatched	0.47	0.44	7.20		2.62	0.009**
	Matched	0.47	0.50	-5.80	19%	-1.72	0.085
Admission status : Continuing student	Unmatched	0.30	0.55	-51.90		-18.45	0.000***
	Matched	0.31	0.31	-1.50	97%	-0.47	0.635
Admission status : Other student	Unmatched	0.35	0.23	27.40		10.21	0.000***
	Matched	0.35	0.34	1.40	95%	0.39	0.696
Student Level : Sophomore	Unmatched	0.24	0.30	-13.90		-4.95	0.000***
	Matched	0.24	0.25	-3.60	74%	-1.10	0.273
Student Level: Other	Unmatched	0.16	0.18	-5.60		-1.99	0.046
	Matched	0.15	0.14	2.10	62%	0.67	0.503
Degree Pursued: Associate's	Unmatched	0.46	0.63	-35.70		-13.02	0.000***
	Matched	0.46	0.49	-5.70	84%	-1.66	0.097

Figure B-2. Individual Covariate Balance

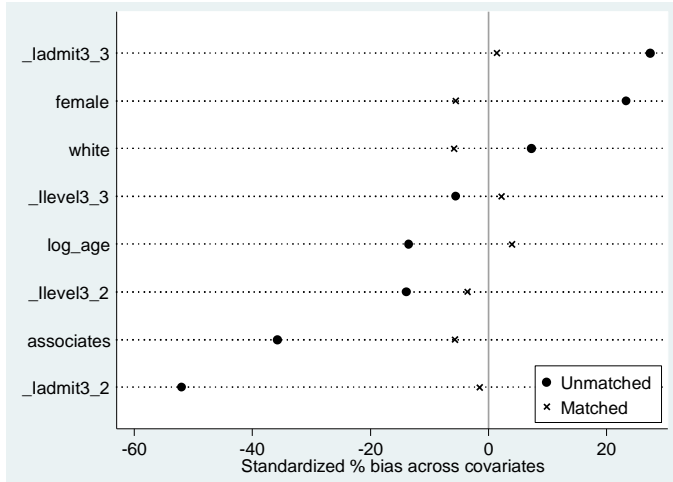
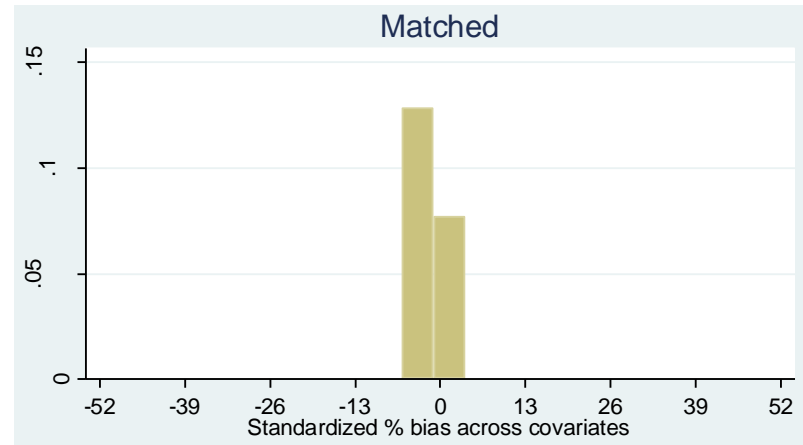
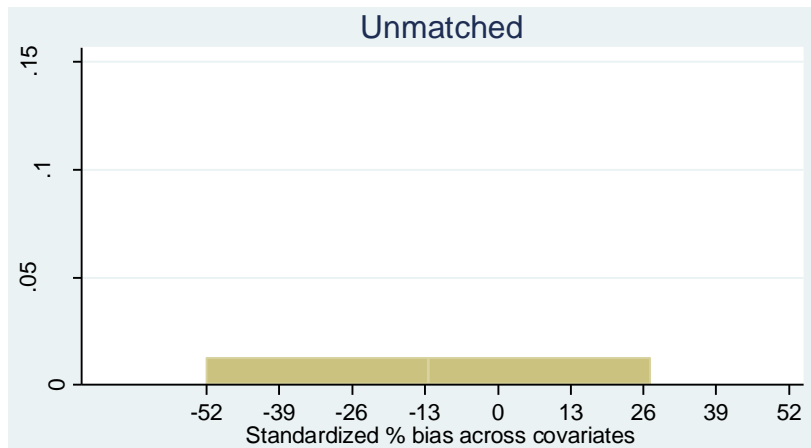


Figure B-3. Overall Covariate Balance



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