

# Skills Infusion in Information Technology Education

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## Abstract

The rising cost of higher education has lead parents, employers, and politicians to question the need for a college degree. Skills Infusion is a professional development program in which faculty review a course they teach to identify the career readiness competencies defined by the National Association of Colleges and Employers (NACE). The NACE competencies are skills that are expected by employers across all sectors of the economy. In addition to describing the Skills Infusion program, a description of how an information technology undergraduate program is expanding on the program to incorporate skills mapping to provide further evidence of accountability in higher education.

**Keywords:** Career Readiness, Skills Mapping, Curriculum Mapping, Higher Education, Accountability

## 1. INTRODUCTION

The expectations that society places on higher education is evolving. It can be argued that the purpose of higher education has been to challenge one's beliefs (Busteed, 2019) through the quest for knowledge. This lends credence to college and university mission statements that talk about global citizens and lifelong learning (Pasquerella, 2020). Lately, the question has arisen as to whether these continue to be the only expected outcomes of higher education.

The rising cost of higher education (Hanson, 2021) has prompted politicians and parents to question whether the outcomes of obtaining a degree justify the costs (Kelchen, 2018). Effectively, higher education is being held accountable. A shift has occurred in which employability is an additional outcome expected of higher education (Sin, Tavares, & Amaral, 2019). In the Fall semester of 2019, Ball State

University introduced its Skills Infusion Program (2021) as a strategy to enhance job skills that will transfer to the workforce across academic disciplines. The remainder of this manuscript will expand on the issue of higher education accountability and the Skills Infusion Program.

## 2. ACCOUNTABILITY IN HIGHER EDUCATION

As the cost of attending college continues to rise (Carnevale, 2020), the need for higher education is being questioned (Carapezza, 2021; Quiroz-Gutierrez, 2021). For students not receiving a full scholarship, the rising cost of higher education presents a challenge and a debate to many, not to mention the time invested in it. While there are other benefits presented with the attainment of a college degree, the potential to earn more than is likely attainable without a degree is the main reason.

According to the U.S. Bureau of Labor Statistics (2021), education attainment and earning potential are directly related. Jobs that require higher-level education and higher skills get paid very high wages, jobs that require little to no education and low-level skills get paid lower wages. Unemployment rates are significantly lower for college-educated personnel, whereas lower educated personnel face very high-level unemployment rates. Similar to the 2009 inflation crisis, the COVID-19 pandemic followed the same trend mentioned above across multiple industries. Earnings, bonuses, and other benefits increase significantly for workers with college degrees compared to those without.

The government and other stakeholders that invest in higher education have increased expectations of accountability (Zumeta, 2011). These stakeholders are asking institutions of higher education to provide evidence that students are learning marketable skills that lead to high paying jobs.

### **3. NATIONAL ASSOCIATION OF COLLEGES AND EMPLOYERS (NACE)**

NACE was established in 1956, connecting over 9000 college service professionals, 3200 universities, and 300 business solution providers. NACE is a major source of information on employment opportunities for college students.

NACE (2021) identified eight career readiness competencies that are essential for college graduates in order to secure high-paying jobs. These competencies include career and self-development, leadership, communication, professionalism, critical thinking, teamwork, equity and inclusion, and technology in the workplace.

- **Career and Self-Development:** Continuous professional and self-development abilities include awareness of their strengths and weaknesses, building relationships, and progress in job growth.
- **Communication:** Includes strong verbal, written capabilities, and communicates in a clear precise manner through various media.
- **Critical Thinking:** Making decisions through reasoning and judgment without bias.
- **Equity and Inclusion:** Engage and include people from local and global cultures, awareness racial policies and laws.
- **Leadership:** Inspiring and motivating self and teams towards organization goals.

- **Professionalism:** Integrity and accountability towards self, others, and organization.
- **Teamwork:** Working in a team to attain common goals and objectives.
- **Technology:** Embracing technology, and constantly updating themselves with newer technologies, knowledge of technology usage policy.

NACE (2021) asserts that when higher education incorporates these core competencies, students are better positioned to successfully start their careers, independent of academic discipline. Career readiness includes the essential skills and competencies that students will need to enter the job force and build on their careers (Department of Education, 2016; Zook, 2018). The issue of competency has more recently been identified as a priority with ACM and IEEE in their joint Computing Curriculum 2020 Task Force report (2020). The report further defines competency to be the summative outcome of knowledge, skills, and disposition. It is commonly accepted that higher education is a purveyor of knowledge. To be competent, the task force is stating that students must also have the ability to go from theory to practice by applying work-related skills and to have the appropriate individual character to appropriately and professionally carry out those skills.

### **4. CURRICULUM MAPPING**

Curriculum mapping refers to the process of identifying what is being taught across the curriculum of an academic program (Uchiyama & Radin, 2008). The process starts with assessing what is being done within individual courses. These individual assessments are aggregated to map out where topics are being taught throughout the curriculum. This comprehensive mapping can then be used to identify core competencies, skills gaps, or areas of overlap within the curriculum.

While primarily used for program review associated with both internal and accreditation program assessments, curriculum mapping can also provide evidence of accountability in higher education. A curriculum map and student artifacts can be shared with parents and politicians to exemplify how a program is fostering the skills that will enhance student employability.

### **5. SKILLS INFUSION PROGRAM**

The Skills Infusion Program is a professional development experience that takes place for one semester and focuses on reviewing course syllabi,

mapping course outcomes to the NACE career readiness skills, and reflecting this on syllabi with input from the Career Center and an Indiana employer/alumni partner. The goals are to help students better articulate transferable skills learned in concert with course content and to provide a gap analysis tool that students can use to reflect on skills not yet practiced or learned.

Each faculty participant is tasked to select one of their existing courses for the duration of the workshop. At the end of the workshop, the course (with the newly infused learning outcomes) will be presented to the group.

Faculty participants are tasked with reviewing the NACE competencies and mapping them to the assignments in their course. This is a preliminary exercise that serves to prime the actual mapping of skills that take place during the program.

The first workshop begins with introductions and goal setting for the program. Breakout sessions are conducted with faculty participants and a faculty mentor. The Career Center selects mentors from among the faculty members who were exemplary during previous sessions of Skills Infusion Program. The mentor guides the first iteration of the NACE mapping process, addressing questions by the participants. The intent is for faculty to reflect upon how their course design addresses the eight Career Readiness competencies. For each assignment, faculty will need to identify the competencies that are being addressed and reinforced. These should then be incorporated into the syllabus as part of the student learning outcomes. After the first workshop, the entire group reconvenes and presents their progress.

The second workshop is dedicated to introducing faculty to alumni and BSU Career Center personnel. These individuals serve to provide faculty with insight into the expectations of employers. Faculty share the competency mapping they identified for their course. Keeping in mind that the final outcome is to have a syllabus that shows students how the assignments translate into career readiness competencies, the alumni and Career Center personnel then provide the faculty with suggestions on how to improve and clarify the student learning outcomes.

The final workshop serves as a wrap-up. Faculty present their new syllabi with the NACE mapping embedded in the document. The faculty answer questions on how the mapping took place and the rationale behind the decisions. This final

workshop concludes with an "ah-ha" session where faculty present their biggest takeaway from the program.

#### *CT 211: System Administration Fundamentals*

One of the authors of this article utilized the CT 211 course for the focus of the skills infusion workshop. The course is designed to introduce students to Windows Server systems administration. Topics covered in the course focus on enterprise technology solutions for organizations. Specific topics include service configuration (e.g., DNS, DHCP), high availability, and systems scalability. The course is quite technology-centric, and a required course for all CIT students.

#### *CT 466: Capstone in Computer Technology*

The second class revised through the Skills Infusion Program was the Capstone Course in Computer Technology. The class serves as the culminating course of the program. It is designed to foster a systems thinking approach to information technology infrastructure design and preparation for the transition from student to working professional. With the latter goal in mind, each assignment in the course was reviewed for the NACE skills that it fostered.

## **6. EXTENSION OF THE SKILLS INFUSION**

The NACE competencies provide a good starting point to identify the transferable skills that are universal to jobs across disciplines. This was the extent of the expectations by the university for participation in the Skills Infusion Program. However, this seemed insufficient for an information technology program whose students will need to show that they have knowledge, skills, and abilities in specific technologies as they apply for internships and full-time employment.

In addition to the NACE competencies in the CT 466 capstone course, specific technology skills were mapped out for each of the course assignments. This skills mapping was based on the instructor's personal experience and interactions with employers. To provide context for what was done, an explanation of the term project is in order. The purpose of the degree in Computer and Information Technology is to prepare students to be the next generation of IT professionals. To reach this goal, students need to be able to integrate the diverse technologies required by employees across departments and job functions. The capstone course presents teams of students with a fictitious retail company for which they have to develop the technology infrastructure and systems required for the

company to be operational. It may be unlikely that students will have the opportunity to build an organization from scratch; it provides them with an opportunity to develop a more comprehensive, systems approach to information technology. This fosters an understanding of the connections and interdependencies between the diverse technologies that are taught in previous classes.

The progression of the project contains the following stages:

1. Design and build a virtualized data center infrastructure
2. Design and build a network infrastructure
3. Install and configure core infrastructure services (e.g. DNS, DHCP, Active Directory, website)
4. Install and configure enterprise (e.g. email servers), departmental (e.g. human resource, accounting, finance, point-of-sale server), and individual software (e.g. office suite applications, email client, anti-virus, point-of-sale client).
5. Secure the previously listed components in this design.

So how does all of this relate to Skills Infusion and skills mapping? For each stage of the project, the specific skills and technologies that were required were identified. The data center infrastructure alone consisted of several technical skills. To build the skills mapping for the project, an engineering journal was used to document the skills used at each step in the process. Upon review of the engineering journal, the marketable skills were listed for each assignment throughout the project. The marketable skills were identified based upon reviews of job descriptions related to associated positions in information technology. This skills mapping will provide students with a list of projects/assignments and the corresponding skills developed.

The purpose of the skills mapping is to provide students with a tool to assist them in building resumes and cover letters for internships and jobs that accurately reflect their skills development. A common refrain among students is, "What do I put in my resume?" Frequently, the answer is that students list the overarching topic for each of the classes they took. The result is a generic list of operating systems and applications.

It is recommended to students that they customize the content of a resume and cover letter to address the specific knowledge, skills, and abilities indicated in the job description and responsibilities (Doyle, 2021; Weickmann, 2021).

Students do not typically have the relevant work experience to bolster that aspect of their resumes. Instead, students are encouraged to draw upon their roles in projects to highlight how they applied the skills that correlate with the internship or job to which they are applying. The skills mapping gives students an inventory of the specific technologies and skills that were associated with those assignments. Students can draw upon this to customize the education and/or skills sections of their resumes with activities that are relevant to the internship/job.

In addition to students, the skills mapping also addresses the concerns of other stakeholders. Students can show parents documentation of the marketable skills that were developed in the course. The skills information can also be used as evidence to politicians that student tuition results in gaining identified marketable skills that will positively impact student employability and career development.

## 7. STUDENT SURVEY

A typical collegiate course will present the student learning outcomes in its syllabus. These outcomes indicate what students will know or be able to do at the end of a course. These student learning outcomes are important for conveying the larger goals and objectives for the course. They do not, however, provide the granular identification of marketable skills offered through the skills mapping.

Of concern is whether students can independently identify the technology skills embedded in courses. A preliminary exercise was conducted with the students in CT 466. The project groups were asked to review their assignments to identify the NACE outcomes and technology skills that they thought the assignments developed. To help in this process, they were provided with the NACE career readiness outcomes and a discussion of marketable technology skills. The skills mapping conducted by the instructor was not provided to the students in advance of the assignment.

A review of the submissions yielded some interesting observations. The first observation is that students did not identify the technical skills with sufficient specificity. For example, an assignment required project groups to build a project plan using an online, collaborative project management tool that they were to use throughout the semester. Instead of stating the tools they used, such as Asana or Trello, students indicated that they used "project management

software” or “online digital technologies”. These generalizations were evidenced by most of the groups for all of the assignments. There are possible causes for this observation. It may have been a lack of clarity or misinterpretation of the instructions. It could also be as simple as a lack of motivation. The class was primarily enrolled with students in their last semester before graduation.

Another observation was that students were able to articulate how the assignments aligned with the NACE career readiness competencies. Students from each of the project groups were able to write action statements indicating how the assignments fostered specific NACE competencies.

## **8. WHERE DO WE GO FROM HERE?**

The deep skills mapping was only conducted in the Spring 2021 capstone course. As a capstone course, the higher-order skills should be critical thinking, technology integration, and systems thinking.

The program intends to conduct NACE and technical skills mapping throughout the Computer and Information Technology degree’s curriculum. Once the faculty have completed the skills mappings of their assigned classes, the collected data will facilitate three program initiatives.

### *Student marketable skills database*

The priority of the skills mapping is to provide students with a comprehensive database of the marketable skills they should expect to develop in individual courses throughout the curriculum. Students will be provided a tool by which they can look up the classes they have taken and review what marketable skills they were to have acquired.

In light of the preliminary data suggesting that students have difficulty identifying the marketable skills in a given class, providing a database of marketable skills for the curriculum should provide multiple benefits to students. Students entering the Computer and Information Technology program do not always know what area of information technology they would like to pursue. Being able to review the marketable skills associated with courses in the curriculum will provide students with insight into the responsibilities associated with the different technology areas. The extended set of marketable skills in the database will also have a broader selection of skills to choose from as students create customized cover letters and

resumes for internship and job applications.

### *Curriculum mapping*

Students will not be the only stakeholders to benefit from the marketable skills database. At the time of the Spring 2021 semester, curriculum mapping for the Computer and Information Technology program was based on the Student Learning Outcomes defined on the course master syllabi. This has provided a broad overview of the content throughout the program. The problem has been that the student learning outcomes are written to address the larger concepts or topics. When working with information technology the details are critical in determining where there are skills gaps. For example, the student learning outcome may indicate that a course will “develop a complex Active Directory domains design that meets organizational needs”. At a broader, conceptual level, the statement conveys the intended outcome. What is not provided are the technical details. To effectively manage the overall curriculum in an information technology degree, the program director needs to know the version of the operating systems being used; in which classes are they being taught; are the Active Directory designs incorporating both Organizational Units and subdomains?

This is not a criticism of student learning outcomes. They are not intended to provide granular detail about the content of the course. Highlighting the limitation of the student learning outcomes simply reinforces the programmatic value of the skills mapping. The skills mapping will answer the questions presented about the mentioned student learning outcome about Active Directory. Being able to analyze the details of the content across courses will help identify the gaps in skills desired by employers and those that are taught in the curriculum.

### *Accreditation*

The process of skills mapping will also support assessment associated with accreditation. The U.S. Department of Education (2021, par. 1) states, “The goal of accreditation is to ensure that institutions of higher education meet acceptable levels of quality”. The accrediting bodies for respective academic disciplines typically present broad learning objectives that degree programs in their field of study should accomplish. It is up to the academic program to reflect those student learning outcomes in their programmatic goals and objectives. The academic programs are then required to conduct periodic assessments to provide evidence that it is accomplishing the learning objectives set forth by the accrediting body.

The purpose of assessment is to determine whether an academic program is effectively meeting its stated goals and objectives. The skills mapping can aid in identifying key points across the curriculum that will provide the most relevant assessment data. If the accrediting body requires specific skills or competencies, the skills map will identify the courses where assessment should be done. It may be that the program administrator wants to show the progression of competency in a skill across the curriculum. The skills map will pinpoint where assessment can be conducted to gather data on student competency for that skill.

## 9. CONCLUSION

The Skills Infusion Program was designed to encourage instructors to identify how their courses will foster the career readiness competencies identified by NACE. The competencies, which include critical thinking/problem solving; oral/written communications; teamwork/collaboration; digital technology (literacy); leadership; professionalism/work ethic; career management; and global/intercultural fluency, are relevant to all academic disciplines. Students are then able to use this information to highlight how they have developed these universal competencies as they apply for internships and jobs. The Computer and Information Technology program is taking this process a step further by also identifying the technical skills developed in its courses. The identification of competencies in specific technologies will benefit both students and administrators. It will provide all stakeholders with data to show that the program is effectively preparing students for their careers upon graduating.

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