



Annual External Evaluation Report

PathTech: Successful Academic and Employment Pathways in Advanced Technologies

NSF Award #1104214

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1. Overview of PathTech and the External Evaluation

1.1 About the PathTech Project

The Successful Academic and Employment Pathways in Advanced Technologies (PathTech) project was a four year research study funded through a grant from the National Science Foundation (NSF) Directorate for Education and Human Resources (DEHR) under the Advanced Technological Education (ATE) program (NSF Award #1104214). The NSF ATE program promotes the improvement of education, particularly at two-year colleges, for science and engineering technicians entering into high-technology fields. The ATE program supports different types of activities, including the development of curriculum, educator professional development, career pathways, articulation between two-year and four-year programs for potential educators, and research to add to the understanding of various aspects of educating technicians for careers in high-technology fields.

PathTech was a research study designed to examine the progression of students from high school into advanced technology programs, specifically engineering technology (ET), at community colleges and into the workforce. This field-based targeted research study involved collaboration between two-year community and technical colleges, industry partners, and local high schools. These collaborations led the PathTech research team to explore unanticipated avenues that can strengthen partnerships and pathways and ultimately inform practices in ET programs through advancing the knowledge base around ET students.¹ This study was conducted over four years between September 1, 2011 and August 31, 2015. Grant funds for this project period total \$1,196,790.

The NSF ATE grant for the PathTech project was awarded to the University of South Florida (USF), which established a collaboration of higher education institutions in Florida, including researchers from the Departments of Sociology and Education at USF, the Florida Advanced Technological Center (FLATE) at Hillsborough Community College (HCC), Polk State College (PSC), St. Petersburg College (SPC), and State College of Florida (SCF). Dr. Will Tyson (USF – Sociology) is the principal investigator, and Dr. Marie Boyette (FLATE at HCC) has been serving as co-principal investigator since the project inception. Dr. Kathryn Borman (USF) served as another co-principal investigator until her retirement at the end of the spring 2013 semester. In Year 1 of the grant, the project leaders expanded the research team to include university students and other research staff to contribute to the PathTech project. In January 2013, Dr. Lakshmi Jayaram (USF – Sociology) was added to the project as the lead qualitative investigator and Dr. Edward Fletcher (USF – Education) was added as a quantitative investigator. Dr. Chrystal Smith (USF – Sociology) was the PathTech program manager through 2014 when recruitment and data collection ended.

1.1.1 PathTech Research Design and Methodology

The PathTech project has worked toward contributing to a growing body of knowledge on advanced technician education and to the overall mission of the NSF ATE program by:

- increasing understanding of recruitment and pathways into ET programs,
- providing information to improve the education of engineering technicians,
- discovering promising practices and recommending interventions at high schools to increase the visibility of ET programs at local community colleges, and

¹ NSF ATE grant request for application

- providing information about practices that produce more qualified science and engineering technicians to meet workforce demands.

RESEARCH QUESTIONS

The purpose of the PathTech research study was to answer two main research questions, each with three sub-questions:

1. Who enrolls in ET community college programs out of high school?
 - a. How are student demographic and academic characteristics related to ET enrollment?
 - b. How do students learn about ET programs (i.e., outreach)?
 - c. How can the pathway from high school into ET programs be improved?
2. How do ET students benefit from enrolling (in degree programs) and earning degrees through these programs?
 - a. What are the most critical steps in ET degree attainment from enrollment through gatekeeper courses and to the degree?
 - b. How do these students become ET graduates?
 - c. How do ET students differ from comparable students in their degree and employment outcomes?

Throughout the life of this project, these research questions were the main focal points of all aspects of the research study, including instrument development, quantitative analysis plans, and all reporting and publication efforts.

METHODOLOGY

PathTech was a mixed-method study that employed both descriptive statistics and empirical analysis of verifiable quantitative data from state databases along with ethnographic (qualitative) methods. Quantitative analyses were used to examine statewide trends in career academy participation and engineering technology enrollment. Quantitative data from the Florida Department of Education (FLDOE) PK-20 Education Data Warehouse (EDW), Florida Education & Training Placement Information Program (FETPIP), and other sources,² as well as data from site visits, were used to construct several indicators of high school preparation that predict enrollment into ET programs. The research team analyzed retrospective data from students in Grades 9-12 to measure high school and post-secondary course taking, achievement, and degree attainment. Four cohorts of students who graduated from high school and entered into the full-time workforce or post-secondary schooling in 2007-08, 2008-09, 2009-10, 2010-11 have been tracked through this data.

Qualitative analyses focused on four engineering technology programs housed at community college campuses in the Tampa Bay region of Florida, as well as feeder high schools and local industry employers. Site visits and in-depth interviews were conducted in this region, which contains a concentration of high school STEM career academies, STEM industries, and community colleges that offer advanced technology associates degrees. In addition, the PathTech team conducted a case study of women in ET programs at local community colleges in Year 3, collecting data through background surveys and in-depth interviews.

² The PathTech team has obtained quantitative data from other sources in order to fill gaps caused when some datasets have not been available as planned.

1.1.2 PathTech Project Timeline

Throughout the life of the PathTech project, the research team planned to conduct the following activities:

Year 1

1. Create project brochure highlighting goals and purpose of the study for stakeholders
2. Conduct pilot site visit to pilot test instruments in one high school, community college, and industry
3. Request additional Florida Department of Education (FLDOE) data updates
4. Carry out data preparation, descriptive analysis of current FLDOE data
5. Conduct propensity score analysis to create samples of students with equal propensity of being in a STEM-themed career academy and propensity score analysis at the school level to create pairs of schools with equal propensity of having a STEM-themed career academy in using Cohorts 1 and 2
6. Conduct a literature review on technician education
7. Write one paper for dissemination at a relevant conference and/or journal article for a peer reviewed journal

Year 2

1. Carry out site visits to:
 - a. Four community colleges with Associate of Science degrees in ET
 - b. Four high schools with engineering career academies
 - c. Local industry partners that hire Associate of Science degreed engineering technicians
2. Conduct multivariate, multi-level analysis of ET enrollment based on student-level demographic and academic factors and school-level characteristics among students in STEM career academy propensity groups
3. Carry out data preparation, descriptive analysis of Florida Education & Training Placement Information Program (FETPIP) employment data and post-secondary academic outcomes
4. Conduct multivariate, multi-level analysis of the impact of enrollment in engineering technologies on early post-secondary outcomes among Cohorts 1 and 2 students who enrolled in ET programs compared to students who did not
5. Write 1-2 papers for peer-review journal and/or conference presentations (e.g., AERA)

Year 3

1. Carry out site visits to [and corresponding analysis for]:
 - a. Four community colleges with Associate of Science (AS) degrees in ET
 - b. Four high schools with engineering career academies
 - c. Local industry partners that hire AS degreed engineering technicians
2. Conduct multivariate, multi-level analysis of the impact of AS engineering technology degree attainment on short- and long-range post-secondary employment and academic outcomes

among students who enroll in ET programs and comparable students who did not in all cohorts.

3. Write 1-2 papers for peer-review journal and/or conference presentations (e.g., AERA)

Year 4

1. Complete analysis of all data sources
 - a. Complete final analysis of all interview and focus group data
 - b. Complete multivariate, multi-level analysis of the impact of AS engineering technology degree attainment on short- and long-range post-secondary employment and academic outcomes among students who enroll in ET programs and comparable students who did not in all cohorts.
2. Write 1-2 papers for peer-review journal and/or conference presentations (e.g., AERA)

An analysis of the progress made toward the above tasks follows in Section 2: External Evaluation Findings.

1.2 About the External Evaluation

The external evaluation of PathTech is being conducted by ICF International, led by Thomas Horwood as lead evaluator, Kristen Peterson as the lead analyst, and supported by Dr. Teresa Duncan and Dr. Katerina Passa. The external evaluation is intended to complement and support the efforts of the PathTech research team. The approach to external evaluation involves: (1) monitoring the progress of the various aspects of the project (e.g., outreach, data collection, quantitative analysis, qualitative analysis); (2) providing objective reviews of project instruments, protocols, analysis plans, and reports; and (3) serving as an external resource and advisor for technical and logistical issues.

2. External Evaluation Findings

This report serves as the fourth and final in a series of annual evaluation reports and covers the final year of the implementation of the PathTech project. It serves as an update on the progress of the research project in meeting its goals, and includes cumulative updates for the duration of the project. Data were collected for this report through conversations with the PathTech project team during monthly calls, an external evaluation database used to track monthly progress of project activities, evaluator site visits to USF and the Florida Forums on Engineering Technology (ET Forums), and a review of project documents (e.g., grant application, research instruments, research protocols, reports).

2.1 Cumulative Evaluation Findings

In Years 1 and 2, the PathTech team submitted multiple data requests to FLDOE to request statewide education data to analyze trends in students' academic and career pathways. In Year 2, the team received FLDOE data; however, FLDOE declined to release data on race in conjunction with employment data, significantly limiting any potential analysis using this data. During Year 2, the PathTech team began exploring other relevant datasets that they could use to conduct a similar analysis, including data from the National Academy Foundation (NAF) and the National Longitudinal Survey of Youth, 1997 Cohort (NLSY97). In Year 3, the team continued pursuing these alternate data sources and began preliminary analysis with the NLSY97 data, and conducted additional analysis with this alternate data in Year 4 (see Exhibit 2). Delayed tasks involving quantitative data analysis are reflective of delays in obtaining

FLDOE data and missing variables in that data that were discussed in the annual evaluation reports in Years 1 and 2.

Exhibit 2 shows the tasks, activities and completion status for each of the main tasks planned for each year of the grant project period.

**Exhibit 1: Status of PathTech Tasks Planned for Each Project Year
(September 1, 2012 to August 31, 2015)**

Year 1 Tasks	Activities	Time Completed
Task 1. Create project brochure highlighting goals and purpose of study for stakeholders	Year 1 - PathTech web site landing page was developed and includes a brief project overview Year 2 - Established a social media presence through Facebook and Twitter. Updated web site with project information, staff biographies and event photographs	Completed Year 2 (delayed)
Task 2. Conduct pilot site visits to pilot test instruments in one high school, community college, and industry	Year 1 - Conducted the pilot site visits at one community college and one ET company Year 2 – Conducted pilot sit visit at local high school	Completed Year 2 (delayed)
Task 3. Request additional Florida Department of Education (FLDOE) data updates	Year 1 - Submitted data requests to FLDOE Year 2 - Submitted additional data requests to FLDOE. FLDOE data was obtained, but missing the race variable	Completed Year 2 (delayed)
Task 4: Carry out data preparation, descriptive analysis of current FLDOE data	Year 1 – Submitted data requests were to FLDOE Year 2 – Obtained, examined, and cleaned datasets (although race variable is missing, making it of limited use)	Completed Year 2, with limitations (delayed)
Task 5: Conduct propensity score analysis to create samples of students with equal propensity of being in a STEM-themed career academy and propensity score analysis at the school level to create pairs of schools with equal propensity of having a STEM-themed career academy in using Cohorts 1 and 2	Year 1 – Created analysis plans based on known variables expected to be collected Year 2 – Delayed analysis to Year 3 Year 3 – (see Exhibit 2, Year 3 Task 2)	Completed Year 3, with limitations (delayed)
Task 6. Conduct a literature review on technician education	Year 1 - Conducted a literature search to collect articles and other materials in three topic area: high schools, community colleges, and industry. Wrote three literature reviews, which will be updated on a regular basis throughout the grant project period to continually inform the project	Completed Year 1 (on schedule)
Task 7. Write one paper for dissemination at a relevant conference and/or journal article for a peer reviewed journal	Year 1 – No Action Year 2 – Integrated into subsequent dissemination plans	Completed Year 2 (delayed)
Year 2 Tasks	Activities	Time Completed
1a. Carry out site visits to 4 community colleges with AS degrees in ET	Year 2 - Developed participant consent forms, interview protocols, and demographic questionnaire . Recruited four community college partners and are actively recruiting participants through AutoCAD courses and online tool	Completed Year 3 (delayed)

1b. Carry out site visits to 4 high schools with engineering career academies	Year 2 – Developed all participant consent forms and interview protocols. Recruited two high schools and looking at other STEM magnets	Completed Year 3 (delayed)
1c. Carry out site visits to local industry partners that hire AS degreed engineering technicians	Year 2 - Developed participant consent forms, interview protocols, and demographic questionnaire . Recruited participants during the annual ET Forum. Conducted 10 interviews with industry staff in April and May 2013 Year 3 – Finalized coding and analysis	Completed Year 3 (delayed)
Task 2: Conduct multivariate, multi-level analysis of ET enrollment based on student-level demographic and academic factors and school-level characteristics among students in STEM career academy propensity groups	Year 2 – Conducted initial analysis of ET enrollment with FLDOE data without race variable Year 3 – (see Year 3 Task 2)	Completed Year 3, with limitations (delayed)
Task 3: Carry out data preparation, descriptive analysis of Florida Education & Training Placement Information Program (FETPIP) employment data and post-secondary academic outcomes	Year 2 – Obtained data and prepared it for descriptive analysis (however, it is of limited use since FLDOE will not release employment data in conjunction with demographic data) Year 3 – (see Year 3 Task 2)	Completed Year 3, with limitations (delayed)
Task 4: Conduct multivariate, multi-level analysis of the impact of enrollment in engineering technologies on early post-secondary outcomes among Cohorts 1 and 2 students who enrolled in ET programs and comparable students who did not	Year 2 – Developed analysis plans Year 2 – Conducted initial analysis of ET enrollment using FLDOE data Year 3 – (see Year 3 Task 2)	Completed Year 3 (delayed)
Task 5. Write 1-2 papers for peer-review journal and/or conference presentations (e.g., AERA)	Year 2 - Submitted abstract using FLDOE data to <i>Educational Evaluation and Policy Analysis</i> journal on using state longitudinal data to address policy issues. Paper drafted using the pilot data, planning to submit to the <i>Youth & Society</i> journal. Presented at the Engineering Technology (ET Forum) the Annual Meeting of the Southern Sociological Society	Completed Year 2 (on schedule)
Year 3 Tasks	Activities	Time Completed
1a. Qualitative: Carry out site visits to 4 community colleges with AS degrees in ET	Year 3 - Conducted multiple site visits to 4 community and technical colleges and conducted interviews with 57 community college students.* In addition, developed additional protocols for a case study of women in STEM programs and interviewed 5 women to collect additional data for the case study. Transcribed, coded and completed descriptive statistical analysis of all participants.	Completed Year 3 (on schedule)
1b. Qualitative: Carry out site visits to 4 high schools with engineering career academies	Year 3 - Conducted multiple site visits to 3 high schools and conducted interviews with 55 high school students, 3 high school teachers, and 3 high school district administrators across three high schools.*** Transcribed and coded data from interviews at all high schools.	Completed Year 3 (on schedule)
1c. Qualitative: Carry out site visits to local industry partners that hire AS	Year 3 - Conducted interviews with 7 industry employers.^ Transcribed all interviews	Completed Year 3 (on schedule)

degreed engineering technicians	and completed coding and analysis for industry employer interviews.	
Task 2. Conduct multivariate, multi-level analysis of the impact of AS engineering technology degree attainment on short- and long-range post-secondary employment and academic outcomes among students who enroll in ET programs and comparable students who did not in all cohorts.	Year 3 - Received FLDOE data in Year 2 but planned multi-level analyses were limited due to the lack of the race variable. Requested and received NLSY97 data to use for this analysis in place of FLDOE data (see Tasks 2-4 in Year 2). Cleaned data and conducted initial analysis.	Completed Year 3 (on schedule)
Task 3. Write 1-2 papers for peer-review journal and/or conference presentations (e.g., AERA)	Year 3 - Presented at Southern Sociological Society meetings, the American Sociological Association, and the Society for Applied Anthropology meeting. Drafted paper for the <i>Education Evaluation and Policy Analysis (EEPA)</i> . Submitted an extended abstract to Russell Sage for an edited volume on higher education and submitted an extended abstract to present at the American Educational Research Association (AERA) conference	Completed Year 3 (on schedule)
Year 4 Tasks	Activities	Time Completed
Task 1. Complete analysis of all data sources	Year 4 – Continued and completed qualitative and quantitative analysis	Completed Year 4 (on schedule)
Task 2. Write 1-2 papers for peer-review journal and conference presentations (e.g., AERA)	Year 4 – Presented at the Southern Sociological Society and AERA as well as locally at the FLATE industry advisory meeting. - Three quantitative or mixed methods papers in progress/submitted and two qualitative papers still in progress.	Completed Year 4 (on schedule)

At the conclusion of the PathTech project, all planned tasks have been completed along with additional case study data collection and analysis on women in ET programs of study. However, this project had a slower launch phase than anticipated, delaying the vast majority of tasks in Years 1 and 2. Many of these delays were due to unforeseen challenges including restricted access to local high schools for pilot and full site visits and limitations to FLDOE data variables.

In spite of these initial delays, the PathTech team was able to move forward and completed all Year 3 tasks on schedule. This was accomplished by a significant push to collect qualitative site visit data during Years 2 and 3, completing the qualitative data collection with 179 interviews conducted with community college students, industry partners and high school students. In addition, based on the initial themes emerging from analysis of community college interviews, the team added a case study of female ET students to explore the unique opportunities and challenges faced by this population. They created an updated protocol for these interviews and completed six case study interviews during Year 3.

Returning to the project schedule was also impacted by significant efforts to obtain alternate quantitative data to address research questions requiring multivariable, multi-level analysis. In addition to attending conferences and meetings to disseminate findings, the PathTech team has cultivated partnerships with both the ET and educational research communities. These have led to access to industry partners for participation in the study and data sharing possibilities with NAF, which have strengthened the overall PathTech study. When full FLDOE data could not be obtained, the team leveraged these partnerships to learn more about alternate data sources for their analysis. Ultimately, the team decided to use data from the National Longitudinal Survey of

Youth, 1997 (NLSY97) to examine factors that lead people into technology careers and factors that relate to individuals staying in those careers. The PathTech team worked quickly and effectively to realign with the project time table, resulting in a successful completion of this project.

2.2 Year 4 Progress

This annual external evaluation report for Year 4 describes an assessment of the PathTech project team’s progress according to the work plan during the final year of the grant. The Year 4 project period was September 1, 2014 to August 31, 2015. Exhibit 1 shows the activities conducted in Year 4 for the two key tasks planned for this final year.

**Exhibit 2. Status of Year 4 PathTech Tasks
(September 1, 2014 to August 31, 2015)**

Year 4 Tasks	Activities	Time Completed
Task 1. Complete analysis of all data sources	Year 4 – Continued and completed analysis on: <ul style="list-style-type: none"> o relations between STEM-AS degree and STEM-BS degree completion and current occupation using NLSY97 and survival analysis o high school site visit data o motivations on entering into ET programs using mixed methods data 	Completed Year 4 (on schedule)
Task 2. Write 1-2 papers for peer-review journal and conference presentations (e.g., AERA)	Year 4 – Presented at the Southern Sociological Society and AERA as well as locally at the FLATE industry advisory meeting. <ul style="list-style-type: none"> - Three papers in progress/submitted: <i>The Unique Habitus of Community College STEM AS/AAS Degree Students</i> (Sociology of Education); <i>Skills Developed and Skills Desired: Satisfying Employment needs through Successful High School and Industry Partnerships</i> (in progress); <i>A Longitudinal Analysis of Young Adult Pathways to STEMH Occupations</i> (American Educational Research Journal). 	Completed Year 4 (on schedule)

The focus of the PathTech project during Year 4 was on analysis and publication. Some staff transitioned off this project during the final year, including the program manager, Dr. Chrystal Smith, and the lead qualitative investigator, Dr. Lakshmi Jayaram. Dr. Jayaram continued to work on a qualitative paper examining students’ motivation for four typologies of ET students and Dr. Smith continued her analysis of the case study of women in ET programs. Additional qualitative research was continued by a graduate assistance who was hired to complete analysis of the high school interview data and lead relevant publication efforts. This included analyzing data from high school students and industry partners to examine any disconnect between employers’ needs and students’ skills.³

During Year 4, Dr. Edward Fletcher and Dr. Will Tyson continued to conduct quantitative analysis for the NLSY97 dataset. They presented preliminary analysis and findings at the Southern Sociological Society meeting, the American Educational Research Association (AERA) conference, the American Sociological Association annual meeting and locally at the

³ Mehta, Fletcher, and Tyson (2015). Skills developed and skills desired: Satisfying employment needs through successful high school and industry partnerships. *In progress*

FLATE industry advisory meeting. Led by Dr. Tyson, they analyzed links between enrollment at community colleges and four-year universities and degree attainment and workforce outcomes, using survival analysis.⁴ They have also worked with Dr. Jayaram on a mixed methods study examining cycling in and out of the classroom and students' consideration when trying to balance academic needs, job needs and family needs.⁵ All told, this has led to a greater number of presentations and publications than anticipated, exceeding the PathTech team's objective for Task 2.

3. Conclusions

In Year 4 of the PathTech project, the team built upon the successes they achieved in Years 1 through 3, concluding qualitative and quantitative analysis and continuing to work on five publications as well as numerous conference presentations. After challenges obtaining FLDOE data, the team conducted analysis using NLSY97 data alongside qualitative site visit data. The team continued to pursue networking and partnership opportunities with key stakeholders who are both important to completing the project as well as to those in the field who have an interest in the outcomes of the study through local, regional and national forums and conferences. This has generated excitement about PathTech in Florida and beyond. Through their outreach to various stakeholder groups, the PathTech team has been able to identify the pulse of these groups to understand how to carry out their research based on a devised plan while also being responsive to emerging themes and trends.

⁴ Tyson and Fletcher (2015). A longitudinal analysis of young adult pathways to STEMH occupations. *Submitted to the American Educational Research Journal*.

⁵ Tyson, Mehta and Jayaram (2015). The unique habitus of community college STEM AS/AAS degree students. *Submitted to Sociology of Education*.