



## **ASSESSING INFORMATION TECHNOLOGY EDUCATIONAL PATHWAYS THAT PROMOTE DEPLOYMENT AND USE OF RURAL BROADBAND**

**2<sup>nd</sup> Annual Report**

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## **INTRODUCTION**

This report describes the activities, findings and deliverables generated during Year 2 of the National Science Foundation Advanced Technological Education (NSF ATE) four-year study. The study collaborators include Tallahassee Community College (TCC) and Chipola College along with the Florida State University Information Institute, all located in northwest Florida.

## **PROJECT GOALS**

The goals of this four-year project are to:

1. Understand the alignment of IT staffing with the needs of employers and employees working in IT positions;
2. Strengthen the employee pool of IT/broadband staffing (including general IT, broadband and network technicians);
3. Improve educational support related to broadband, telecommunications, and networks for future and current IT employees in non-metro Northwest Florida; and
4. Understand how to transfer this competency to other similar non-metro markets.

These goals are in the process of being accomplished by a collaboration between university researchers and community college program administrators.

## **RESEARCH QUESTIONS & SPECIFIC OBJECTIVES**

The specific research questions addressed by this phase of the study include:

RQ 1 How do the IT/broadband skills graduates gain through two-year community college programs compare to the needs expressed by employers in nonmetro/metropolitan areas?

RQ 4 What, if any, differences are there between the skills needed for IT/broadband employees in nonmetro and metropolitan areas?

The specific objectives for this project are:

1. Understand private sector and Community Anchor Institutions' (CAI; e.g., public libraries, schools, community centers) IT/broadband staffing needs to facilitate recruitment and placement activities available through Chipola, and TCC;
2. Identify skill sets IT employees need on the job as reported by new professionals and identify any gaps between these skill sets and the staffing needs reported by employers;
3. Determine if there are differences in the needed IT/broadband employee skill sets between metropolitan and nonmetro areas of Northwest Florida to understand what specific skill sets are needed for employees in nonmetro areas;

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4. Recommend changes to existing IT/broadband curricula at the Chipola and TCC IT/broadband programs to best meet the IT staffing needs of employers in nonmetro Northwest Florida and as a guide for other nonmetro areas; and
5. Build on existing industry-education relationships and create a process to provide ongoing feedback for future curriculum considerations.

### MAJOR ACTIVITIES

#### Phase I

Curriculum Analysis and job posting analyses were preliminarily reported in the 2013 NSF Annual Report but a summary is provided here. The report, *Preliminary Report of Job Posting and Curriculum Analyses*, featured the preliminary data for the curricula analyses. It was presented to the Advisory Committee and the entire research team on June 9, 2014 and is attached here in Appendix A as the *NSF ATE First Interim Report*.

The research team cleaned and organized the data collected from 225 job postings. We analyzed the job postings using the Florida Department of Education (FL DOE) Career and Technical Education IT frameworks, and then again using the Office of Personnel Management (OPM) IT Competencies framework. We opted for a second look using the latter framework to determine if there is a different outcome using a labor-generated standard (such as that from OPM). The purpose of analyzing the job description texts from the job posting ads was to examine the core IT job competencies desired by employers.

The research team conducted an automatic coding process using text mining to identify the alignment of curriculum learning outcomes and IT job competencies. The coding results will show how the expected curriculum learning outcomes taken from two FL DOE frameworks, Networking Services Technology (NST), CIP Number 1511090103 and Computer Information Technology (CIT), CIP Number 1511010305, overlap with the IT job competencies and requirements from the job description texts. Table 1 shows that 6 out of 7 search terms (N=221) are covered by 2 FL DOE curriculum frameworks (the term ‘broadband technician,’ which was drawn from 4 jobs, was added and is not covered by FL DOE curriculum frameworks).

Table 1. Number of Jobs Corresponding to Search Terms and FL DOE Frameworks

Search Terms	Number of Jobs	DOE Frameworks
Broadband Technician	4	N/A
Help Desk Technician	23	CIT, NST
PC Support Technician	87	CIT, NST
Network Technician	44	NST
Computer Repair Technician	37	CIT
Network Systems Technician	16	NST
WAN/LAN Technician	14	NST
Sum	225	2

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The number of unique job posting ads is 225. The descriptive statistics are from the 225 IT jobs obtained using 7 search terms (i.e., 7 different job categories), 13 locations, and 15 online and offline sources. Of the 225 jobs, 84.9% resulted from 4 search term categories: PC Support Technician (N=87, 38.7%), Network Technician (N=44, 19.6%), Computer Repair Technician (N=37, 16.4%), and Help Desk Technician (N=23, 10.2%). These 4 dominant search term categories are presented as blue-shaded sections in Table 2. Jobs for Network Systems Technician (N=16, 7.1%) and WAN/LAN Technician (N=14, 6.2%) represent 13.3% of the total. Broadband Technicians are wanted for only 4 jobs (1.8%). Table 2 shows the number of jobs by locations—metropolitan (metro), non-metropolitan (non-metro), and other—and job search terms. Other refers to jobs with the unknown locations or multiple locations such as work at home.

Table 2. IT Jobs by Location and Job Search Terms

	Metro	Non-Metro	Other	Total
Broadband Technician	4 (1.8%)	0	0	4 (1.8%)
Computer Repair Technician	33 (14.7%)	3 (1.3%)	1 (0.4%)	37 (16.4%)
Help Desk Technician	19 (8.4%)	2 (0.9%)	2 (0.9%)	23 (10.2%)
Network Systems Technician	12 (5.3%)	4 (1.8%)	0	16 (7.1%)
Network Technician	40 (17.8%)	2 (0.9%)	2 (0.9%)	44 (19.6%)
PC Support Technician	82 (36.4%)	0	5 (2.2%)	87 (38.7%)
WAN/LAN Technician	10 (4.4%)	2 (0.9%)	2 (0.9%)	14 (6.2%)
<b>Total</b>	<b>200 (88.9%)</b>	<b>13 (5.8%)</b>	<b>12 (5.3%)</b>	<b>225 (100.0 %)</b>

For this analysis, the research team used the Computers in Technology (CIT) and Networking Services Technology (NST) curriculum frameworks to create a keyword library and used the library as a codebook for retrieving the relevant job description texts from 225 job posting ads, assigning the most appropriate matching codes to each job posting ad.

The FL-DOE curriculum frameworks consist of standards at both macro and micro levels, and the keyword library was built from the comprehensive set of keywords collected from both level standards. Brief results of the comparison between curricula and the job postings are provided below.

## Phase II

### *IT Student and IT Educator Focus Groups*

Descriptive data were collected from current students enrolled in undergraduate IT programs as well as newly hired IT professionals with three years or less post-graduate experience. Dr. Froh and Dean Stewart organized groups of current students for focus group interviews in April 2014. The research team drafted questions to guide the focus group discussions and related topics were allowed to be brought into the conversation. One focus group included five metropolitan community college IT students and the other group included seven non-metro community college IT students.

Members of the research team conducted two focus group interviews with members of the IT faculty at Chipola College and TCC. Three full-time faculty members participated from each institution. The research team drafted questions to guide the focus group discussions and related topics were allowed to be brought into the conversation. The same focus group prompts were used at both Chipola and TCC. The focus groups and interviews were recorded and analyzed by multiple researchers for emergent themes and for comparison between and among groups.

### *Employer Interviews*

Employer interviews were held in two phases, as the principal investigators were able to provide contacts and access. Phase 1, conducted in August-September, 2014, included eight interviews of a variety of employers that included healthcare providers, engineering consultants, several IT/software consultants, a marketing firm, an IT employment agency and a broadband wholesale and retail sales company. An online pre-interview survey was used to collect interviewee/business basic profile and descriptive statistics.

Phase 2 included 10 interviews that were completed in November and December 2014. The participants were drawn from eleven employers who were surveyed at a campus IT career fair and who agreed to participate in follow-up telephone interviews. The Phase 2 participants included two banking executives, four government agency technology directors, two IT consultants (software, cloud computing), one from a university IT support desk, and one representative of a major network operations/management company. The phase 2 pre-interview data (basic profile and descriptive statistics) were collected via a face-to-face survey at the job fair. This protocol change was submitted to the FSU Human Subjects Committee prior to use.

The Phase 1 interviews were analyzed using the Office of Personnel Management IT management competencies standard (see <http://www.opm.gov/policy-data-oversight/assessment-and-selection/competencies/>) to test a labor-oriented IT knowledge, skills and abilities framework. This framework was also used to re-analyze the job posting data collected in the first six months of Year 1 for comparison to the initial employer interviews. This exercise provided a useful breakdown of skill categories and classifications as part of the study team's process of identifying IT skills frameworks that can be used to examine the alignment between curriculum driven learning outcomes objectives and employer expectations. This effort also resulted in the acceptance of a conference poster (see <http://ssrn.com/abstract=2418547>) and paper (see <http://ssrn.com/abstract=2485678> or <http://dx.doi.org/10.2139/ssrn.2485678>) presentation at the 2014 Telecommunications Policy Research Conference in Washington, D.C.

Data collection and transcription of the Phase 2 interviews is complete and the total of 18 interview transcripts will be analyzed using a combined framework of the 2013-14 FL DOE IT Curriculum Frameworks and emergent codes from the Year 1 job posting analysis. In initial coding using this combined framework, emerging codes from the employer interviews will be included. The anticipated completion of this analysis is March 30, 2015.

*New Professional Interviews*

Eleven new professionals were recruited through the efforts of the principal investigators for this first phase of the new professional data gathering. The interview participants included five men and six women with a variety of educational experiences. Seven of the participants possess a 4-year Bachelor's degree, three a combined AA/Bachelor's degree, and one with AA and AS degrees. Only two of the new professionals held a professional certification upon hire and eight had participated in some type of experiential learning, including internships, apprenticeships, and other experiences. These new IT professionals work in a variety of capacities that include IT technician (n=4); IT director (n=1); project manager (n=2); and consultant, sales, and engineer (n=1, each). They are employed by companies that include technology-specific organizations (n=4), healthcare organizations (n=3), business/corporate organizations (n=2), and government agencies (n=2).

The questions used for the current IT student focus groups were used as the guide for interviewing the new IT professionals. The interviews were semi-structured, so related topics were allowed to be brought into the conversation. The intent of future data collection with new IT professionals is to track TCC and Chipola graduates (see student profile management, next section), beginning with the graduates from December 2014 through December, 2016, and to obtain interviews after they are able to find employment; if no employment is obtained, these graduates may yet be interviewed with a modified interview instrument.

*Student Profile Management*

The research team created an instrument to collect data on IT students' profiles, characteristics, and decisions in pursuing a 2- or 4-year IT degree or certificate at TCC and Chipola. For a preliminary analysis, the research team used the Qualtrics software to compile and aggregate a database of student information. The schools were asked to assign an identifier to each record so they could track student information to provide a longitudinal view of academic student pathways. The schools performed the data entry into the survey software, creating a database for each school, thus precluding any need for unauthorized access to protected student data. There was some unclear data from the information gathered from both schools. The research team is working to clarify the tracking instrument for the rest of the project duration. This is an important challenge for the schools, as the resources and infrastructure to readily collect this data in a way that is meaningful for this study is a challenge.

**Phase III**

*Classroom Observations*

After reviewing classroom observation literature, the research team chose to use Smith et al.'s (2009) *Classroom Observation Protocol for Undergraduate STEM* as the observation

instrument; it is non-participatory and describes classroom activities from the student and instructor behaviors without judging teaching quality. Members of the research team met with the Co-PIs from Chipola and TCC to train with the instrument by watching a sample classroom recording and coding the activities. With feedback from the team and the Co-PIs, changes were made to the coding instrument to make it easier and more relevant for the project's needs. The instrument was altered again with feedback from evaluator McMartin to include important general and technical competencies as identified from the Office of Personnel Management IT job competencies and from the job posting analysis top ten emergent codes. The revised instrument was submitted to the FSU Human Subjects Committee for approval.

Part of the classroom observation protocol involves a debriefing interview with the instructor by the Co-PIs after the observed class session. The team developed interview questions, received feedback from the Co-PIs, and submitted the interview questions to the Human Subjects Committee for approval.

Classroom observations will be completed in February 2015. The observations and post-observation interviews will help the team identify the nature of IT teaching practices and learning outcomes, especially in comparison to the FLDOE IT framework. Dean Stewart of TCC and Dr. Jim Froh of Chipola will conduct the classroom observations and faculty interviews at each other's school, to improve impartiality of the observation and remove bias or undue pressure during the instructor interview.

## **SIGNIFICANT RESULTS**

This section reports results for the research questions addressed in this phase of the study.

### **Research Question 1**

Research question 1 asked, "How do the IT/broadband skills graduates gain through two-year community college programs compare to the needs expressed by employer through job postings, in nonmetro/metropolitan areas?"

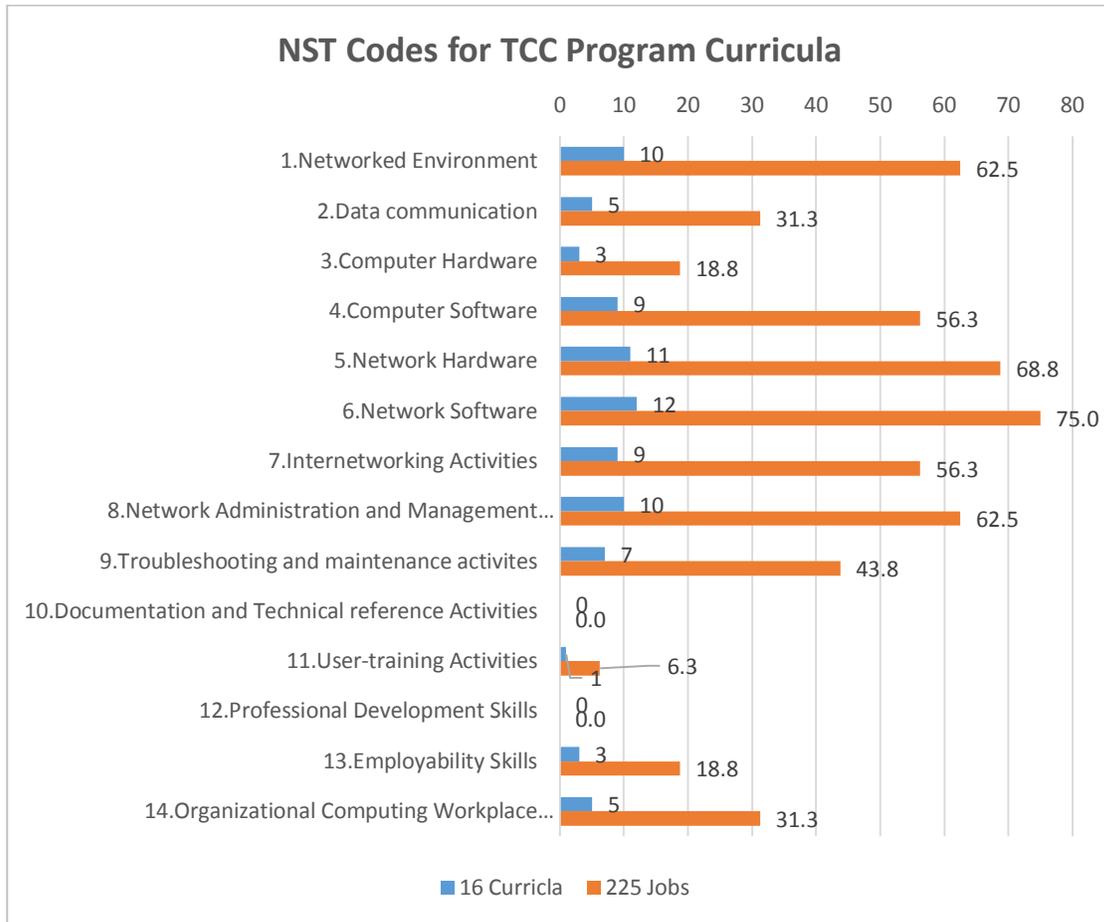
#### *IT Curriculum and Job Posting Analysis*

The research team analyzed and triangulated the results of the initial IT curriculum and job posting data; this resulted in the First Interim Report (Appendix A), presented to the Advisory Committee and external Evaluator Flora McMartin on June 9, 2014 as the NSF ATE Recap.

The comparison of the Networking Services Technology (NST) codes (N=16) for the TCC program and the IT job posting results (N=225) reveals alignment between job postings (both variables exceed 30%) in five areas: Networked Environment, Computer Software, Network Hardware, Troubleshooting and Maintenance Activities, and Organizational Computing

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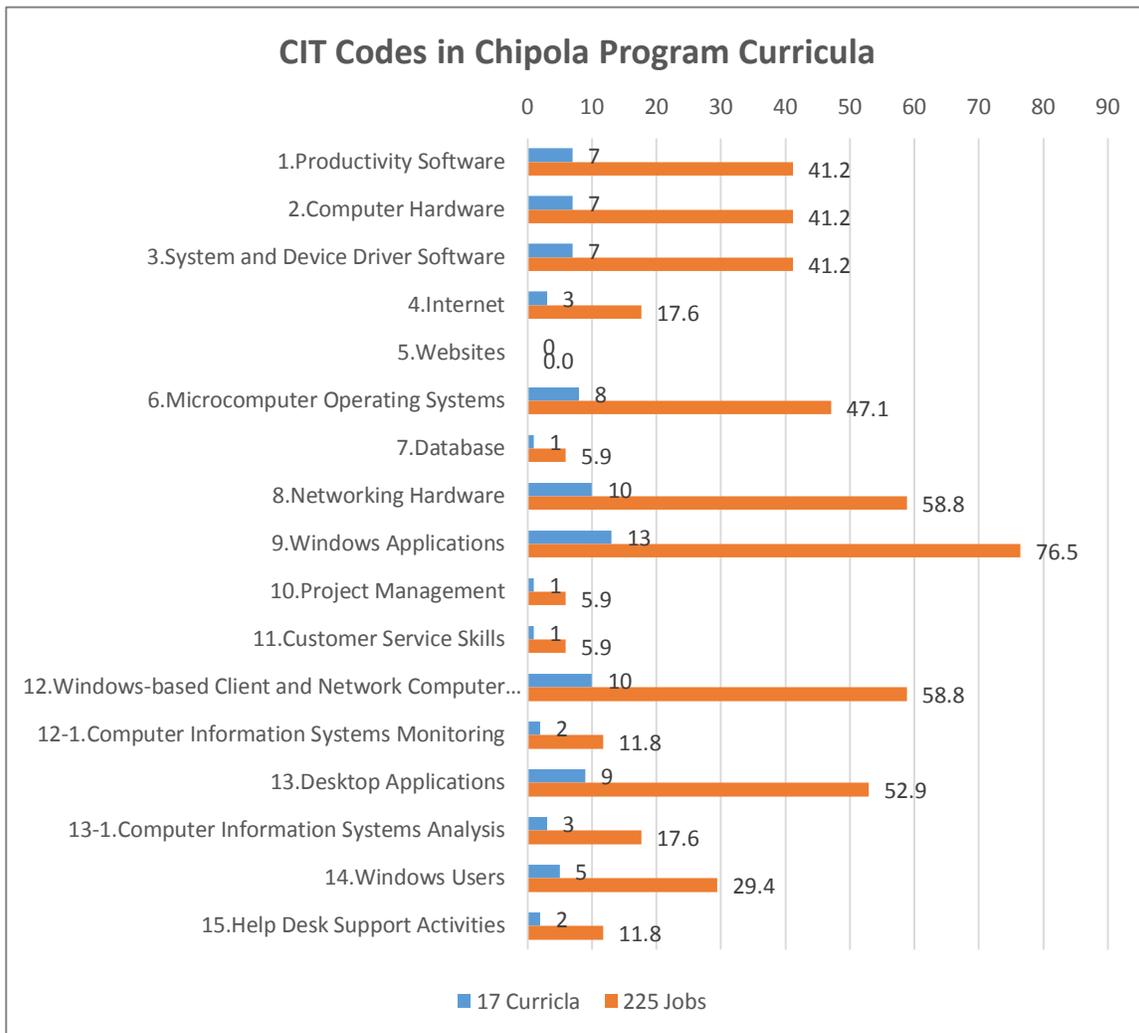
Workplace Competencies,. The TCC NST curriculum particularly stresses the learning outcomes that support Network Software, Network Hardware, Networked Environment, Network Administration and Management Computer Software, and Internetworking activities. Less emphasis is placed on Troubleshooting and Maintenance Activities, Data Communication, Organizational Computing Workplace, Employability Skills, Computer Hardware, and User-training Activities. The areas of Documentation and Technical Reference, Professional Development Skills, and Employability Skills show the biggest gap between the FL DOE standards and the syllabi, as the TCC syllabi do not include any learning outcomes for Documentation and Technical Reference Activities and Professional Development Skills and no job posting ads required Employability Skills. Figure 1. illustrates the alignment between the TCC NST curriculum and the learning outcomes derived from the job postings. The NST competencies analysis does reveal that Troubleshooting and Maintenance Activities (69.2%) occurred in more than two-thirds of the non-metro job postings obtained.



The comparison of the Computing Information Technology (CIT) codes (N=17) for the Chipola College program and the IT job postings (N=225) reveals alignment between job postings and four of the 17 CIT learning outcomes (both variables exceed 30%): Networking Hardware,

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System and Device Driver Software, Computer Hardware, and Computer Information Systems Monitoring. Areas that job postings emphasize but the curriculum minimizes include Websites, Database, Project Management, Help Desk Support Activities, and Customer Service Skills. Learning outcomes on which the curriculum heavily focuses but that are less prevalent in the IT job postings include Windows Applications, Windows Users, Desktop Applications, Microcomputer Operating Systems, and Windows-based Client, Network Computer System, Productivity Software, Internet, and Computer Information Systems Analysis. The area with the biggest gap between the two objectives was Websites (5)—the Chipola syllabi do not include any learning outcomes for this area.



A key factor examined in this study was the differences reported between the needs of metro employers versus those of non-metro employers as evidenced in the IT job postings. The CIT

and the NST competencies identified as desired in the metro IT job postings reveal a variety of differences with those in the non-metro IT job postings but with such a small sample of non-metro job postings, the comparison is not reliable. This step is repeated in Year 3 of the four-year study and the research team will attempt to gather a larger sample of job postings in order to examine the non-metro phenomenon with greater validity.

Key preliminary findings that can be drawn include:

1. Strong alignment with job ads can be seen in five areas of the TCC/NST curricula—Networked Environment (1), Computer Software (4), Network Hardware (5), Troubleshooting and Maintenance Activities (9), and Organizational Computing Workplace Competencies (14)—and in four areas of the Chipola/CIT curricula—Computer Hardware (2), System and Device Driver Software (3), Networking Hardware (8), and Windows Applications (9).
2. Strong misalignment with job ads can be seen in three areas of the TCC/NST curricula—Documentation, Technical Reference Activities (10), Professional Development Skills (12), and Employability Skills (13)—and in the area of Websites (5) in the Chipola/CIT curricula.
3. Four areas are more emphasized in the TCC/NST curricula than in the job ads—Data Communication (2), Network Software (6), Internetworking Activities (7), and Network Administration and Management (8)—and five areas are more emphasized in the Chipola/CIT curricula than in the job ads—Productivity Software (1), Micro-computing Operating Systems (6), Windows-based Client and Network Computer Systems (12), Desktop Applications (13), and Windows Users (14).
4. One area is more emphasized in the job ads than in the in the TCC/NST curricula—Computer Hardware (3)—and five areas are more emphasized in the job ads than in the Chipola/CIT curricula than—Websites (5), Database (7), Project Management (10), Customer Service Skills (11), and Help Desk Support Activities (15).

#### **Research Question 4**

Research question 4 asked, “What differences, if any, are there between the skills needed for IT/broadband employees in non-metro and metropolitan areas?”

This question is not completely answered at this time, as there is no data from non-metro new professionals. However, a discussion of the activities and findings of the skills for metro employees follows.

*Faculty and Current Student Focus Groups*

The research team completed focus group (faculty, student) findings; these data provided information used to create the employer and new professional interviews and were used to triangulate results for a report that focused on the non-metro site (Chipola College).

An initial analysis of the focus group data provided an opportunity to frame the findings using a labor policy perspective to more fully understand the challenges that face two- and four-year institutions in Florida. Thus, the team used a labor-oriented coding scheme to understand how the views of faculty and current students compared to IT competencies identified in the Competencies Model for IT Program Management provided for the U. S. Office of Personnel Management (see <http://www.chcoc.gov/transmittals/TransmittalDetails.aspx?TransmittalID=4058>). Considering that the focus of this study is on entry level IT jobs, higher-level competencies desired by senior positions were eliminated. The codebook consists of 25 general competencies, 1 physical competency, and 33 technical competencies.

This analysis presents current students' perceptions of IT job competencies that they will need to be employed in the IT field, followed by the new professionals' perceptions of the job competencies they actually need to be successful based on an assessment of their current career experiences. We derived these competencies from the conversations using descriptive coding "which summarizes the primary topic of the excerpt[s]" (Saldana, 2009, p. 3) taken from recordings of the discussions and interviews, and are based on the definitions provided by the OPM competency model (2011). The competencies are organized by the categories of technical and general; no physical competencies were reported in either the focus groups or the interviews.

Based on the 'topic of the excerpts', the key salient codes that emerged answered the research questions, along with a narrative description of how this manifests as described by the student or new professional. Thus, we coded the instances of the competency with the general and technical competency codes; we then assessed these for relative frequency and intensity.

Current students perceive self-management and learning as core competencies, along with accountability, flexibility, oral communication, and teamwork/collaboration, which are shared by job competency results in common with new professionals. However, the employers' strong emphases on writing, customer service, interpersonal skills, reading comprehension, and problem solving are not identified from current students' perception. The top four technical competencies from job postings—operations support, technology awareness, infrastructure design, and configuration management—are valued similarly by current students. Further discussion of the analysis is available in Appendix A.

*New Professional Interviews*

The research team completed Phase 1 of the new professional interviews, which serves as a pilot and protocol validation for use in the new professional interviews in upcoming years. These findings will be complemented in future phases by additional new professional interviews that will be conducted with the cohorts from TCC and Chipola as they progress post-graduation. At this time, we are unable to make any statement about the metro/non-metro distinctions as we have no non-metro data.

Interview participants were primarily from the TCC and FSU IT programs and had graduated within the previous one to three years. Of the eight interviews completed for this phase of the study, four of the participants were male. All of the new professionals are working in the IT field but while several attended secondary and some post-secondary school in rural areas, none of them are currently working in a rural area. Half of the respondents were dual-enrolled in college technical programs while finishing secondary school, two matriculated from TCC to FSU, and all eight possess a four-year Bachelor's diploma. Only three of the professionals have certifications, and two of these individuals earned them due to an employer's request. Six of the eight professionals participated in internships as part of their undergraduate program although they were not required by program guidelines.

The top general competency identified is self-management, which includes the control of one's own behavior in an effort to set and achieve goals, multi-task, work without supervision, complete assignments on time, and essentially "demonstrate responsible behavior" (OPM, 2011, n.p.). All of the respondents indicated the need for this competency, half with great frequency. The respondents described being able to independently learn skills on the job from peers and mentors and to take advantage of on-the-job training sessions, as well as, being able to use basic Web searches to create productive research in order to self-develop and maintain technical skills currency. Overwhelmingly, respondents reported that they relied heavily on accessing online information in the form of community forums and tutorials to discover new knowledge and maintain the currency of their formal education.

Technology awareness is the most prevalent technical competency observed – it appeared in every respondent's interview with high or average frequency. Each participant described the need to acquire knowledge of unfamiliar applications or problems, confronting new or different hardware and software, and being required to understand all types of operating systems. One participant stated, "Employers want to know that I am versed in the product *they* use, which my coursework could not fully prepare me for." Other high frequency competencies are infrastructure design, and operations support, both of which are observed together, especially as respondents discussed the importance of understanding networks, database programs and their interactions with applications and programming.

*New professionals'* perceptions of core job competencies better align with the job competency analysis than do those of *current students*. They identified self-management, interpersonal skills,

and learning, along with oral communication, reading comprehension, writing, teamwork/collaboration, problem solving, and accountability as core competencies. They also mentioned creative thinking, customer service, and flexibility. New professionals' perceptions of core job competencies also match well with the top ten technical competencies (and more so than that of current students). The top three technical competencies— technology awareness, infrastructure design, and operational support—are also considered core competencies by both new professionals and employers.

A strong finding was that while current students focused on the value of certifications as a primary means of acquiring those technical competencies, many of the new professionals expressed that they felt that taking advantage of both curricular and extra-curricular activities in their IT programs had offered them the chance to increase skills, contacts, experience and therefore job opportunities and that certifications were less valuable for acquiring job skills.

Contrary to the outcomes of the new professionals' focus groups, the job posting competency analysis suggests that the need for self-management and learning skills is relatively low. The reason why learning is considered relatively less desired can be further studied from interviewing employers or hiring managers who create the job descriptions regarding competencies.

#### *Student Profile Tracking*

The research team created a student profile tracking mechanism that will provide basic student information by which willing participants can be interviewed once they gain (or are not able to gain) employment.

This phase of data collection examined 177 community college students' profiles, characteristics, and decisions on currently pursuing two- or four-year IT degrees or certifications at TCC and Chipola College. This information is aggregated, although some is missing from the TCC program. Each school input its own student data and the schools were asked to assign an identifier to each record so that they could track student information to provide a longitudinal view of academic student pathways. Most of the data requested could be gathered from the students' applications, as the codebook for the survey was modeled on this information gathering mechanism. However, some dimensions of the pathway relevant to this study relate to the geographic location of the student prior to entering the program or subsequent to program completion. Also, the survey requested household Internet capacity for each student. The detail below suggests that these, along with several other questions, were inadequately answered, thus we are not able to comprehensively answer some of the study research questions. The data collection preliminary results show multiple educational and career pathways and multiple situational factors that may influence or change student pathways. Those factors include students' educational backgrounds, attained IT skill sets, participation in distance learning, financial support, and geographic considerations. Collecting the data to answer these questions accurately may require a different approach.

The finding generated from this phase indicates the challenge of obtaining and maintaining student data, which requires intensive resources and includes obstacles posed by privacy constraints.

### *Employer Interviews*

The research team completed employer interviews in two phases, with complete analysis currently underway.

A sampling frame was developed for the first phase of the employer interviews because an appropriate frame was not available. The initial data for the sampling frame was provided by three Co-PIs of the NSF ATE study: Dean Kate Stewart of TCC, Dr. James Froh of Chipola, and Associate Dean Ebe Randeree of FSU. They submitted their respective employers' contact lists used for curriculum advisory, for student internships and employment, and to support the recruitment and hiring efforts of the region's local employers. In order to create a robust sampling frame and to ensure that sufficient metro and non-metro employers were included, the Co-PIs worked with the research team to identify additional employers from the results of the job posting data collection efforts conducted in Phase One of the employer interview process and from a list of employers who had emerged as important in other phases of the data collection (e.g., the administrator/faculty/student focus groups). The final sampling frame comprised 15 employers, from which 8 were recruited for interviews by the Co-PIs and the research team.

For the second phase of the employer interview process the research team recruited participants from employers attending a career fair on the Tallahassee FSU campus; these employers represent organizations from across North Florida and would be likely to recruit students from the neighboring schools. As indicated above, this resulted in a larger sample (n=18) of employer interviews and these are currently in the analysis process.

### **KEY OUTCOMES**

The Year 2 activities led to a number of key outcomes:

- The team was able to identify the alignment of IT learning outcomes from two IT programs provided by TCC and Chipola; these were compared with the learning outcomes desired by employers as expressed in the IT job postings.
- The team identified key challenges with using syllabi as indicators of learning outcomes, including disconnects among state standards, school resources, instructor implementation, and student understanding (see Appendix A).

- The team identified and implemented more effective data management and analysis procedures and tools, including the use of multiple text mining and natural language tools that increase the team's ability to process larger amounts of data to be collected in the future phases of the study.
- The team identified challenges involved in collecting sufficient student data to implement reliable student tracking programs. In addition, the student data that was collected, when compared to the job postings, did demonstrate the challenges program administrators and instructors face when attempting to provide experiential learning opportunities to students.
- The emphasis on certifications in both collaborator institutions reflects opportunities provided by the schools' participation in various grant funding (H1B and TAAACTE) programs. Each provides certification preparation courses and provides funding to students to sit for the exams (Chipola's is optional; TCC's is required). However, preliminary findings from the initial new professional interviews and the employer interviews suggest that while certifications are welcome, they are less important in entry-level positions than are general competencies such as communications, self-management and problem solving skills. In addition, current students indicate a great urgency to obtain as many certifications as possible before entering the job market, but again, new professionals and employers indicate that experiential learning is a much greater factor in developing abilities to manage well on the job than the development of any particular technical skill.

The study team has been successful in disseminating information about the study in a diverse number of settings that include library and information studies and national policy conferences. Two journal articles are in the process of being edited for submission to publications.

### **OPPORTUNITIES FOR TRAINING AND PROFESSIONAL DEVELOPMENT**

The process of implementing the research design has allowed the personnel at the participating community colleges to become more familiar with research data collection and analysis procedures. This has expanded to roles as data collectors, as the Co-PIs recruited students, new IT professionals, and IT employers for the study. They have contributed to the refinement of the faculty and student focus group protocol, and were responsible for setting up each session at their locations. Dr. Froh and Dean Stewart trained with the research team on the classroom observation protocol in early December 2014, with modifications to the coding instrument made based on their feedback. They will each be the lead classroom observer when these sessions are conducted in February 2015, and will also conduct the post-observation interviews with faculty.

The graduate students who have been working alongside the lead researchers have benefited from opportunities to increase their methodological knowledge. They have learned more about why data collection techniques are selected and implemented (including gaining experience in conducting focus groups and classroom observations), and how data analysis procedures can be

carried out (including learning how text mining techniques can be applied to the research problem of this project). The students have also had the opportunity to participate in relationship building among the three teams of participants and have presented findings at several major conferences.

### **DISSEMINATION TO COMMUNITIES OF INTEREST**

The project team attended iConference 2014, a premier conference for information science and information technology researchers, in Berlin, Germany in March of 2014. The team, represented by Co-PI Marcia Mardis, presented a poster entitled “Assessing Information Technology Educational Pathways that Support Deployment and Use of Rural Broadband.”

The team presented a poster at the 42nd Telecommunications Policy Research Conference (TPRC) titled “Policy-driven Workforce Needs in Northwest Florida: IT Job Competencies.” At the conference, the project team also presented a paper, “Aligning Expectation and Reality About IT Career Preparation: Perception Of Job Competencies by Students, New Professionals, and Employers.”

Two posters for the Association for Library and Information Science Education (ALISE) Conference in Chicago, Illinois in January 2015: Lee, J., Spears, L., and Ambavarapu, C. (2015, January). Between the IT curricula and job posting ads: Comparative analysis of IT job competencies for IT professionals in Northwest Florida. Poster to be presented at *the 2015 Association for Library Information Science Education (ALISE) Annual Conference*, Chicago, IL, and Spears, L. I., Ma, J., & Ambavarapu, C. R., Mardis, M.A. & McClure, C.R. (2015). Early Results of an Assessment Study of Promoting Rural North Florida Information Technology Education to Career Pathways. Poster to be presented at *the 2015 Association for Library Information Science Education (ALISE) Annual Conference*, Chicago, IL.

A paper has been selected for iConference 2015 and will be published in the proceedings as: Spears, L. I., Lee, J., Ambavarapu, Mardis, M.A. & McClure, C.R. (2015, March). Meeting the Needs of IT Stakeholders in a Northwest Florida State College. Paper presented at the *iConference 2015*, Newport Beach, CA., March 24-27, 2015.

In addition, two journal articles are in preparation for submission to publications.

### **YEAR 2015 ACTIVITIES**

Next steps in the project include:

1. Creating several journal papers for the project that focus on a) Year 1 findings; b) rural-serving college challenges; c) the use of the text-mining method for unstructured texts; and d) IT career and education frameworks that guide competency requirements both for academic and industry use.

2. Classroom observations will be completed in the first quarter of Year 3. After the observations and post-observation faculty interviews are complete, dissemination of results to a broader group of educators in like-institutions may render some greater understanding of the challenges in using frameworks for such a dynamic subject areas;
3. From the classroom observation analysis results, the research team will produce themes from the actual classroom experience to triangulate with the syllabi learning outcomes analysis.
4. The team will finalize a master list of employer-recommended skills as well as revise the interview guide for new professional interviews.
5. During the third quarter of the next reporting period the team will repeat the content analysis on a new set of syllabi and job ad postings.

We are continually seeking other opportunities to examine emerging factors in the ongoing efforts of educators to align pedagogical efforts and student learning outcomes with the needs of IT employers. For instance, other related studies agree with our findings that experiential learning, coherent syllabi creation and use, and the need for guidance beginning in high school may be factors that have strong influence on students' choices and resulting career paths. Identifying ways to examine these phenomena is continually a part of the research team's weekly project review.

### **YEAR 2014 PRODUCTS AND PUBLICATIONS PRODUCED FROM YEAR 2014**

#### **Conference Publications**

Spears, L., Mardis, M.A., Coleman, L.E., McClure, C.M. (2014). *Assessing Information Technology Educational Pathways that Support Deployment and Use of Rural Broadband*. A poster was presented at iConference 2014 in Berlin Germany in March 2014. A short paper related to the poster was published as well.

Lee, J., Spears, L.I., Ambavarapu, C., Ma, J., Hollister, J.M., Mardis, M.A., McClure, C.M. (2014). *Aligning Expectation and Reality About IT Career Preparation: Perception Of Job Competencies by Students, New Professionals, and Employers*. Paper presented at the 42<sup>nd</sup> Telecommunications Policy Research Conference.

Spears, L. I., Lee, J., Ambapavaru, C. R. Ma, J., Hollister, J. and Mardis, M. A, Randeree, E., and McClure, C. *Policy-Driven Workforce Needs in Northwest Florida: IT/Broadband Job Competencies in Metro and Nonmetro Areas* (March 31, 2014). Available at SSRN: <http://ssrn.com/abstract=2418547>. Poster presented at the 42nd Telecommunications Policy Research Conference.

### **Technologies or Techniques**

Graduate students who joined the NSF research team in early 2014 contributed stronger data management and analysis skills, resulting in the use of Natural Language Toolkit (NLTK) in which Python was deployed to conduct text mining on the syllabi and job posting documents. We have continued to use this process on the transcribed texts of the employer interviews, as those data proved to be voluminous. Reliability test are being conducted by manually coding part of the sample of the employer interviews and comparing the results to text mining outcomes using Python and Leximancer. In addition to testing the effectiveness of various text mining software for this type of analysis, this work will provide feedback on the use of IT frameworks from both academic and industry domains for use in curriculum interventions to be proposed for Fall 2015.

### **PARTNERS AND COLLABORATORS**

Career Source Chipola is consulting on the student tracking process and has provided data and employer information for researchers to recruit employers for interviews.

In July 2014, the Information Institute was contracted by the Florida Information Technology Career (FITC) Alliance to assess and evaluate the program impacts and provide a proof of concept demonstration of the process by which technology curricula can be assessed for validity of learning outcome soundness and implementation effectiveness. This provides a valuable reliability test of the methods currently in use on the NSF ATE project.

As a result of the NSF ATE project, the Information Institute has been engaged as the program evaluation team for a related study, the Florida Information Technology Career (FITC) Alliance. As part of the project, the team has extended the IT education alignment methodology to this study, which encompasses a broader region of North Florida and involves a larger scope of participants that includes a sample of high schools, two- and four-year colleges, and university computing programs. The FITC study provides a proof of concept opportunity for the methods employed in the NSF ATE study and meaningful gains have been made in understanding the challenges facing students, educators, and employers. This work will influence the future phases of the NSF ATE study with improved data collection and analysis approaches and enriches our dissemination opportunities.

### **IMPACTS**

This project supports the goals of NSF ATE program through research into effective and sustainable preparation for IT/broadband technicians in Northwest Florida. Through its multiple methods pursuit of its research questions, this project is designed to address the the dearth of collaborative research on the intersecting needs of IT educators, students, and employers concerning broadband.

## **Assessing Information Technology Educational Pathways that Promote Deployment and Use of Rural Broadband: Annual Report**

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Using the methodology identified in the NSF ATE study, the research team has collaborated with the Florida Information Technology Career (FITC) Alliance to assess a curriculum learning outcomes of a sample of high schools, two- and four-year colleges, and research universities (Florida A&M University and Florida State University) and to determine the extent to which these align with employer and workplace needs. This study is broader in scope with a greater range of participants, and is building on the findings of the NSF study. Between the two studies, the use of text mining and natural language text tools has been tested, providing findings that will inform the next phases of the NSF ATE study. In addition areas that merit further studies have been identified, such as the extension of the education to career pathway to begin high school; the need to understand the role of guidance counselors, who may be underrepresented and lack the tools to provide guidance on such a dynamic and evolving field; the need to identify best practices for syllabi creation and use; and the need for dialogue on the standards being produced (or needing to be created) for the young IT discipline.

The project has heightened awareness and attention to the FLDOE Career and Technical Education frameworks on the parts of TCC and Chipola, including the instructors at each institution. Contacts have been identified with the Florida College System from which a dialogue can be generated with a wider group of college administrators about their use of the IT program frameworks.

As we are in the second year of a four-year study, analysis has identified areas noted above that are beyond the scope of our original proposal. However, the diffuse nature of job/career placement (looking at a broader scope) and the overwhelming preoccupation of the colleges to deliver IT certifications in spite of preliminary findings indicating employer lack of participation suggests the need to change our data collection procedures in Year 3 to a broader scope of jobs in a greater variety of sources such as campus and community career centers. In addition, the need for improved student career pathway tracking is indicated; this is a time-consuming task but early conversations with new professionals have provided fruitful insight into what may be needed for interventions in this area.

Preliminary and final research findings will be disseminated via a workshop with regional faculty and industry representatives and a final one-day seminar, broadcast online, to be held at FSU as part of the Eppes Professor Lecture Series. Additionally, research findings will be disseminated through presentations at conferences, such as Tech Expo, a regional technology exposition, and articles in publications, as well as utilizing Internet communication and educational tools. All Co-PIs continue to present the findings to their stakeholders and communities.

The study team will propose to present results at regional and national broadband and education conferences such as the National Career Development Association (NCDA), League for Innovation in the Community College (STEMtech, Innovations and Learning College Summit), and the American Association for Community Colleges' (AACC) Rural Community College Alliance (RCCA) conferences. Articles reporting project results will be submitted to journals

such as *Community College Journal*, *Community College Review*, *Community College of Research and Practice*, *New Directions for Community Colleges*, *Educational Research Review*, and other community college and non-metro education journals. Policy conferences such as the Association for Public Policy Analysis (APPAM) and the Telecommunications Policy Research Conference (TPRC) will be targeted for presentations of findings

This project reflects a true collaboration among academic, employer, and community stakeholders and should yield benefits for many schools around the state. This study will further define a field that requires a flexible worker who can manage the constant stream of new knowledge and can support work functions that are increasingly broadband dependent. This study will also establish the use of the term non-metropolitan (non-metro) to describe the areas of the study more inclusively as communities that are adjacent to metro or urban areas and comprise a population of both urban and rural residents.

After a successful first round of dissemination that has included the collaboration with the FITC Alliance and the more expansive list of partners, we are exploring Phase II of dissemination, which will include targeted community college stakeholders such as researchers and academic administrators charged with developing curricula that support and enhance computing and technology workforce needs.

### **Impact on Other Disciplines?**

Conduct of the project's research activities will have profound effect in the capacity of information science faculty and doctoral students to conduct collaborative research into workforce development. This combination of research and practice is aided by the use of rigorous techniques such as content analysis, text extraction, and machine learning. This collaborative effort has expanded into other studies that encompass multiple institutions, including other universities, other two- and four-year colleges, and high schools and has extended into the disciplines of computer science and computer engineering.

At a more widespread level, project deliverables will be transferrable to other regions based on the comparative analyses that will be completed. In addition, the project team is positioned to annually update research and disseminate results, on campus at the projected annual seminar and at regional industry expos such as Tech Expo, produced by TalTech of Tallahassee. Plans are underway to attend Tech Expo 2015 as well as the school's digital technology expo, Digitech. This expo alone draws interest from the greater Northwest Florida industrial organizations. Similar efforts will be coordinated with Opportunity Florida, which supports regional workforce development in Northwest Florida. In addition, key advisory committee members are positioned to use results to influence curricula at all institutional levels.

### **Impact on the Development of Human Resources**

Post-secondary educational programs designed to prepare highly qualified entry-level IT/broadband workers in non-metropolitan communities must provide a broad array of skills for those who are supporting institutions with employees who may possess below average technical skills but have strong needs for technology access. The findings of this study will align the efforts of educators directly with the needs of employers and industry and are informing the creation of a network and infrastructure by which each domain can articulate goals, objectives, needs and challenges.

Each of the partner institutions is gaining perspectives on employer needs and increased opportunity to gather feedback that is structured and balanced by the articulation provided by the study. The identification of opportunities and methods to better position the employers in non-metro communities to provide experiential learning is a key way that human resources can be deployed to benefit both employers and schools and provides a more robust pathway for students progressing into technology careers.

### **Impact On Physical Resources That Form Infrastructure**

Because a key aim of this project is to identify the value of and need for broadband IT technicians in rural areas and is engaging community stakeholders, this project is likely to impact the resources rural communities allocate to enhancing their broadband availability through serving great demand for high speed connectivity. This prospective impact statement is unchanged in Year 2.

### **Impact on Institutional Resources that Form Infrastructure**

Because a key aim of this project is to identify the value of and need for broadband IT technicians in rural areas, this project is likely to impact the resources two and four-year colleges allocate to their own broadband and network infrastructure in order to educate these individuals.

### **Impact on Information Resources that Form Infrastructure**

A major activity of this project is to compare employers' needs to curriculum content. A likely impact of this project will be the revision and reinvigoration of IT curricula at rural community colleges in the region. This project has also impacted a state-level study that has broadened the scope to include high schools and universities along with other discipline domains, creating a network for increased dialogue across North Florida and among education institutions at all levels.

### **Impact on Society Beyond Science and Technology**

This study of non-metro communities that have deployed broadband or are preparing to do so will support the efforts of CTE to facilitate economic development and connect the communities

to global society. This study has the potential to influence the ongoing examination and adoption of IT standards for curriculum that are dynamic and responsive to the changing needs of industry. It also serves to extend the dialogue about the place of IT education beyond the scope of workplace training, in order to build a body of knowledge from which flow best practices. This research meets the challenge of the NSF ATE's goal of improving and supporting the dynamic education of technicians in the workplace who sustain these growing digital efforts and further defines IT/broadband skills needed in non-metropolitan labor markets in communities nationally.

### **CHANGES AND PROBLEMS**

No changes in approach are anticipated at this time.

The research continues in a smooth manner and the input from and contribution of TCC and Chipola has increased the level of input in the study. Both TCC and Chipola provided opportunities and participants for the faculty, administrator, and student focus groups along with preparing each session's logistics. TCC and Chipola recruited employers for interviews and they will continue to coordinate the effective tracking of students through the IT programs and into workplace roles. With privacy concerns, the time-consuming nature of compiling the data and being able to gather comparable data, the team will have to focus on what best can be tracked for the next two and a half years.

An ongoing concern to which the partners will need to pay concerted attention is the changes in IT program curriculum resulting from state level review. The FL DOE has again updated the current IT curriculum. We anticipate having to compare the current and future programs, crosswalking the outcomes for the programs, and ensuring that the research approaches are responsive to and appropriate for these changes.

There were no changes that have had significant impact on expenditures, in use or care of human subjects, or in use or care of vertebrate animals.