Assessing Alignment between High School IT Courses and State IT Curriculum Frameworks

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Abstract: High school technology education can expand science, technology, engineering, and mathematics (STEM) participation when students become aware of potential STEM careers and connect these career decisions to their educational decisions. To understand how students can navigate technology education experiences as career pathways from high school to two- and four-year colleges and universities, researchers analyzed syllabi to assess how necessary technology knowledge and skill sets have been developed and implemented into current high school technology education courses in North Florida, USA. Two questions guided this investigation: 1) What are the technology course learning outcomes and content coverage in selected high schools; and 2) To what extent does the content reflect relevant technology learning frameworks? To answer the research questions. This research suggests additional areas for research that may shed light on the apparent dissimilarity between the classroom experience and content frameworks: the role of teacher preparation for teaching technology; the need for high school technology instructors to engage in professional development and training is limited by time and funds; and more in-depth exploration of the extent to which state curriculum shapes classroom experiences.

Introduction

Researchers (e.g., Iskander, Gore, Furse, & Bergerson, 2013; Ullman, 2012) have reported that high school technology education can expand science, technology, engineering, and mathematics (STEM) participation because in high school students "become aware of potential STEM careers and connect these career decisions to their educational decisions" (Hall, Dickerson, Batts, Kauffmann, & Bosse, 2011, p. 41). To understand how students can navigate technology education experiences as career pathways from high school to two- and four-year colleges and universities, researchers assessed how necessary technology knowledge and skill sets have been developed and implemented into current high school technology education courses in North Florida. Two questions guided this investigation:

1. What are the technology course learning outcomes and content coverage in selected high schools; and
2. To what extent does the content reflect relevant technology learning frameworks?

To answer the research questions, we analyzed syllabi. Syllabus analysis is a subset of curriculum analysis, a process commonly used to illustrate academic program content. At the core of curriculum analysis is course syllabus analysis, an efficient and unobtrusive means of assessing knowledge generating activities and intended skill sets within a curriculum (Apigian & Gambill, 2008; Madson, Melchert, & Whipp, 2010; Veltri et al., 2011; Willingham-Mclain, 2011). A course syllabus, which contains information such as course schedules, assignment descriptions, student learning objectives, subject content, and grading criteria, is a "contract" between the instructor and the student, a permanent record for academic institutes, and a reference tool for students (Parkes & Harris, 2002).

Underlying Framework

The National Career Clusters Frameworks are comprised of 16 Career Clusters. The Clusters serve as a tool for organizing curriculum design and instruction and are a foundation for connecting 79 career pathways with

the necessary competencies (i.e., knowledge and skills) to pursue a specified career. Information Technology (IT) is not the largest of the career clusters, but was projected to be the fasting growing Career Cluster through 2018 (Carneval, et al., 2011). Each CTE program is aligned to a career cluster and is detailed in the curriculum frameworks. With partners from education, business and industry, and trade associations, the curriculum frameworks include program standards that are both academically integrated and responsible to business and industry.

The Florida Department of Education (FLDOE) CTE frameworks in IT served as the standard or benchmark for this study. The Florida CTE frameworks exist for middle and high school courses, Post Secondary Adult Vocational (PSAV) programs, and degree and certificate programs (FLDOE, 2017). In 2013, the Florida Legislature put into law new graduation requirements, starting with the class of 2014, in which students can choose to take more CTE in a particular career pathway, in place of Algebra II, chemistry and physics courses, and earn industry certifications as part of a pathway to a diploma. Specifications on the purpose, program structure, the integration of academic content within CTE courses are outlined into each of the course's curriculum framework. An example program structure for Web Application Development & Programming, which is attached to Standard Occupational Classification (SOC) Code of Computer User Support Specialists and Computer Programmers is shown in Figure 1.

OCP	Course Number	Course Title	Teacher Certification	Length	SOC Code	Level	Graduation Requirement
A	8207310	Digital Information Technology	DIT Teacher Certifications	1 credit	15-1151	2	PA
B	9007210	Foundations of Programming	BUS ED 1 @2 COMP SCI 6 COMP PROG 7 G	1 credit	15-1131	3	VO
	9007220	Procedural Programming		1 credit	15-1131	3	VO
C	9007230	Object-Oriented Programming Fundamentals		1 credit	15-1131	3	VO
D	9007510	Web Programming		1 credit	15-1131	3	VO
	9007520	JavaScript Programming		1 credit	15-1131	3	VO
	9007530	PHP Programming		1 credit	15-1131	3	VO

(Graduation Requirement Abbreviations- EQ= Equally Rigorous Science, PA= Practical Arts, EC= Economics, VO= Career and Technical Education)

Figure 1. Sample program structure for SOC Web Application Development & Programming course

Method

In this study we conducted curriculum analyses, which involved unpacking curricula to understand components or parts of the curricula (Jansen & Reddy, 1994) with a focus on capturing the learning outcomes in each syllabus. Learning outcomes were extracted from the syllabi and compared to competencies conveyed in the FLDOE technology curriculum frameworks.

Data Collection

Based on the comprehensive course description and immediate availability of technology course syllabi in participating high schools, we used a purposive sample of North Florida syllabi in this study. We collected a total of 57 technology-related syllabi from 15 high schools across four participating school districts: District B (High School B1, High School B2), District D, District G, and District L.

The districts were roughly of the same geographic size, but they served widely varying student demographics and locales. The table depicts descriptive information for each school districts.

Table. School District Characteristics, Exemplars, and Number of Technology Course Syllabi[1]

District and Exemplar School	Locale	Total Schools (Schools that Provided Syllabi)	District/School Grade (2014-2015)	Technology Course Syllabi	Pupil Teacher Ratio
District B	Town	50(4)	B	11	15:1
High School B1				26	17:1
High School B2					
District D	Urban	201(4)	B		
High School D1					
High School D2					
Academy D3					
District G	Rural	8(4)	B	4	14:1
High School G1					
District L	Town	64(4)	A	16	16:1
High School L1					
Total/Average		323(20)	B+	57	

As the table shows, we collected syllabi from the technology course syllabi by school district ranging from four to 26.

Data Analysis

The unit of analysis was an individual syllabus from a high school technology related course. We collected a total 57 syllabi, but three were excluded because they were duplicates. As a result, 54 syllabi were analyzed for their similarity to the Florida Department of Education (FLDOE) technology curriculum frameworks from the *Information Technology* and *Engineering & Technology Education* Career Clusters.

The Information Technology Career Cluster frameworks were from 2013-14; however, we were not able to access the 2013-14 Engineering & Technology frameworks so our working assumption was that the 2014-15 learning outcomes were the same. We compiled all of the standards listed here to form the basis the high school technology syllabi analyses. We then extracted learning outcomes from each syllabus (N=54). Learning outcomes can appear in various syllabus sections, such as *Course Description, Learning Outcomes, Course Objectives, Course Outline,* or *Weekly Assignment.* The learning outcomes from each syllabus were then compared to their counterpart competencies conveyed in the FL DOE technology curriculum frameworks.

We then compared the syllabi learning outcomes to the competencies/content standards through automated keyword matching. The keywords were technology concept words and phrases derived from FL DOE technology curriculum frameworks' learning outcomes.

Results

We analyzed all high school technology course syllabi (N=54) for the extent to which they reflected the FL DOE technology curriculum frameworks. Figure 2 provides a breakdown of the course topics.

1 Demographic information reported by National Center for Education Statistics (NCES) in the Common Core of Data. Retrieved from http://nces.ed.gov/

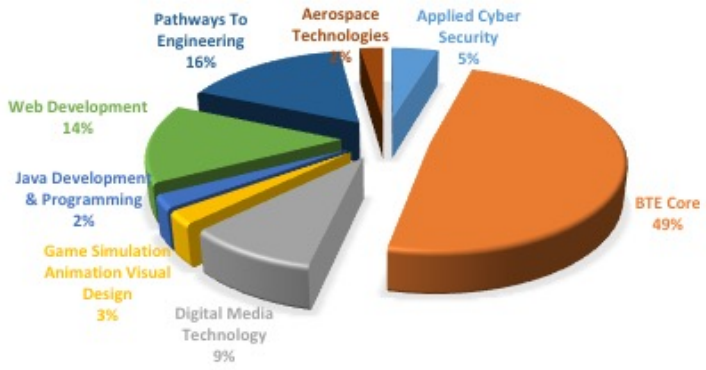

Figure 2. Percentages of Types of Technology-Related Courses (N=54)

As Figure 2 shows, Business and Technology Education (BTE) courses were the bulk of the provided syllabi (26 or 49%), followed by Pathways to Engineering courses (9 or 16%), Web Development (7, or 14%), Digital Media Technology (5 or 9%), and Applied Cybersecurity (3 or 5%). The least frequently offered courses were Game Simulation and Animation Visual Design (2, or 3%), Java Development and Programming (n=1) and Aerospace Technologies (n=1).

Similarity Between Technology Course Syllabi and State Standards

In the first set of analyses, we calculated the extent to which the keywords in the FLDOE curriculum standards and frameworks were reflected in the technology course syllabi gathered from District B, District D, and District L.

Figure 3 provides a summary of the extent to which district syllabus content overall reflected FLDOE frameworks, with District G's syllabi having the strongest similarity and District L's being the most dissimilar.

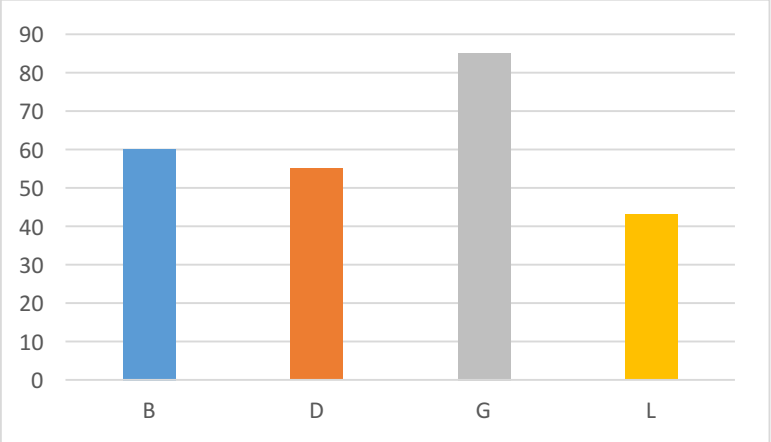

Figure 3. Percent of Similarity Between Course Syllabi and FLDOE Frameworks by District (N=54)

As Figure 3 shows, District G's syllabi had the overall greatest amount of similarity to the FLDOE frameworks, followed by District B and District D, with District L's syllabi having demonstrated the least amount of similarity.

Discussion

In this section, we address the research questions by comparing the literature to our empirical findings and then drawing conclusions.

RQ1. What are the technology course learning outcomes and content coverage in selected high schools?

Based on the sample, the emphasis in high school technology courses is on presenting introductory topics in information technology. The FL DOE technology framework that is most represented in the sample was the BTE (Business Technology Education) Core, which contains courses such as Introduction to Information Technology, Computing for College and Careers, etc. There were 13 FL DOE programs for the Information Technology Career Cluster that were not represented in the sample. The missing frameworks contain courses that present more advanced, specialized topics in information technology. While the introductory topics taught in high school technology courses may serve to spark an interest in IT or serve as a basis for further IT education at the college or university level, more could be done to closely align the knowledge expectations from high school to college or high school to employment.

Our results suggest that there is a wide range of similarity between the high school course syllabi and the FLDOE frameworks between schools and among topics. For example, District G's syllabi reflected a 100% similarity to the FLDOE frameworks while Introduction to Information Technology courses most closely followed the FLDOE frameworks in all districts. This great variation is a warrant for further research, but does suggest that many schools' offerings are linked to FLDOE's goal to "prepare individuals for occupations important to Florida's economic development" (FLDOE, 2015).

RQ2. To what extent does the content reflect relevant technology learning frameworks?

Although the syllabi collected were from technology-related courses, they did not only follow the FLDOE technology-related frameworks. There is no standardized method for courses to adhere to the FLDOE frameworks, and there are so many Clusters to choose from that more research should be conducted to determine how instructors are choosing to include learning outcomes from multiple frameworks.

Certain courses focused on finance education, and the syllabi contained no technology-related learning outcomes that would allow them to be compared to the FLDOE frameworks for Information Technology or Engineering & Technology. However, they could be compared to learning outcomes in the finance-related frameworks. What is important about their inclusion in the sample is that, despite the fact that the syllabi do not list any technology-related learning outcomes, they were still considered part of the high school technology curriculum. It is possible that the course does convey technology-related skills that are not listed in the syllabus, but it could also suggest a lack of consensus about what qualifies as a technology course and what should be included in high school technology curricula.

Additionally, the syllabi demonstrated an occasional lack of coherence between different parts of certain syllabi. There was evidence of disagreement between the *Course Description* and *the actual Course Content/ Course Schedule*. There is no format that the syllabi consistently follow, and there is also a lack of consistency concerning syllabus quality across districts and schools. For instance, a *Digital Design 1* course received from District L contained learning outcomes consistent with the *Foundations of Web Design* course in the FL DOE technology curriculum frameworks in the description of the course, but the actual course topics contained learning outcomes such as "How to Use Paint" and "Understanding Adobe Photoshop." Although the *Course Objectives* section of the syllabus described a course focused on web design and web development, the actual *Course Topics* focused on digital photo manipulation.

5. Conclusion

The findings revealed that schools across the four counties offered basic courses like *Introduction to Information Technology, Introduction to Engineering Design,* and *Principles of Engineering,* all which strongly reflected content FLDOE standards. Web design and development is another frequently offered content area that reflects FLDOE standards. These basic courses give students a foundation to pursue in later educational experiences. Some districts offered advanced level courses like *Java Programming, Cyber Security,* and *Aerospace Technology*, but these courses reflected little of the FLDOE framework content. Course designers may wish to more closely align content to the FLDOE frameworks to ensure that learning outcomes are built upon in subsequent post-secondary experiences.

Further research into the availability and effectiveness of these opportunities for high school students in North Florida is crucial, as previous research suggests the importance of these extracurricular activities in encouraging student enrollment in STEM degrees and careers (VanMeter-Adams et al., 2014). However, if course

content and state frameworks are not in concert, then students may not receive the foundation or inspiration they need to exit the K-12 pipeline and enter STEM college and/or career pathways.

This research suggests two additional areas for research that may shed light on the apparent dissimilarity between the classroom experience and content frameworks. First, the role of teacher preparation for teaching technology needs to be explored. The opportunity for high school technology instructors to engage in professional development and training is limited by time and funds. (Gal-Ezer & Stephenson, 2009). Second, more in-depth exploration of the extent to which state curriculum shapes classroom experiences is warranted.

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