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Cover

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| Federal Agency and Organization Element to Which Report is Submitted: | 4900 |
| Federal Grant or Other Identifying Number Assigned by Agency: | 1801163 |
| Project Title: | PathTech LISTEN: Mixed Methods Longitudinal Investigations of Students in Technician Education |
| PD/PI Name: | William T Tyson, Principal Investigator Marilyn Barger, Co-Principal Investigator Lakshmi Jayaram, Co-Principal Investigator |
| Recipient Organization: | University of South Florida |
| Project/Grant Period: | 10/01/2018 - 09/30/2021 |
| Reporting Period: | 10/01/2018 - 09/30/2019 |
| Submitting Official (if other than PD\PI): | N/A |
| Submission Date: | N/A |
| Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions) | N/A |

Accomplishments

* What are the major goals of the project?

PathTech LISTEN seeks to advance knowledge of pathways into and out of technician education by conducting **two longitudinal interviews and a follow-up survey** with a purposeful sample of 100 participants drawn from the national PathTech LIFE survey. The primary focus of PathTech LISTEN is to initiate a research-based tracking mechanism of students and workers in advanced technology fields. This focus is facilitated through the following objectives: (1) factors that motivated students to pursue technician education, (2) how students faced academic and personal challenges while enrolled, and (3) post-enrollment educational and employment outcomes. This study draws from a diverse cohort of students from all demographic backgrounds and life experiences.

This study addresses a documented knowledge gap about pre-college and post-college career and educational pathways of advanced technology students. There are no systematic and/or comprehensive longitudinal data collection efforts dedicated to two-year college AS/AAS STEM programs comparable to the Baccalaureate and Beyond Longitudinal Study (B&B:93) or other similar investigations of four-year university students and their post-graduate outcomes. The PathTech team seeks to fill this niche by building on their prior work to construct a survey instrument, based on data gathered from in-depth interviews, to gather longitudinal data on technician educational and occupational pathways. This study will broaden our understanding of student pathways to account for the complex lives of the emerging technician workforce.

*** What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

Major Activities: During Year 1, the PathTech LISTEN team undertook several major activities.

First, we successfully completed the institutional review board process (IRB) at the University of South Florida to conduct longitudinal interviews and construct a pilot survey based on the interview data.

Second, we developed a sampling strategy that would allow us to include a diverse group in the LISTEN study. We drew respondents from the PathTech LIFE survey who had volunteered to participate in future research. From that group of 2,363 (out of 3,216), we sampled from students who had indicated they were completing their degree/certification/licensing program that semester or completed the first round of LIFE survey data collection in Spring 2017, over two years ago. This purposeful sampling allowed us to gather rich information about both pathways into and out of technician programs and focus on the transition to the workforce as well. In addition, we over-sampled for groups underrepresented in technician education: women, racial and ethnic minorities, first-generation students, veterans, students with disabilities, LGBT students, and non-US citizens. We also over-sampled for students who had attended a four-year university before enrolling in their two-year college program, including students with bachelor's degrees. This sampling strategy produced a diverse group to interview for the LISTEN project.

Third, we hired two graduate students, and trained them on qualitative research methods as well as interview techniques in particular. We also conducted trainings related to the use of qualitative research software (NVivo). In so doing, we discovered a transcription add-on service with the software that creates a rough transcript of the interview utilizing voice-recognition. We anticipated this would aid the transcription process and expedite moving into the analysis phase.

Fourth, we conducted interviews throughout the summer, culminating in 94 in-depth interviews about former technician students' educational and occupational pathways.

Specific Objectives: The in-depth interviews covered a variety of topics including the respondent's post-high school pathway into higher education and career, their experience with their program, their work experience, the STEM education background, family background, and life experiences that created interest in the technician field.

Preliminary analysis has yielded several interesting themes:

In examining students' post high school pathways, we see diversity in experience both between traditional-aged and non-traditional aged students as well as within each group as well. For example, we interviewed some traditional-aged students who went straight into A.S. programs directly from high school, while others took technician classes at their community colleges as dual-enrollment students and then continued to four-year programs. Among non-traditional aged students, we interviewed people who worked in the field prior to enrolling in their programs as well as individuals seeking a change in careers, people who had STEM educational backgrounds and others who had none. For example, one interviewee had been working in the retail industry, and then completed a program in engineering technology and then went on to receive a bachelor's degree in engineering. While another interviewee had been a social worker,

took a few technician classes, and then returned to school for a master's degree in a STEM field. There were also students who had completed bachelor's degrees in STEM fields who were seeking applied credentials.

Overall, participants responded very favorably about their experience in their programs. In particular, students spoke very highly about their instructors, and appreciated the real-world experience many of them brought to the classroom. They also enjoyed project-based learning and actively learning by doing. Students discussed their appreciation that their programs had well-equipped labs with the latest technology. They felt this provided them with a seamless transition to the equipment they used at their workplaces. In addition, students across the board found their programs to be "100%" relevant to their jobs in the technician field. One area that several students struggled with was scheduling classes. As many of them were working while in school, not everyone could attend daytime classes. Sometimes they had to wait an extra semester, or even a year, to take a prerequisite class in order to complete required sequences. Students also felt that due to the small departments with only a few instructors, there were often a limited number of classes that could be offered each term, and that sometimes slowed down their progress towards completing their programs as well.

When LISTEN participants talked about their jobs, it was clear that they really loved working in the technician field and reported high levels of job satisfaction. When asked to describe their jobs, they often used phrases such as "trouble-shooting," "problem-solving," "active," and "everyday is new." Most people did not describe many challenges in the workplace, however some women respondents did describe some issues. When asked how they found their jobs, the overwhelming majority stated it was through Indeed.com and LinkedIn. A few also mentioned the importance of cultivating contacts through internships and work experience, and some had family members who also work in the field who helped them find positions.

We also investigated participants' educational background and found that outside of the dual enrollment students, most were limited in the math and science courses they took during high school. Students who participated in career and technical education in high school described a very positive experience and did find it to motivate their interest and commitment to joining the technician workforce. Students who had internships identified the opportunity as critical to finding and qualifying for good technician jobs. Several students also discussed the challenge of finding paid internships as unpaid internships were not feasible given their financial situations.

Lastly, when asked about life experiences that really triggered an interest in the technician field, LISTEN participants discussed experiences where they could "fix things," as well ones where they could satisfy their curiosity for "how things work", and ones where they could innovate and improve on an existing system or create something new. Many respondents fondly remembered activities such as building and design projects from high school, STEM Fair projects, and the "egg-drop" challenge.

Significant Results:

As of summer 2019, 92 interviews were conducted with alumni of engineering technology, advanced manufacturing, micro- and nanotechnology, and energy and environmental technology programs. Participants were recruited from the 3,216 students who completed PathTech LIFE survey. They include recent high school graduates, bachelor's degree recipients, and non-traditional age first time in college students. The majority did not have prior work experience in STEM. Most completed AS/AAS degrees, certificates and/or licenses. Some continued to bachelor's degree programs in STEM fields.

Overall, the findings indicate LISTEN participants successfully transitioned into the workforce and report their programs provided excellent preparation for their current jobs, regardless of their educational and occupational backgrounds.

Most of the 92 interviewees did not have a STEM job before enrolling. Among those 51, 11 got a job in their field during their program and a majority (29) got a job in their field after college. Among the 41 who had a STEM job before enrolling, 15 had a job in their field during college and almost all (34) got a job in their field after college. Of the 8 students who were unemployed after college, 6 were pursuing bachelor's degrees in a STEM field. These findings will be featured in the ATE IMPACTS 2020 report.

Key outcomes or Other achievements:

We administered a pilot industry survey to (15) industry professionals participating in the 2018 Hi-Tec Industry Forum. Industry Sectors represented were: Technology & Nanotechnology, Energy (2), Manufacturing (Precision Manft, Laser Manft, Advanced Manft), Machine Design, Education, Adv Materials, Aerospace / Engineering, Laser & Electro-Optics, Nuclear, Cross-Industry, Defense.

The participants indicated the need for the following technical skills in new hires: Read technical drawings (73%), Measurement (67%), Electricity / electronics (53%), Mechanical testing (53%), Work safely (47%), Wiring (40%), Read charts/graphs (40%), Coding (33%), Others: data science, tool & die, creativity & problem-solving, material management, "plumbing" – gas, liquid, vacuum, etc, laser techs.

The participants indicated the need for the following "soft" skills in new hires: Teamwork / Collaboration (100%), Personal Responsibility & Work Ethic (93%), Problem-Solving (87%), Verbal Communication (87%), Ethics (80%), Time Management (80%), Written Communication (73%), Social Skills (73%), Planning & Organizing (73%), Other: Documentation, Leadership, Innovation.

Participants encouraged the following educational paths for their employees: Take courses at the community college (93%), Earn certificates (60%), Earn AA/AS degrees (47%), Comments: expect employees to already have AS degrees.

Of the group surveyed, 73% of participants hired from two-year technical programs, and 27% said they did not. They said they mainly hired from these programs: data science, analytics, cyber, MTT, CNC, mechatronics (2), MTMS, EE, CS, laser tech, machine tech, drafting, mechanical, electrical, nuclear engineering tech, senior technician. They also said they hire from these Disciplines: engineering, IT, applied math, computer science, maintenance, tool & die, engineering tech (2), chemistry, material tech, technicians.

Participants hired new employees using the following channels: Internships / Co-ops (82%), Faculty referrals (55%), On-campus job fair (45%), On-campus interviewing (45%), Social media (i.e. LinkedIn) (45%), Alumni networks (45%), Campus job boards (27%), Other: Headhunter, partner with colleges. One participant commented, "Don't know where to recruit from at colleges," and another participant said, "don't hire from two-year programs – need senior folks."

The final question of the survey was, "In the past year, have you hired a student from a two-year technical program?" 53% responded YES and 47% responded NO.

Based on this pilot survey, the results, and gaining stakeholder feedback at the HITEC conference, we have revised the industry survey, and are actively looking for venues to distribute the survey during Year 2 of the project.

*** What opportunities for training and professional development has the project provided?**

During Spring 2019, Drs. Tyson and Jayaram co-taught a graduate research practicum, "Issues in Higher Education Practicum: Mixed Methods Research and Grantsmanship." The course involved four objectives: 1) introduce mixed-methods research designs, 2) review substantive issues in higher education, 3) learn to write a grant proposal, and 4) gain hands-on experience analyzing quantitative and qualitative data from PathTech LIFE and PathTech Tampa Bay (DUE #1104214).

In this course, we focused on how to integrate qualitative and quantitative methods into a cohesive research design. This course was particularly useful for students with training in qualitative and/or quantitative methods who want to develop a working appreciation for other sets of methods and learn how to collaborate with scholars of diverse methodological backgrounds.

Through this course, students: (1) learned research methods used to examine current debates in higher education, (2) developed unique research agendas to address these issues and learn the process of gaining external funding for this research, and (3) engaged in a practicum experience working on PathTech LIFE and PathTech LISTEN. Students developed their own mixed-methods project using project data that ranged from examining the experiences of students with disabilities, parent-students, and women technicians, the impact of taking career and technical education classes, the role of advising, the knowledge and utilization of campus resources, as well as the experiences of first-generation students.

The graduate students were trained in interview techniques through meetings and practice interviews. Both GAs observed Dr. Jayaram conducting an interview and Dr. Jayaram observed the GAs conducting interviews before they conducted interviews on their own. Pending supplemental funding (explained below), the GAs will undergo qualitative methods training in January 2021 and start analyses of interview transcripts.

* How have the results been disseminated to communities of interest?

We introduced LISTEN to our local stakeholders at the Fall 2018 FLATE ET Forum and to the national ATE community through a presentation and showcase at the 2018 ATE PI Meeting. We also presented at the 2018 and 2019 High Impact Technology Exchange Conference (Hi-TEC). Early findings will be featured in the October 7, 2019 ATE IMPACTS blog and forthcoming ATE IMPACTS 2020 report. LISTEN is also featured on the PathTech ATE Central Microsite at <https://ate.is/pathtech>.

The following files supporting these presentations are attached under Products below:

Pilot Industry Survey for Hi-TEC July 2018 & Industry Forum Pilot Results - In anticipation of receiving LISTEN funding, we pilot tested an industry survey at the 2018 Hi-TEC by distributing it at an Industry Forum hosted by Dr. Barger. We quickly analyzed the findings and presented them during our session.

Applied Research 101: PathTech LIFE and LISTEN Research in Action - This is the PowerPoint from our session at the 2019 in which we did a tutorial on applied research, presented findings from LIFE, and introduced LISTEN.

* What do you plan to do during the next reporting period to accomplish the goals?

We have several goals for Year 2 of PathTech LISTEN:

First, we will round out Year 1 data collection, and analyze interview data utilizing qualitative research software.

Second, we will continue with our efforts to collect data from industry personnel about hiring practices and workforce development.

Third, we will also begin compiling a best practices document for colleges about ways to track student transition from school to work.

Fourth, we will host an advisory board meeting to gain feedback on the first round of data and plan for Round 2 during the summer 2020.

Fifth, we will conduct Year 2 data collection and analyze interview data.

Sixth, we will submit manuscripts to peer-reviewed journals based on analyses of Year 1 interviews.

Supporting Files

| Filename | Description | Uploaded By | Uploaded On |
|------------------------------|---|---------------|-------------|
| Detailed Interview Guide.pdf | Detailed Interview Guide - Guide used for all Year 1 Interviews | William Tyson | 09/30/2019 |

| Filename | Description | Uploaded By | Uploaded On |
|---|--|---------------|-------------|
| Industry Survey - May 28 2019.pdf | Industry Survey - Current version of industry survey | William Tyson | 09/30/2019 |
| PathTech LISTEN Evaluation Report, September 2019.pdf | PathTech LISTEN Evaluation Report | William Tyson | 09/30/2019 |

Products

Books

Book Chapters

Inventions

Journals or Juried Conference Papers

View all journal publications currently available in the [NSF Public Access Repository](#) for this award.

The results in the NSF Public Access Repository will include a comprehensive listing of all journal publications recorded to date that are associated with this award.

Licenses

Other Conference Presentations / Papers

Will Tyson and Lakshmi Jayaram (2018). *Applied Research 101: PathTech LIFE and LISTEN Research in Action*. ATE PI Conference. Washington, DC. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Will Tyson and Lakshmi Jayaram (2019). *PathTech LIFE and LISTEN: Annual Report of Research on Technician Education Students*. High Impact Technology Exchange Conference. St. Louis, MO. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Will Tyson and Lakshmi Jayaram (2018). *PathTech LIFE: Findings from a National Survey of Advanced Technology Students*. High Impact Technology Exchange Conference. Miami, FL. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Other Products

Other Publications

Patents

Technologies or Techniques

Thesis/Dissertations

Websites

Supporting Files

| Filename | Description | Uploaded By | Uploaded On |
|---|---|---------------|-------------|
| Pilot Industry Survey for Hi-TEC - July 2018 (7-21).pdf | Pilot Industry Survey distributed at the 2018 Hi-TEC Industry Forum organized by Dr. Barger | William Tyson | 09/30/2019 |

| Filename | Description | Uploaded By | Uploaded On |
|---------------------------------------|---|---------------|-------------|
| Industry Forum Pilot Results.pdf | Results of Pilot Industry Survey quickly tabulated and presented at the 2018 Hi-TEC PathTech presentation | William Tyson | 09/30/2019 |
| ATE PI 2018 - PathTech LIFE Final.pdf | Applied Research 101: PathTech LIFE and LISTEN Research in Action presentation at the 2018 ATE PI Meeting | William Tyson | 09/30/2019 |

Participants/Organizations

What individuals have worked on the project?

| Name | Most Senior Project Role | Nearest Person Month Worked |
|----------------------|---------------------------------------|-----------------------------|
| Tyson, William | PD/PI | 6 |
| Barger, Marilyn | Co PD/PI | 1 |
| Jayaram, Lakshmi | Co PD/PI | 12 |
| Jenkins, Sarah | Graduate Student (research assistant) | 3 |
| Oliveira, Kristopher | Graduate Student (research assistant) | 3 |

Full details of individuals who have worked on the project:

William T Tyson

Email: wtyson@usf.edu

Most Senior Project Role: PD/PI

Nearest Person Month Worked: 6

Contribution to the Project: Dr. Tyson leads all research effort in this project including leading the USF based research team. Dr. Tyson selected the recruiting sample and sent recruiting emails to prospective interviewees. He assigned interviewers to everyone who agreed to be interviewed for the project.

Funding Support: N/A

International Collaboration: No

International Travel: No

Marilyn Barger

Email: mbarger@hccfl.edu

Most Senior Project Role: Co PD/PI

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Barger represents FLATE in their partnership with USF. She has distributed an industry survey to industry representatives at conferences.

Funding Support: N/A

International Collaboration: No

International Travel: No

Lakshmi Jayaram**Email:** ljayaram@usf.edu**Most Senior Project Role:** Co PD/PI**Nearest Person Month Worked:** 12

Contribution to the Project: Dr. Jayaram co-led the project with Dr. Tyson. Dr. Jayaram lead the interviewing team and conducted interviews. Dr. Jayaram also prepared the industry survey that has been distributed to Dr. Barger.

Funding Support: N/A**International Collaboration:** No**International Travel:** No

Sarah Elizabeth Jenkins**Email:** sarahbasile@mail.usf.edu**Most Senior Project Role:** Graduate Student (research assistant)**Nearest Person Month Worked:** 3

Contribution to the Project: Sarah conducted interviews of former community college students.

Funding Support: N/A**International Collaboration:** No**International Travel:** No

Kristopher Oliveira**Email:** koliveira@mail.usf.edu**Most Senior Project Role:** Graduate Student (research assistant)**Nearest Person Month Worked:** 3

Contribution to the Project: Kristopher conducted interviews of former community college students.

Funding Support: N/A**International Collaboration:** No**International Travel:** No

What other organizations have been involved as partners?

Nothing to report.

What other collaborators or contacts have been involved?

Ben Reid from Impact Allies is the external evaluator.

Impacts

What is the impact on the development of the principal discipline(s) of the project?

LISTEN adds to our knowledge of post-enrollment pathways of technician education students. This work has a direct impact on sociology of education, the principal discipline and content area of interest for the research team. Sociology of education with respect to STEM higher education generally examines traditional STEM pathways of traditional age students pursuing STEM bachelor's degrees at four-year universities. This study adds to our knowledge of student college experiences in two-year college technician education programs, particularly among underrepresented groups including nontraditional age students. This study also examines the short-term impact of enrollment in these programs, particularly as it pertains to

transitions into the workforce and/or four-year STEM bachelor's degree programs. This research reflects of breadth of options available to these while they're enrolled and after they leave. This is a unique contribution to our field.

What is the impact on other disciplines?

This study specific informs the advanced technology fields of the individuals in this study: advanced technologies, engineering technologies, micro and nano technologies, and energy and environmental technology. This study reveals more information about the diverse backgrounds and pathway of their studies to help them better understand their motivations to enroll in these programs, the life circumstances they faced while enrolled, what benefits they received in these programs, the challenges they faced, and how they are using the knowledge they gained after their enrollment.

What is the impact on the development of human resources?

We have presented our findings to community college faculty and administrators at the Engineering Technology Forums sponsored by the Florida Advanced Technological Education (FLATE) Center at Hillsborough Community College and Hi-TEC. Early findings will also be published in ATE IMPACTS 2020 and the ATE IMPACTS blog, both of which also have a community college audience who can use project fundings to better the lives of their students, including improving retention and persistence. This information can also help college programs better prepare students to meet their post-enrollment educational and employment goals. Colleges can also use this information to improve their career preparation and alumni tracking efforts.

What is the impact on physical resources that form infrastructure?

Nothing to report.

What is the impact on institutional resources that form infrastructure?

Nothing to report.

What is the impact on information resources that form infrastructure?

Nothing to report.

What is the impact on technology transfer?

Nothing to report.

What is the impact on society beyond science and technology?

Colleges can use the results of this study to improve opportunities for people from various backgrounds and create pathways for these students into STEM fields.

Changes/Problems

Changes in approach and reason for change

The primary change we made was that we interviewed 95 people instead of the proposed 150. We made this change for several reasons. First, qualitative methods typically dictate that interviewing should continue until responses reach the point of saturation, meaning new interview data yield repeating themes. In this case, we felt like after 95 interviews, we had been learning the same information. Second, the process of recruiting participants and scheduling interviews was more tedious than expected. We started recruitment on May 21 and our biggest recruitment periods began on June 5 and June 24. Overall, we had a high YES response rates to recruitment emails and interviewed a high percentage of people who said YES; however, it typically took 1-3 weeks of correspondence between interviewer and potential interviewees to actually schedule and complete the interview. It was difficult to know when participants would actually be available. Some did not actually schedule a time and just called our project phone number. Third, we only had funding for graduate assistants through the summer ending at the first week of August. So we were down to one interviewer (Dr. Jayaram) after we reached 92 interviews.

The length of time and effort it took to schedule interviews made it difficult to complete remaining research tasks, so instead of completing interviews, transcription, and analysis all at once, we completed the interviews over the summer and used the NVIVO transcription service to complete about 80-90% of transcription.

Actual or Anticipated problems or delays and actions or plans to resolve them

We plan to apply for supplemental funding to get funding for a transcriptionist to complete transcriptions of the first round of interviews in Spring 2020 and over the summer and fall. This will help us complete analyses in a timely fashion.

It took longer than expected to complete the first two tasks, primarily because scheduling and conducting interviews often required one to three weeks of sending emails back and forth with potential participants. We used the automated NVIVO transcription service which transcribes with about 80-90% accuracy, not enough conduct analyses. We anticipate having similar challenges during Summer 2020, so we are seeking funding to hire our two GA for the Spring 2020 semester and 2020-21 academic year and by hiring clerical staff to help with transcription and reporting tasks.

Our two GAs, Sarah Basile and Kris Oliveira, are entering their 3rd year as PhD students in Sociology at USF. Hiring them for the Spring 20 and 2020-21 academic year would keep them on the project from January 2020 through August 2021, almost the end of the project (September 30, 2021). This would give them more time to conduct interviews and it would allow them to actively participate in data analysis and writing manuscripts. Part-time clerical staff can complete transcription and help with reporting tasks such as data visualization and preparing presentations and reports.

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.

Significant changes in use or care of biohazards

Nothing to report.

Special Requirements

Responses to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements.