FITC Final Report
Appendix E

Job Posting Analysis Preliminary Findings: A Sample of Florida State College at Jacksonville Job Post

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1. Introduction

Florida State College at Jacksonville (FSCJ) is a four-year college located in Jacksonville, Florida—a region that acts as a hub for many Information Technology (IT) companies (Kotkin, 2013). To assess how well the FSCJ IT programs are preparing two and four-year graduates for internships, part-time, and full-time jobs, this job posting analysis study asks two research questions:

> RQ1: What required competencies do technology employers identify in their job postings for entry-level technology-related positions?
>
> RQ2: To what extent are the competencies specified in employer job postings related to the learning outcomes in the FSCJ Associate in Science (AS) and Bachelor of Applied Science (BAS) programs?

Specifically, the analysis aims to

- Examine the knowledge, skills, and abilities conveyed in the Associate in Science (AS) and Bachelor of Applied Science (BAS) programs' learning outcomes ; and

- Identify the key knowledge, skills and abilities from job postings and match them with the AS and BAS programs' learning outcomes.

2. Literature Review

2.1 Curriculum Development and Industry Requirements

Curriculum assessment and revision are important ways to ensure that an educational program remains relevant and attractive to potential students. One indicator of a program's success is the employability of its graduates (Khan, 2011; Woodward, Imboden, & Martin, 2013). Because of the rapidly changing technology industry, educational programs must undergo frequent evaluation in order to prepare graduates to enter this dynamic industry, and this curriculum evaluation must be informed by industry expertise (Hwang & Soe, 2010). To meet regional industry employer needs, it is helpful to seek collaboration with industry partners and understand the skills that employers seek in prospective employees (Woodward et al., 2013). This analysis examines job skill requirements for information technology (IT) professionals.

2.2 Job Post Content Analysis Method

Job posting content analysis is a well-established method for determining the skills employers are looking for in IT workers (Debuse & Lawley, 2009; Smith & Ali, 2014). Job advertisements are an unobtrusive data source, offering potentially large sample sizes for researchers to understand the necessary IT employee knowledge, skills, and abilities (KSA) (Lee & Wingreen, 2010). Online job search sources are crucial for IT job seekers because the job postings are more context-rich and more likely to specify desired *soft skills* and technical competencies (Gallivan, Truex III, & Kvasny, 2004).

This analysis employs the Leximancer software for textual data analysis. Debuse and Lawley (2009) used Leximancer to examine Australian and North American job posting advertisements to identify required skills for graduates in technology-related programs. Automated text analysis eliminates the time-consuming necessity of manually analyzing the job posts and also generates helpful context-based data visualizations.

2.3 Internships

Employers sometimes express concerns with the job readiness of graduates in IT-related disciplines with noting that students or graduates who are highly skilled in technical competencies often lack valuable general, workplace competencies or soft skills (Galloway, Marks, & Chillas, 2014; Venables & Tan, 2009). In the curriculum guidelines for undergraduate computing program, the Association for Computer Machinery and the Institute of Electrical and Electronic Engineers (hereafter referred to as (ACM/IEEE) specify four main ways to incorporate soft skills that employers desire into undergraduate computing curricula through non-technical skill courses, capstone projects, team projects, or internship programs (Makasiranondh, Maj, & Veal, 2011). Researchers examined the potential value of internships for undergraduate IT students from the perspective of three main stakeholder groups: students in computing disciplines, IT employers, and postsecondary academic institutions (Galloway et al., 2014; Ralevich, & Martinovic, 2010; Venables & Tan, 2009). It was found that internships offer

students the chance to develop soft skills in a workplace environment and allow them to gain hands-on experience with the technical skills they have learned in their courses (Vairis, Loulakakis, & Petousis, 2013).

Through internships, students also have the opportunity to develop career goals or determine if they feel well-suited to a particular job before they enter the workforce and even become more employable once they graduate (Shoenfelt, Stone, & Kottke, 2013; Vairis et al., 2013). Similarly, research suggests that employers benefit from internship programs because student interns are likely to be familiar with the latest technologies and offer a fresh, unique perspective (Galloway et al., 2014). Furthermore, academic institutions that provide internships are well-positioned to offer a curriculum that meets the needs of the industry as well as students seeking to increase their employability (Ralevich, & Martinovic, 2010).

Other studies suggest that although internships are a means of increasing employability, students who already exhibit desired workplace competencies are more likely to secure an internship position than students who could use the internship experience to develop business or soft skills (Chillas, Marks, & Galloway, 2015). Often, employers expect interns to be immediately productive workers as opposed to inexperienced students requiring training. In addition, Ralevich and Martinovic (2010) report that some employers are unwilling to offer internship opportunities, and there may be a conflict between students' expected wages and the reality of their positions.

3. Method

3.1 Data Collection

The job postings used in this analysis were collected and maintained as a blog by one FSCJ faculty member from January 2012 to November 2014 to provide students with information about available positions such as internships, full-time, part-time, and volunteer positions. After removing duplicate postings and unnecessary information, this analysis comprises a sample of 72 (N=72) job postings from January 2013 to November 2014. The 72 job postings include 30 advertised internship positions, six full-time positions, and four part-time positions; the remaining 32 jobs were uncategorized. The internship postings included contained the same skill requirement information as the part-time and full-time job posts.

3.2 Data Analysis

This assessment employed Leximancer software to analyze the 72 job postings, removing the posters' contact information and company demographic information. As a powerful software tool designed for analyzing natural language text data, Leximancer can visually generate main themes of concepts in context. As Bozkurt and Helm (2012) noted, "these concepts are not just keywords that occur frequently, but words that 'travel together' throughout the text" (p. 340), meaning they are often paired together throughout the text. Leximancer generates themes to indicate the terms' relative connectedness by their proximity to each other. All of these visuals help identify main themes in job postings and required skills specified in the job posts.

In addition to the visual concept map, Leximancer also automatically generates a list of the most frequently occurring concepts/themes in the text. These concepts were manually

grouped based on the concepts' original meaning in the job ad and were further analyzed to determine the principle concepts related to them. The analysis then compared the 72 job postings with the 125 selected FSCJ syllabi to assess how well the academic programs are preparing students to meet the needs of employers within the local technology industry. The 125 syllabi include four programs: *Associate of Science* (*AS) in Computer Information Technology* (31 syllabi), *AS in Networking Systems Technology* (50 syllabi), *Bachelor of Applied Science (BAS) in Information Technology Management* (24 syllabi), and *BAS in Computer Systems Networking and Telecommunications* (20 syllabi). The concepts generated from job postings were compared with the concepts generated from course syllabi.

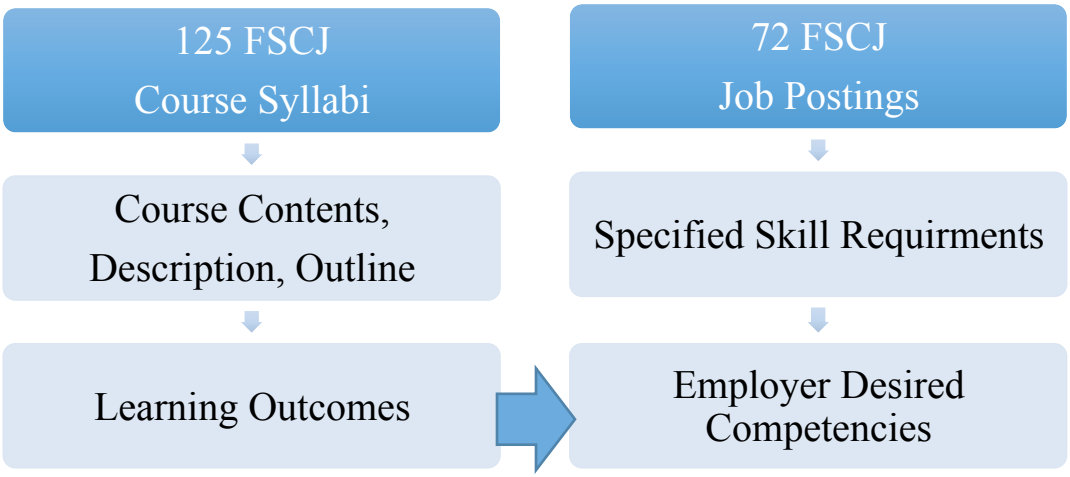

Figure 1: Illustration of FSCJ curriculum analysis and FSCJ job post analysis comparison method

4. Findings

4.1 Job Post Analysis

The processed job postings were fed as an input to the Leximancer tool. A Leximancer *theme* is a group or cluster of concepts that have some commonality or connectedness as seen from their close proximity on the concept map.[1] Figure 2 presents the visual concept map generated from Leximancer that identifies emergent themes in the analyzed job postings.

[1] http://info.leximancer.com/faq-displays-and-outputs/

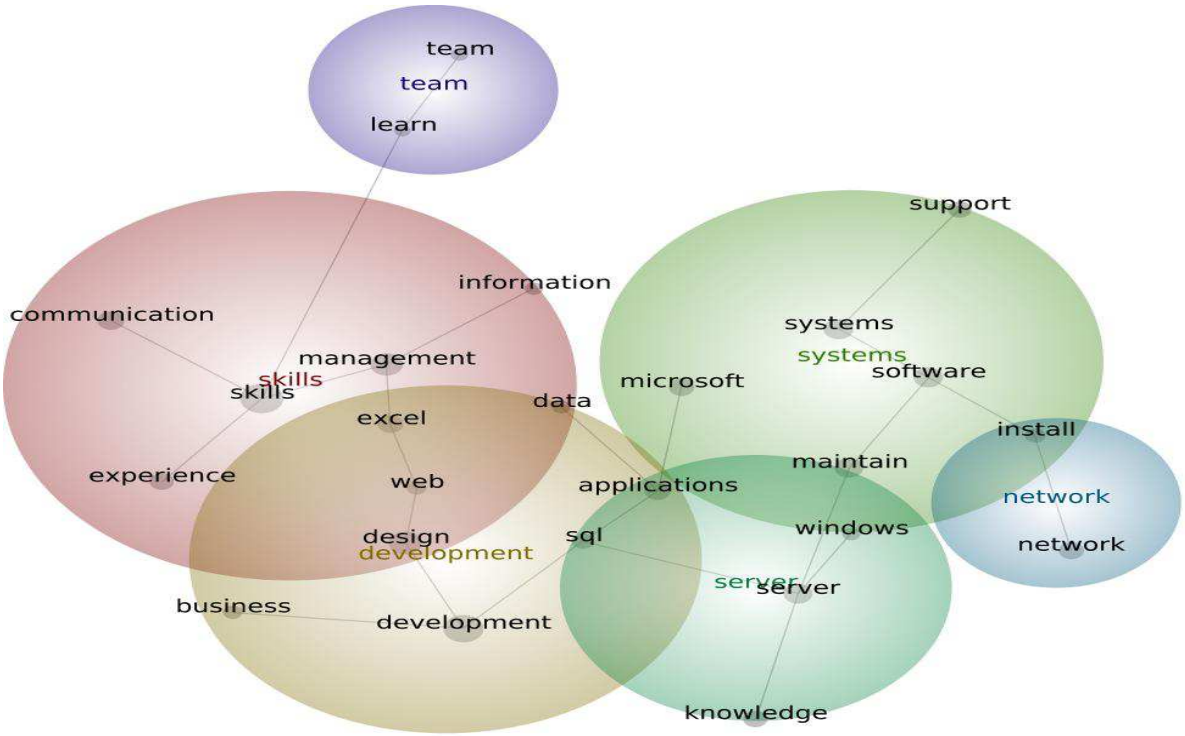

Figure 2: Leximancer themes Generated from Job Posts

Figure 2 presents the six main themes that emerged from the data analysis. Each theme comprises a set of relevant concepts. Themes on a Leximancer concept map are heat-mapped, meaning that hot colors (red, orange) denote the most important themes, and cool colors (blue, green), denote those less important.[2]

The overall ranking of the most frequently occurring concepts within the 72 jobs postings are presented in Table 1. The *principle concepts* related to the most important concepts are presented in Tables 2 and 3. The frequency of concept occurrences in the job posts is given by the count value and their relevance percentage. The relative strength of a concept's frequency of occurrence is identified with the help of the relevance percentage. It is the percentage frequency of text segments coded with that concept, relative to the frequency of the most frequent concept in the list. Thus, the most frequent concept will always be 100%. This does not mean all text segments contain that concept. Other relative percentages are calculated by dividing a concept's count into the top occurring (100% relevance) concept's count.

The concepts were cleaned to remove the words that offered little meaning in the jobs such as "required," "location," etc. The key concepts identified are: *"development," "skills," "software," "systems," "communication," "management," "server," "maintain," "knowledge," "experience," "support," "design,"* and *"network"* with a relative percentage greater than 50%.

Table 1: Key concepts generated from the selected job postings (N=72)

[2] https://www.leximancer.com/faq/display_and_output.html

Job Posting Analysis: Florida State College at Jacksonville

Concept	Count	Relevance percentage	Concept	Count	Relevance percentage
Development	57	100	Applications	24	42
Skills	56	98	Business	21	37
Software	37	65	Microsoft	20	35
Systems	36	63	Team	19	33
Communication	34	60	Install	16	28
Management	33	58	Excel	15	26
Server	31	54	Information	13	23
Maintain	31	54	Learn	13	23
Knowledge	30	53	Web	12	21
Experience	30	53	SQL	11	19
Support	30	53	Data	11	19
Design	29	51	Windows	11	19
Network	29	51			

These concepts were manually grouped into two overall skill types: General Competency and Technical Competency. The General Competency category includes: *"Communication," "Management," "Business," "Team,"* and *"learn."*
Technical competencies include: "*Development," "Skills," "Software," "systems," "server," "maintain," "knowledge," "support," "design," "network," "applications," "Microsoft," "install," "Excel," "information," "Web," "SQL," "data*," and *"Windows."* The principle concepts related to the most important concepts (Development and Skills) are listed in Tables 2 and 3.

Table 2: Principle concepts related to the key concept -'Development' from 72 job postings

Related Concept	Count	Likelihood Percent	Related Concept	Count	Likelihood Percent
SQL	8	73	Server	8	26
Design	19	66	Skills	14	25
Web	6	50	Systems	8	22
Excel	7	47	Software	8	22
Information	6	46	Network	5	17
Data	5	45	Support	5	17
Applications	10	42	Team	3	16
Management	12	36	Windows	1	9
Experience	10	33	Communication	3	9
Knowledge	9	30	Learn	1	8
Maintain	9	29	Install	1	6
Business	6	29	Microsoft	1	5

Table 1 shows that Leximancer identified "development" as a key concept with highest frequency. When that concept was selected, it presented a list of related concepts with their count and likelihood percentage. Table 2 identifies the concepts related to development. The

Likelihood Percent denotes the probability that text segments containing a particular concept will also contain another specified concept. From the above table, for example, the concept *SQL* occurred 8 times and it has a likelihood percent of 73% which means 73% of the text segments with *SQL* also contains *Development*. Similarly, the related concepts for the key concept-Skills are presented in Table 3.

Table 3: Principle concepts related to the key concept -'Skills' from 72 job postings

Related Concept	Count	Likelihood Percent	Related Concept	Count	Likelihood Percent
Communication	26	76	Windows	3	27
Excel	11	73	Knowledge	8	27
SQL	6	55	Development	14	25
Design	15	52	Software	9	24
Web	6	50	Team	4	21
Management	13	39	Applications	5	21
Learn	5	38	Server	6	19
Microsoft	7	35	Maintain	6	19
Experience	10	33	Install	3	19
Information	4	31	Systems	5	14
Business	6	29	Network	3	10
Data	3	27	Support	3	10

4.2 Curriculum Analysis

The analysis then compared the results of the job post analysis with the results of the FSCJ AS and BAS programs syllabi Leximancer analysis. The main themes identified from the AS and BAS programs are presented in Figure 3.

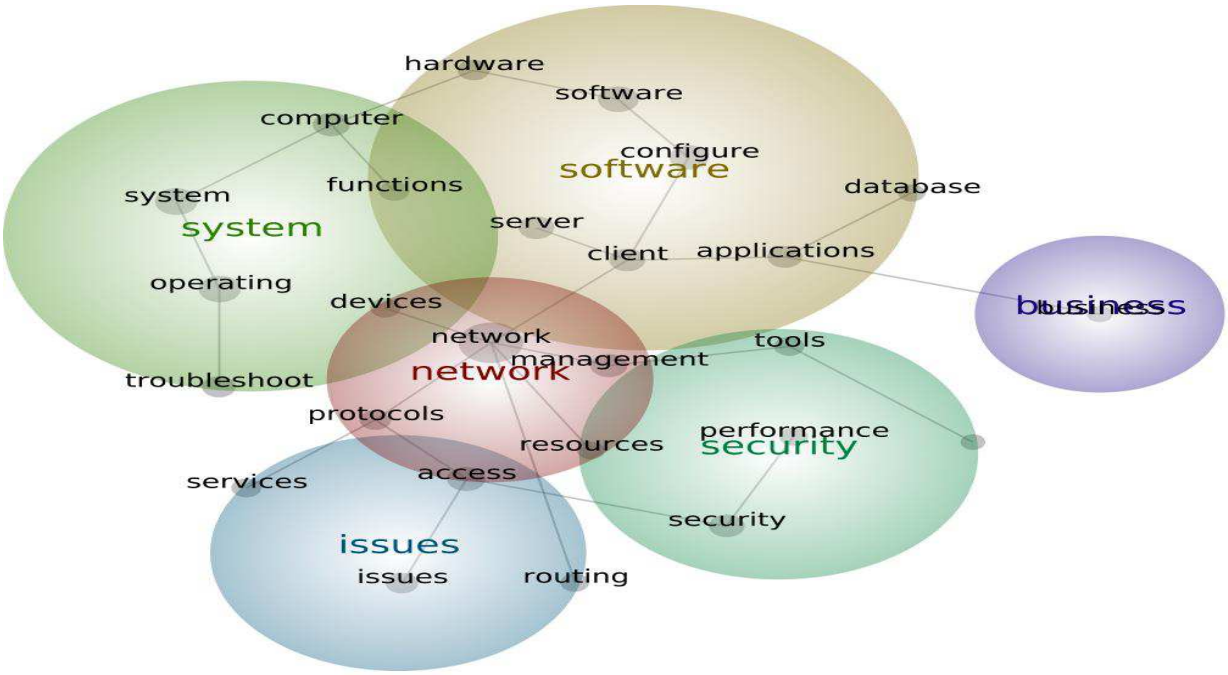

Figure 3: Leximancer Themes Generated from the FSCJ AS and BAS IT Curricula

The concepts generated from the AS and BAS programs are clustered automatically into higher level themes. “network” and “software” themes were the most frequently occurring themes whereas “issues” and “business” themes were less important, as indicated by the cooler colors. The main concepts identified from these programs are presented in Table 4.

Table 4: Key concepts rankings for the FSCJ IT curricula

Concept	Count	Relevance Percentage	Concept	Count	Relevance Percentage
Network	190	100	Client	43	23
System	98	52	Business	43	23
Operating	73	38	Hardware	41	22
Configure	72	38	Services	38	20
Software	69	36	Tools	37	19
Security	68	36	Functions	35	18
Computer	66	35	Routing	34	18
Access	64	34	Protocols	33	17
Issues	61	32	Devices	33	17
Management	54	28	Performance	30	16
Server	52	27	Database	27	14
Applications	50	26	Resources	18	9
Troubleshoot	50	26	Information	18	9

The key concepts from FSU AS and BAS IT programs were shown in Table 4. Here one can see the concepts extracted were more related to technical competencies. The concepts identified

from the job postings and curriculum were then manually grouped into 5 broad categories. A sample of the source data was examined from where concepts were drawn and they were manually grouped into the categories listed in Table 5.

Table 5: Concepts grouping from job postings and FSCJ curriculum

Category	Job Postings	Curriculum
Development	Development (1)	Configure (4)
	Skills (2)	Issues (9)
	Maintain (8)	Troubleshoot (14)
	Knowledge (9)	Services (16)
	Support (11)	Tools (17)
	Design (12)	Functions (18)
	Install (18)	Information (25)
Business Skills	Communication (5)	Business (10)
	Management (6)	Management (15)
	Business (15)	
People Skills	Team (17)	
Applications	Software (3)	Software (5)
	Applications (14)	Applications (12)
	Microsoft (16)	Hardware (15)
	Excel (19)	Database (23)
	Information (20)	
	Web (22)	
	SQL (23)	
	Data (24)	
Systems	Systems (4)	Operating (3)
	Windows (25)	Computer (7)
		Devices (21)
		Performance (22)
		Resources (24)
Networking	Server (7)	Network (1)
	Network (13)	System (2)
		Security (6)
		Access (8)
		Server (11)
		Client (14)
		Routing (19)
		Protocols (20)
Experience	Experience (10)	

The key concepts from job postings and FSCJ curriculum data sets were analyzed and manually divided into groups/categories, and for each data set, concepts were shown in the order of their rank. The ranking of each category was determined by the highest ranked member, the categories are displayed in descending order of the highest item ranked within the job postings data. For example, *Development* is the highest ranked of all the job postings data, and thus *development* is the highest ranked category. The concept categorization has some overlap with

those of Debuse & Lawley (2009**)** who define overall grouping as *Experience, Technological Skills, People Skills, Business Skills, Miscellaneous,* and *Theoretical Skills*. The technological skills in their study were further divided into *Development, Applications,* and *Systems*. The curriculum analysis results suggest the *technical skills* (e.g., networking, systems, development, and applications) are the highest priority, containing a wide variety of examples. The analysis identified *business skill* as the second most important skill category and failed to cover the *people skill.* A comparison between job postings and curriculum data suggest that both employers and IT academic programs value *technical skills* the most, especially skills related to software development, computer networking skills, and application development.

5. Discussion

5.1 Findings Discussion

Job posting content analysis is useful to investigate and understand employer expectations of employee competencies in technology-related fields (Debuse & Lawley, 2009; Gallivan, et al., 2004; Smith & Ali, 2014). Consistent with the findings of previous research, the job posts demonstrated a requirement for entry-level employees to have both technical and non-technical skills, or technical competencies and general competencies. Based on the analysis of 72 FSCJ job posts for part-time, full-time, internship, and uncategorized entry-level positions, it was determined that employers desire technical competencies such as software and application development skills, system and networking skills, and along with general competencies such as business and people skills.

By comparing the results of the job post analysis (N=72) to the results of the syllabus analysis (N=125), it was determined that FSCJ has well-designed AS and BAS Information Technology programs that are responsive to employer needs. The skills and competencies a graduate learns from these programs closely resemble employer requirements. There are, however, people skills and some technology competencies or skills identified in job postings that are trending in the IT field such as WordPress or testing tools such as A/B Testing that are not included in course syllabi. Because this analysis focused on course syllabi as the unit of analysis, it is possible that these learning outcomes may be conveyed in other aspects of the course such as the textbook, classroom instruction, etc.

5.2 Limitations

Two main limitations were identified in this analysis. First, Leximancer automatically analyzes text documents to identify the high level concepts, highlighting the key ideas in the text. If the text files (job postings) provided as input to Leximancer tool are not cleansed, the concepts identified may be random, so manual intervention is required to eliminate all those concepts which are irrelevant in the analysis. For example, in the initial run of the analysis, the addresses and contact information were identified as concepts in the themes. Second, the FSCJ curriculum analysis focused on analyzing course learning outcomes listed in the syllabi without including other course materials as well as content conveyed through course instruction, meaning that some learning outcomes not listed in the syllabi are included in other parts of the curriculum.

6. Conclusion

This job posting analysis employs a text mining approach using Leximancer software to examine the main employee skills required by potential technology employers and the learning outcomes articulated in the selected IT academic program curricula. Although these findings are preliminary and need to be further validated by the other FITC assessment methods, the findings provide some evidence about the different focuses of employer needs and academic programs. Specifically, findings indicate that both industry and academia share a focus on the critical value of *technical skills* and *soft skills* in student course learning and workforce performance. In particular, employers need employees who have not only attained sufficient technology competencies, but those who have also obtained work experience and general competency skills.

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