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SKILLS-FOCUSED ACADEMIC CHANGES TO RESPOND THE IMPACT OF COVID-19 ON THE IT WORKFORCE

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Abstract:

The COVID-19 pandemic has impacted the global economy massively, resulting in a magnitude of transitions and transformations in labor markets worldwide. Along with the need for more upskilling and reskilling, skills-based hiring has become another accelerating trend during the pandemic. Skill-based hiring challenges educators to take an innovative as well as viable approach to prepare students for this evolving workforce landscape. We propose a skills-focused approach emphasizing more on skills-based competencies rather than solely knowledge-based degree qualifications. This study demonstrates how we are reshaping our Information Technology (IT) undergraduate program with major shifts in thinking about how hiring is done today. We map the undergraduate IT curriculum against the skills identified from current job posting websites, aiming to align the course content to competencies and skills sought after by the employers. We are also creating various innovative channels to expand experiential learning opportunities for skills enhancement.

Keywords: skill-focused, Information Technology, curriculum, workforce, COVID-19

I. INTRODUCTION

The technology field has exploded with a well reported, growing gap in the talent pool. This has been aggravated in the last few months by the impact of the COVID-19 pandemic in two primary ways. Firstly, the demand for technology workers has grown rapidly. Many companies were forced to adopt digital technologies to connect to customers, including food, retail and healthcare [English, 2021]. Secondly, the COVID-19 pandemic affected the workforce dramatically, not just in technology but in labor markets worldwide [International Labour Organization, 2020].

A great number of jobs are expected not to return; however, certain industries are reporting shortages of individuals with the right skills. Skills-based hiring has become an accelerating trend during COVID-19 [Ark, 2021]. The authors of this paper postulate that this major shift in thinking by employers requires an equal transformation by higher education. Colleges must focus more on skills, including creating new education pathways, to ensure graduates are workplace ready. In fact, there has been a haunting debate among educators and industry leaders on the major role that higher education should play between skill-focused and knowledge-based curricula [McPherson, 2018; Schrage, 2010]. Instead following an either-or thinking about skills and knowledge [Humphreys, 2021], the authors take a both-and approach based on their belief that knowledge internalization and skills development should go hand-by-hand. The major goal of this paper is to demonstrate how the authors built an infrastructure of skill-focused teaching and learning for an existing undergraduate Information Technology (IT) program to align with the emerging trend of skills-based hiring. The authors also showcase innovative practices for skill enhancement implemented in their program.

II. OVERVIEW OF SKILLS-BASED HIRING

Skills-based hiring is defined as "identifying the objective skills required for a role and searching for or training candidates who have these specific skills instead of using a degree as a proxy for preparation for a role" [DeMark & Kozyrev, 2021]. It is, however, not a new concept. For example, the Obama White House launched the TechHire initiative in 2015 to connect overlooked communities with technology job opportunities [Arnold, 2018]. Their initial focus was applicants not in a degree program since valuing degrees only was seen to exacerbate the gap between the demand and supply of the technology workforce. The main limitations of only relying on degree-based hiring to find the most suitable job candidates are discussed below.

Firstly, there is a misalignment between higher education and employers regarding how skills are recognized [Weise et al., 2019]. Traditional college transcripts do not fully record skills. The list of courses taken, together with course grades, provides little insight into subject mastery, let alone a person's capability of applying the knowledge learnt to solve real-world problems. On the other hand, job postings on employment websites usually are packed with very specific skills that do not easily relate to the knowledge learned and courses documented on the college transcript. To address such misalignment, either employers need to rethink how to adjust hiring requirements to better align with transcripts or higher education institutions need to work at mapping degrees with job descriptions, or both. Increasingly one of our aims as educational institutions is for our students to be employable on graduation so the emphasis for change may lie primarily with higher educational institutions [DeMark & Kozyrev, 2021].

Secondly, current systems of learning may not provide the agility and transferability required for today's career and lifelong learning [Bonvillian & Sarma, 2021]. Current career changers and college students face unprecedented challenges posed in part by the COVID-19 pandemic and the resulting economic downturn. To help the current and future workforce navigate the difficult transition from education to employment, a shift to a skills-based system may be necessary [Fuller et al., 2017]. Instead of being a replacement, it can be a complement to the degree.

Thirdly, traditional degree-based hiring potentially excludes diverse and relevant talent from the workforce [World Economic Forum, 2021]. It can lead to the elimination of many qualified candidates [LinkedIn Corporate Communications, 2019]. The underlying assumption is that hiring based on a skills approach will create a more equitable outcome, particularly for those populations (females and minorities) most affected by COVID-19.

Efforts are underway to create a more skill-focused hiring and teaching ecosystem. The World Economic Forum has brought together several communities of influential leaders committed to the "Reskilling Revolution" (https://www.reskillingrevolution2030.org/). This aims to create more efficient labor markets by more closely aligning the supply and demand of learning [World Economic Forum, 2021].

Another notable example is the Open Skills Network (OSN) (https://www.openskillsnetwork.org/), The OSN alliance consists of innovators from education, industry, and government that are focused on creating and promoting a national network of skills libraries and skills data as well as a community of practice focused on widespread adoption of skills-based education and hiring practices [DeMark & Kozyrev, 2021].

Skills-based hiring has emerged as a most important technology talent acquisition strategy as IT jobs have remained unfilled [Global Knowledge, 2021]. In their 2020 global survey, Global Knowledge found that 60% of IT decision makers placed skills as their most important hiring qualification, while only 2% cited a relevant degree as their primary hiring criteria

The jobs are out there. CompTIA's 2021 Workforce and Learning Trends report lists 40% of companies had hired IT staff during the COVID-19 pandemic and 66% have plans to hire more in 2021 [CompTIA, 2019].

III. A CASE STUDY: MAPPING CURRICULUM AGAINST THE SKILLS

While there are broad skills mapping initiatives, the approach demonstrated in this study was to limit the initial scope to one particular program, a B.S. in IT at the authors' school. The program includes a set of general education courses (the liberal arts core), a set of core information technology and business courses (the technology core), and a set of specialties (minors) in specific technology fields such as cybersecurity, cloud computing, computer science, digital forensics, game design and development and business analysis. Each of the three components contributes to the development of skills and enables students to provide evidence of their skills through active and experiential learning (internships, projects and research). The overall sequence of courses is shown in Table 1.

Table 1: The Sequence of Courses in the Undergraduate IT Program

Level	Technology Core	Other Courses
Freshman	Technology foundations, cybersecurity and a programming language (Web, Python or Java)	Foundational liberal arts core classes such as writing and mathematics
Sophomore	Computer hardware, software engineering, career awareness, advanced programming (Web, Python, Java, or mobile apps)	Intermediate liberal arts core classes such as social sciences, philosophy, and religion
Junior	Networking, workforce readiness, UX/UI, software testing and documentation	Specialty courses Higher-level liberal arts core classes
Senior	Capstone project, workforce placement, and internship	Specialty courses Any remaining higher-level liberal arts core classes

The next step was to identify skills commonly requested by employers (government and business) in our area. We had previously developed the eRAP system to evaluate student resumes against job descriptions in various technology fields [Green, Liu, & Murphy, 2020]. We used similar natural language processing (NLP) algorithms to identify commonly used technical skills, soft skills and technology tools listed in the requirements section of job descriptions found on the Indeed job site (indeed.com). We then pruned this list manually to remove requirements which were covered primarily in the specialty programs which will be addressed later in our mapping exercise.

The authors used the standard ABET methodology for outcome assessment - introductory (I), reinforced (R), and emphasized (E) - to rate skills development in each course [Shafi et al., 2019]. In addition, the designation of experiential (X) was added to denote when the course involved hands-on use of the technology, soft skill, or tool.

The authors next looked to mapping the skills against the courses. First the syllabi were examined but were found to not contain enough detail about individual skills and experiential activities. Instead, the authors reviewed courses through the learning management system (Canvas) and found this to be a much better source of the details necessary. Our independent assessment was then reviewed by faculty currently teaching the course to identify any missing or miscoded items.

Figure 1 is a diagram showing the mapping in progress for the freshman technology core:

Technical Skills	IT 110	IT 120	IT 125	IT 129	IT 130
5G	I				
Accessibility			I, X		
Access Controls		I			
Agile/DevOps					I
Analyze Information					
Anonimity	I				
Application Software	I			I, X	I, X
Artificial Intelligence (AI)	I, X				
Assessment		I			
Assistive Technology					
Auditing		I			
Authentication		I			
Authorization					
Binary	I			R	R

Soft Skills	IT 110	IT 120	IT 125	IT 129	IT 130
Accountabiliy	I	I	I	I	I
Active Listening	I, X	I, X	I, X	I, X	I, X
Adaptability					
Assertiveness					
Attentiveness	I, X	R, X	R, X	R, X	R, X
Autonomy					
Communication Skills	I,X	R,X	R, X	I	I
Compliance			I	I	I

Tools	IT 110	IT 120	IT 125	IT 129	IT 130
Dr. Java			X		X
FileZilla			X		
Github		X			
Google CoLab				X	
HTML5			X		
Microsoft Access					

Figure 1: Example of the Course-Skills Mapping

This is a work in progress. One of the outcomes we discussed is to add a Skills/Tools section at the bottom of each of our syllabi to focus the student on the skills learnt and so encourage them to add important skills to their resume.

IV. OTHER SKILL-FOCUSED CURRICULUM CHANGES

College students show a distinct preference towards work-integrated learning and curriculum that incorporates industry requirements, hoping to obtain a better employment opportunity [Oliver,

2019]. Our faculty developed a number of program-specific innovative channels for skills enhancement, i.e., focusing on preparing students with skills necessary to enter and thrive in the technology workplace of tomorrow. While the university does run a Career Development Center that offers general career preparation, our faculty have taken on responsibility for enhancing its academic programs to ensure students are exposed to workplace or work-like experiences throughout the program. These initiatives are listed below.

CREDIT FOR CERTIFICATIONS

IT certifications are valuable in a technology career since employers regularly use them as selection criteria for hiring and promotion [Burning Glass Technologies, 2017]. The authors' program had identified the courses covering the similar body of knowledge required for certifications, such as CompTIA Security+ or CISCO CCNA. While a few students went on to take and pass the certification after the courses, many did not. In 2019, the authors examined how they were accounting for prior learning in their annual program assessment. Previously the program had taken this into account by waiving the relevant courses without granting any credit. We reconsidered this approach and believed that students who passed a certification should be given credit for the course that covered the same body of knowledge. This was in part influenced by faculty's involvement as reviewers in the ACE program for giving credit for prior learning [American Council on Education, n.d.]. The credit for certification approach was approved by the university. It gave students who had taken a recognized certification as part of a high school or community college program, or by studying on their own, an opportunity for additional credits on entering the institution. It has also incentivized current students to study for the certifications, say in the summer break, and then transfer in the credits. The has resulted in more students demonstrating skills on their resumes with certifications.

WORKFORCE READINESS SEMINARS

Students in the B.S. IT program must take three one-credit workforce readiness seminars. The first is offered in the sophomore year and focuses on career awareness. While students prepare a professional resume as they begin looking for work experiences, the focus is on choosing a specialty/minor by the end of the year. Soft skills such as teamwork and oral communication are introduced and practiced.

In the junior year, workforce preparation is the focus of the seminar. Resumes are revisited. Students learn how to search for internships/jobs and review skill requirements. They research jobs associated with their specialty choice, write cover letters, and take part in mock interviews. Again, soft skills such as written communication, presentations (group and individual), and ethics are reinforced. Students are exposed to alums who demonstrate how they moved into their chosen careers and they function as mentors.

In the senior year, focus is on workforce readiness. Students develop a senior portfolio to provide evidence of knowledge and skills and include sample projects that demonstrate proficiency such as Python code, a database, or a cybersecurity password cracking exercise. These can then be used in an interview where employers are often checking for skills evidence. Students are also required to practice responses to technical and behavioral interview questions, including coming up with scenarios that demonstrate some experience, albeit on a class project. Again, graduate students and alums provide some guidance to the students.

All three seminars are required for graduation, ensuring all our students are aware of what it takes to enter the workplace and can demonstrate their knowledge, skills and abilities.

EXPERIENCIAL LEARNING

Employers seek students with experiential learning to demonstrate their skills. Students who participate in an internship have also been shown to increase their employability [Nunley et al., 2016]. Some employers define it solely as an internship in the field but we believe universities have several ways to demonstrate this. The definition of experiential learning can be broadened to students acquiring "work-like" experiences designed to develop hands-on skills while applying

learned fundamental knowledge. It reinforces experiences at the higher levels of the Blooms Taxonomy (apply, analyze, evaluate, and create).

Examples of experiential learning inside and outside an academic program are illustrated in Table 2.

Table 2: Examples of Experiential Learning

Inside the Program	Outside the Program
Significant hands-on activities using common tools (e.g., GitHub, Wireshark, Python).	University work study requiring technical skills (e.g., web development).
Courses teaching the knowledge for a specific industry certification (e.g., A+).	Participation in technology and innovation competitions.
Project-based learning: teaching technology through hands-on projects alone.	Undergraduate research programs in program or through NSF's Research Experience for Undergraduates (REUs)
Courses with significant projects focusing on soft skills such as teamwork, presentations, ethics.	Leadership in student organizations such as ACM, IEEE, and ISACA
Capstone projects: term-length assignments completing a major technology project.	Service-learning projects: students volunteer technology expertise to a not-for-profit or small business.
Technology internship.	Apprenticeship: working students who learn while employed in industry.
Cooperative education (co-op): balancing knowledge with practical, hands-on in the workplace.	Self-learning: hands-on courses leading to certificates or formal certifications.

The authors use the term "experiential" for any skill that involves hands-on learning in a lab/classroom/workplace. Students are encouraged to list these on their resumes. Where students might look for an internship has also been extended. While many still gravitate to the large companies, they are also exposed to innovation through interning with a start-up or small business and service learning through internships with non-profits.

MICRO-INTERNSHIPS

Our program requires all students, except those already working in the field, to take a minimum of one semester-long internship after they have earned about 90-credits. However, evidence shows the value of multiple internships [Wolfgram, Ahrens, & Wu, 2020]. The assumption is that "more is better". The process of getting an internship is stressful and very time-consuming, particularly early on in the program. In an effort to get all students to begin their path to the workforce, we are now offering all students, at any level, the opportunity to work on small projects for outside organization through the Parker Dewy micro-internship program (https://www.parkerdewey.com/). Parker Dewey operates a "gig economy" networking platform for students that connects them with companies for short-term projects. All the projects posted are paid on a fixed-price basis and all the administrative work is managed by Parker Dewey staff. Through the platform, students can take on as many projects as they want, explore different career options and "earn as they learn". We are encouraging our students to look at these opportunities as early as their sophomore year.

DIGITAL BADGING

As students apply for internships, micro-internships and other work-like experiences earlier in their academic journey, there is a need for an alternative way to indicate their knowledge and skills.

Micro-credentials verified and visualized by digital badging are now being widely used to demonstrate competency in a particular skill, verified by a central authority [Fanfarelli & McDaniel, 2019]. Digital badges are widely utilized as a part of an individual's branding and can be verified through a set of metadata [Gibson et al., 2015].

We began with a focused approach on our technology programs. We gained initial experience with digital badging by being added as a higher education institution to the area's Capital CoLAB initiative (capitalcolab.com). To meet the stringent requirements for their existing five digital badges in cybersecurity and data science, we had to map our undergraduate courses against their major employer-generated knowledge, skills, and abilities (KSA) list. This provided us with valuable insights into the employer-requirements and the perceived relevance on what we were teaching.

As the Course/Skills Matrix is developed, pathways to new skills-based digital badges are being identified. These will cover the three vectors (technical skills, soft skills, and tools) and will encompass the liberal arts core, technology core, and the specialties/minors in the undergraduate IT curriculum. One example will be a Technical Writing digital badge which will include liberal arts core courses (two English composition courses) and two IT core classes that are designated as writing intensive (software engineering and software testing).

Mapping the curriculum to an external badge can be time consuming but does provide for additional status for the badge [Ermicioi, Liu, & Murphy, 2021]. Internally developed badges can be mapped against course outcomes and require less effort.

V. CONCLUSION

The authors used a case study method to demonstrate implementing a more skill-focused perspective in an undergraduate IT program. The purpose was to improve student employability by aligning closely with skills-based hiring by employers. This paper illustrated a replicable approach to map curriculum against skills sought by employers and documented a series of program renovations such as credit for certifications earned, micro-internships, a broader definition of experiential learning, workplace readiness classes, and digital badging. We believe higher education institutions are teaching the right knowledge and skills but need to find better ways to demonstrate that to employers.

The skill-focused approach is not intended to replace traditional degrees, but to supplement the knowledge and skills acquired through traditional learning and better identify skills at a more granular level. In higher education, constructing a skill-focused ecosystem can have several advantages as students look to incrementally display their knowledge and skills. They do not want to wait two or four years until they graduate to get the recognition for those new skills.

In summary, the authors believe that it is important to allow college students to explore their career options early in their education and to allow them to master required skills in a modular and agile way. What we educators see is the opportunity for our students to exhibit their skills via trustworthy and transparent platforms and then be in the driver's seat when making informed decisions about their transition to the workforce.

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