W. A. Lawrence-Fowler, L. M. Grabowski and C. F. Reilly, "Bridging the divide: Strategies for college to career readiness in computer science," *2015 IEEE Frontiers in Education Conference (FIE)*, El Paso, TX, 2015, pp. 1-8.

doi: 10.1109/FIE.2015.7344317

The published version of this paper is available from IEEE Explore:
http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7344317&isnumber=7344011

© 2015 IEEE. Personal use of this material is permitted. Permission from IEEE must be obtained for all other uses, in any current or future media, including reprinting/republishing this material for advertising or promotional purposes, creating new collective works, for resale or redistribution to servers or lists, or reuse of any copyrighted component of this work in other works.

Bridging the Divide: Strategies for College to Career Readiness in Computer Science

Wendy A. Lawrence-Fowler, Laura M. Grabowski, Christine F. Reilly
Department of Computer Science
The University of Texas-Pan American
Edinburg, TX, USA
wfowler@utpa.edu

Abstract— **The conversations and debates concerning how a student's time on campus translates to better results upon graduation are not going away. Every day institutions of higher education are challenged to explicitly demonstrate and provide a clear articulation of the value of education as measured by post-graduation employment. We discuss strategies implemented in a computer science program to address the issue of student preparation for the workplace of the 21st century. We discuss the extension of more traditional experiential learning methods including project based courses, capstone courses, cooperative experiences and internships to assist students in developing the necessary skills required to transition from college to the workplace**.

Keywords—experiential learning, career readiness, computer science

I. Introduction and Motivation

In 1976, the headline of Newsweek magazine was "Who Needs College?" [1]. The article's commentary is almost identical to that of today's politicians, pundits and the general public who question how a student's time on campus translates to better results upon graduation and debate the value of a college education. There is a shift in the perception of what the role of a university education is. As described in the Washington Post [2], "students and their parents increasingly view college as training for that first job out of college rather than a broad education for life that provides them with the ability to learn and move through multiple jobs and a career." Adding to the confusion, academia, government, industry, and the media make conflicting claims about the adequacy of the workforce: Is the supply and demand for workers in balance? Is there a particularly severe need to increase the supply and quality within the STEM workforce? Are there simply skills mismatches between employer needs and employee skills? Are students ready to transition to the workforce? No matter the answers, institutions of higher education are challenged every day to explicitly demonstrate and provide a clear articulation of the value of education as measured by post-graduation employment, and stakeholders must make decisions with contradictory, confusing or incomplete data [3].

Lumina Foundation's CEO Jamie Merisotis points out that the shift to a knowledge-based workforce has led to a general confusion about postsecondary education and what postsecondary credentialing means. Merisotis suggests that the confusion leads to an employer's lack of confidence in a graduate's readiness for the workforce. He proposes a transformation of what he refers to as "today's fragmented postsecondary landscape" into one that is student-centered and learning based so that the meaning of the credential is clearer to employers and students [4][5].

In contrast to a traditional higher education model of transferring knowledge, there must be a shift in focus to learning and a shift in the responsibility for the management and direction of learning to the student [6][7]. The move towards making graduates career ready essentially amounts to finding ways to learn basic knowledge, and transforming these capabilities into deeper learning in order to create a flexible and adaptable individual with the appropriate skills to survive in the 21st century [8]. To survive, individuals must adapt and learn in ways that are unprecedented in the formal educational arena.

As university faculty, we have a vested interest in ensuring that our students are employable when they graduate, and we want to help the community understand the value of a college education. We also value a liberal arts education, and work to balance the principle of an education where students learn to become thinkers with the current trend towards an education that prepares students for a job. In this paper, we discuss the approaches we take in our curriculum to help students become well-rounded individuals, as well as prepared for the computing workforce.

We begin by discussing current marketplace factors faced by science and engineering majors. Next, we present the approach we take through our curriculum to help students develop marketable skills while learning to become lifelong learners. We end with a series of narratives based on capstone project experiences and discuss how the capstone project can be used as an opportunity for students to choose specific skills to refine.

II. Marketplace Factors

Historically, the developed world benefited from an industrial economy that offered employment opportunities for all skill levels. However, the combination of globalization, pervasive technical advancements, and shifting demography has changed the employment equation. The knowledge economy, with flexible technology and high performance work systems, demands more skilled and autonomous workers [9]. Job requirements are extended beyond specific discipline based skills and knowledge to more general skill sets including learning, reasoning, communicating, and problem-solving with knowledge that cuts across domains [2][9][10][11]. As Kolb and Yeganeh point out, “Expertise at learning has become a key capability necessary for survival, success and fulfillment” [7].

Though it is often thought that graduates should enter the workforce as a finished product, technical and scientific knowledge evolves so quickly that it is possible that a person's body of knowledge may become obsolete within a few years. In domains undergoing rapid development such as computer science, it is not whether a graduate is ready for the labor market that is most important, rather, upon completion of a degree, students must have not only useful and marketable knowledge and skills, but also the ability to adapt to a continually evolving workplace.

There are a variety of marketplace factors that have influenced our design of a university-level curriculum in computer science. We particularly consider the changing demands of the 21st century workforce. We look at employment rates and the perceived skills gap, the qualities that employers desire in recent college graduates, and we look at the transition from college to career. These issues guide our discussion of the strategies we implement to prepare students to become successful in their transition into the workforce.

A. *21st Century Competencies*

The 21st century skills are defined as competencies required for present and future jobs and include knowledge, skills, abilities, work values, work contexts, and work interests, as well as key tasks and activities required by distinct occupations [9][12]. The U.S. Department of Labor’s Occupational Information Network (O*NET) program has developed a database with detailed information on the competencies of workers by occupations [12]. Using the O*NET data, Carnevale and colleagues at the Georgetown University Center on Education and the Workforce identified competencies highly associated with occupations requiring computer science training [13]. These include cognitive competencies, such as knowledge of math, physics, and other scientific and engineering fields, as well as complex problem solving skills, technology design, and programming. Non-cognitive competencies include preferences for investigation and independent work [13].

In *Revisiting the STEM Workforce*, a companion report to *Science and Engineering Indicators 2014*, the National Science Board describes multiple pathways to these competencies. They identified a need to assess, enable and strengthen workforce pathways and suggested a heavy reliance on higher education in preparing students [3].

B. *Employment Supply and Demand*

Given the challenge of ever changing job requirements, Carnevale suggests that a 21st century worker's prospects "are increasingly grim" without a postsecondary education [3].

In 2012 6.2 million scientists and engineers were employed in the United States, representing 4.8% of the total United States workforce [14]. From 2008 to 2012, employment in these areas increased by an annual growth rate of 1.5%, while overall U.S. employment contracted by 0.9%. Although science and engineering employment was concentrated in two occupational groups, computer occupations (56%) and engineers (25%), when viewed as an aggregate, the increase in employment hides the differential degrees of growth and decline in specialized occupations in these areas [14], an important element in fully understanding employment.

Because labor markets in science and engineering differ greatly across fields, industries and time, it is easy to identify a specialization that is in short supply. For example, employment in social media may be expanding, while other occupations shrink or are moved off shore. And though it is true that highly skilled professional occupations almost always have lower unemployment rates than the rest of the US workforce, there are surprisingly high unemployment rates for recent graduates such as engineering (7.0%), computer science (7.8%) and information systems (11.7%) during the first year [15].

This leads us to focus on how we can better prepare our students for the workplace. We looked at additional marketplace issues in an effort to determine what we can do to increase their competitiveness in the marketplace. Do they lack general 21st century skills, STEM competencies, or computer skills? What do employers want? Are there issues related to transitioning from college to the workplace?

C. *A Skills Gap?*

In a recent survey commissioned by the Chronicle of Higher Education and Marketplace, over half of the employers said they had trouble finding recent graduates to fill positions at their company or organization. Nearly one third gave colleges fair to poor marks for producing successful employees, criticizing degree holders for lacking basic workplace proficiencies [16]. A recent Bentley University study revealed that there are significant disconnects between students' perceptions of their preparation and employers' expectations of students' preparation, and a disagreement over who is responsible [17]. In a survey of 126 CEOs of major U.S. companies conducted by Business Roundtable and Change the Equation, 97% cited the “skills gap” as a problem [18].

Jeffrey Selingo in The Washington Post asserts, "As the price tag of college skyrockets and the job market for recent college graduates tightens, students and their parents increasingly view college as training for that first job out of college rather than a broad education for life that provides them with the ability to learn and move through multiple jobs and careers" [2]. He goes on to suggest that most college seniors are not ready for professional jobs. They either don't have the hard skills in computer coding and data analysis, or, more important, the soft skills employers are seeking such as problem solving and the ability to communicate and collaborate with co-workers and customers.

Conversely, Paul Krugman in the New York Times reports that multiple studies have found no support for claims that inadequate worker skills explain high unemployment [19]. Other discussions in the news media have suggested that the change in the relationship between job openings and unemployment denotes merely a mismatch due to geography and demography [20], or that it is not a skills gap that employers are referring to, but rather an experience gap that is holding recent graduates back from the best jobs [6]. Following from this, it has been suggested that colleges should be closing this gap by ensuring that students get meaningful experiences preparing them for work long before they finish school [6].

D. *What Do Employers Want?*

The majority of employers say that possessing both field-specific knowledge and a broad range of knowledge and skills are important for recent college graduate to achieve long-term career success [21]. In broadest terms, demonstrated proficiency in cross-cutting skills related to communication, teamwork, ethical decision-making, critical thinking, and applying knowledge in real-world settings rank as employer's top priorities when hiring [9][22]. The ability to listen, interpret, follow instructions, and communicate with other people both orally and through writing are also listed [23], as are skills that demonstrate aptitude in a social setting and an ability to work in a team [24][25].

An Association of American Colleges and Universities survey found that employers place the greatest value on demonstrated proficiencies in skills and knowledge that cut across all majors; 88% of surveyed employers thought that it was important for colleges and universities to ensure that students are prepared to complete an applied learning project, and 60% thought that all students should complete a significant applied learning project before graduating [21]. The majority of employers stated that they were more likely to consider a job candidate who had participated in an internship, senior project, collaborative research project, or a field or community based project than a candidate who had not.

E. *Challenges for Transition from College to Career*

Currently, most students have opportunities to learn large amounts of domain knowledge and skills, but with few learning opportunities embedded in real work. Yet, when they graduate they are expected to be capable of applying knowledge and skills with flexibility. They must know what to use when, and they are expected to adapt their knowledge and skills to a variety of situations. We have found that even with project-based and capstone courses students may not be well prepared in domains outside of computer science. More importantly, they lack the skills to understand and remedy this situation. Though they should be ready for continued professional development, they may not be. Boshuizen's example of a software engineer who graduated and within five years had to not only stay up to date by learning a new language, but also adapt to completely new concepts and technologies with the introduction of the next disruptive technology [8] provides an example of the most sought after career skills – those skills related to job retention [26].

Smith and Gast [27] proposed, “There is a great myth that all seniors are ready for graduation and their impending transition into careers or graduate education." This is supported by research reported by Goleman, LaPlante, and Shivpuri and Kim suggesting that many students finish college or enter the workforce only to find that they are ill prepared for dealing with many aspects of both their personal and working lives [28] [29] [30]. Even though job-related domain knowledge is critical for workplace success, there are other necessary skills needed for success in the workplace.

The transition to a career is often difficult because it requires the reorganization of self and the development of a new set of beliefs about life and career. Building on Erikson’s theories of ego identity development in which he argues that establishing an ego identity (an understanding of who we are within the context of who we have been and our place in the social order) is the primary task of adolescence [31], Macia contends that college students are at the point of developing identity as a result of exploration and commitment [32]. Hansen talks about this as an identified point in an individual’s life when they face anxiety and a sense of being adrift, lost [33]. After years of learning the system of how to succeed in school, the twenty something college graduates are thrown into the world of work with no real understanding of how to succeed in it [33]. They are forced to learn a new set of skills and attitudes that align with the workplace [34][35]. He identified critical issues that graduates face when making the transition from college to work [33]. Those that can be addressed in curriculum include:

- Time related issues - shifting from planning one’s own schedule to working five days a week, eight hours a day,
- Learning everything you didn't learn in college and dealing with people of different personality types,
- Professionalism in the workplace based on who you are and what you want to do, and
- Developing a reputation as a valuable employee.

Another approach to address this transition is through internships. To develop mastery, students must acquire component skills, practice integrating them, and know when to apply them. Providing an opportunity to reflect on and integrate their academic experience into the workplace as a professional, quality internships focus on critical skills that employers value highly new employees will need to be successful: risk-taking, leadership, teamwork and collaboration, critical thinking and problem solving [6][36]. The National Association of Colleges and Employers reported that 63% of paid interns received at least one job offer post-graduation [21]. Lander reports that in 2012 69% of companies with 100 employees or more offered fulltime jobs to their interns and that interns had a seven in ten chance of being hired by the company they interned with [37].

III. Enhancing Development of Workplace Readiness

Degree programs in computer science are designed to prepare students with marketable expertise to enter the computing and information fields, as well as the skills and education required to adapt to the rapidly changing characteristics of the fields [38]. Anticipating shifts in skills and abilities, CAC (Computing Accreditation commission) within ABET (Accreditation Board for Engineering and Technology) provides guidelines that challenge faculty to prepare computer science graduates for careers and continuous learning in the ever changing knowledge-intensive workplace [39][40]. Thus, computer science education must cultivate a wide range of capabilities that extend from current engineering and professional practice to those skills and knowledge sets that will result in the next generation of computer scientists with the abilities to lead and solve challenges well into the 21st century [41]. In this section, we describe the bachelor's and master's degrees that are offered by our department and discuss how various learning approaches are incorporated into our curriculum. We then discuss ideas for personalizing the curriculum based on the experiences and desired learning outcomes of individual students. The final section presents narratives as examples of how the capstone project has been personalized for our students.

A. *Computer Science Curricula*

The University of Texas-Pan American (UTPA) offers ABET accredited degrees in computer science and computer engineering, and master's degrees in computer science and in information technology. In Fall 2014, approximately 300 students were enrolled in the computer science bachelor's degree, 250 students in the computer engineering bachelor's degree, and 150 in the graduate programs. In addition to providing a core body of knowledge in the domain, the educational objectives for the degree programs include providing graduates with an understanding of social, professional and ethical considerations related to their disciplines. This paper discusses our use of deliberate practice, experiential learning, and the undergraduate capstone course and the graduate level master's project course to provide personalized opportunities for students to better prepare themselves for their careers.

The undergraduate curriculum for both the computer science and computer engineering degrees begins with a course to introduce the discipline. The course sets context for the remaninder of the program, providing a foundation for the fundamental concepts of problem solving, algorithms and programming. Concrete exercises with limited solution spaces keep students focused on one or two issues at a time. For the last quarter of the course, robots are used to provide opportunities for students to integrate all of the course concepts with immediate and concrete visual feedback. Over the next two years, the curriculum focuses on skill development by introducing progressively more abstract concepts. It incorporates deliberate practice in both lectures and labs in which student performance is compared against an ideal model of performance to help students develop programming skills, as well as introduce problem solving and languages. The curriculum moves from concrete examples with demonstrations of concepts and constructs to more abstract levels of problem solving. This deliberate practice facilitates a "spiral of knowledge development" [36].

A junior level course in systems programming provides an opportunity to complete an indiviudal semester long project in four well defined stages. This creates a space within the curriculum that allows students to transition from iterative practice to more experiential learning. This shift allows them to develop a knowledge framework that organizes both factual and domain knowledge. Students are able to increase their learning effectiveness through four modes of learning: experiencing, reflecting, thinking, and acting, all of which are skills and abilities found in the 21st century competencies [36].

During the final year of the undergraduate curriculum, students typically take courses that have more open-ended projects, and students complete a capstone project.

The master's curriculum focuses on providing students with an opportunity to develop a deeper understanding of fundamental concepts of computer science, as well as broaden exposure to specialized topics. Through elective courses and a capstone project, students can choose to focus on a particular area of interest. Computer science master's students have two choices for the capstone project: a one-semester project or a two-semester thesis. The information technology master's curriculum is designed for students who earned a bachelor's degree in a field that is not computing based. The first semester courses provide a leveling experience for these students. At the end of the information technology degree program, students complete a one-semester project.

B. *Project Based Courses*

The deliberate incorporation of experiential learning in engineering and computer science education is common [36][42][43]. We suggest that a key is to give students project-based work or field studies earlier in their academic career. This provides students with more activities that integrate the lessons of the classroom with the real world [42]. These experiences can be used to address either false beliefs or potential gaps in knowledge and skills that might prevent graduates from successfully advancing their education, finding a job, and succeeding in their career.

We require a project based course in software engineering in each of the undergraduate degrees which may be taken after students have completed courses in advanced algorithms and data structures and in systems programming. The course provides a formal approach to the state-of-the-art techniques in software design and development with focused discussion on project planning, requirements, specification, system design, testing and implementation, and integration of the knowledge that students have learned in their other classes. Team projects are used to provide some experience in real world problem solving. The nature of the projects requires that students learn to not only apply software engineering principles, but, more importantly, develop collaborative and project management skills and expand their written and oral communication proficiency. Teams work on identified problems or challenges, most often involving concepts outside of the students' domains of expertise. This forces students to expand their existing knowledge base beyond the principles of their discipline and software engineering. Addressing a real problem adds value and motivation to the learning experience: the project becomes a challenge with multiple options for a solution, not just an exercise. Students take ownership, and the process to a solution results in identifiable learning outcomes [4][23][44]. At the graduate level, a similar course is offered for both of the degrees. The graduate software engineering course places more emphasis on issues of project management and resource management.

All of the software engineering courses provide an opportunity for students to experience a number of Hansen's critical transition issues. To successfully work within a team students must learn to shift their planning from self to that of the team, often resulting in concessions to schedules developed by the team. They must learn to deal with individuals with different skill sets and different personalities. On a team they must represent their skills and knowledge with honesty. If successful, they learn how to be a valuable team member.

Aside from a required theory course and a capstone senior project, the undergraudate curriculum provides the freedom for students to choose multiple paths through their upper division courses. Through discussion with faculty, students choose pathways that help them reach short term and long term career goals.

Both the undergraduate and graduate database courses include a semester-long project in which students work in groups to design and demonstrate the use of a relational database schema. Students select their own project topic and are encouraged to work with a real client or real problem. The project is divided into phases that are spread throughout the semester. Student teams receive feedback from the instructor on the deliverables for each phase and are encouraged to modify their design based on this feedback prior to progressing to the next phase. The structured phases of the database project help students to understand the software design process, while the open topic of the project provides students with the opportunity to customize the project based on their own interests and learning goals.

These example courses provide a formative learning environment where students can reflect on their experiences, assess their performance, apply feedback to improve their work, and identify their strengths and their weaknesses. Multiple presentations that address content and process allow students to refine communication skills. One of the critical skills desired by employers, and as Jarrett of KORU explains, communication is one of the easiest skill areas to improve in a short amount of time [2][29].

C. *Internships*

Though we encourage students to participate in internships, we are faced with two significant challenges. The first is that there are 21 million college students and only 2 million internships. The "simple" solution is to create 19 million more paid internships, but it seems highly improbable that this will happen. The second challenge is more closely aligned with our specific student populations. Many of the students have commitments that do not allow them to leave the region until after graduation. To address this challenge, we work with our local community to create opportunities for service learning and in this way create opportunities similar to those available through internships. For example, a student's volunteer work with a local nonprofit on social media can evolve into a paid position with the organization. Similarly, an unpaid internship at a local school district can lead to a permanent position. Recently, a project started in a software engineering course with a potential client turned into an opportunity for a team hire for the summer to complete the work.

D. *Capstone and Master's Project Courses*

The undergraduate curriculum includes a capstone senior project in which students construct a software product, following it through the stages from initial specification to the final completed project. The master's in computer science requires a thesis or final project, and the master's in information technology requires a final project. Those students who intend to extend their education beyond the master's level are directed towards the thesis option, while those students who intend to use the master's as their terminal degree are directed towards the final project.

The role of the capstone course is for students to integrate and synthesize learning from within the academic major to help students see the coherence across the discipline's body of knowledge. In the senior design and senior project courses in computer science, typically the goal is to promote coherence and relevance of general education and to foster conceptual connections between a student's general education and that in computer science. Design projects foster integration and synthesis within computer science and often require students to delve into other knowledge domains. The courses provide students many opportunities to explicitly develop skills, competencies, and perspectives that were either only tacitly or parenthetically introduced in other areas of the curricula (or missed altogether), improve their career preparation and facilitate their transition from an academic environment to the workplace.

E. *Thinking about Career Readiness*

We contend that it is important for student success to recognize the role that universities can play in helping students work on personal competence skills, social skills, and career and employment skills concurrently. Career development processes can be embedded in the curriculum and assist students in understanding, evaluating, and developing their personal competencies as they prepare to transition to the workplace. We can add focus on the time of transition from school to work, so that we might better prepare graduates to make this transition - to change their mindset from one geared toward freedom and autonomy to one of structure and teamwork [17]. Getting a job should not be something done after college, rather it should be a multistep process within the curriculum.

IV. Example Experiences

Knowing that "context and continual integration across time" promotes the transfer of knowledge in new contexts, we have opted to go beyond traditional experiential learning methods including project based courses, capstone courses, cooperative experiences and internships to provide further opportunities to assist students in developing the necessary skills required to transition from college to the workplace. We began by developing a simulated corporate environment distributed over time and space to better assist students in transitioning from college to career [42]. Small group contexts provided opportunities for students to learn to communicate clearly in multiple media formats, deal with managing and applying large quantities of data, and making decisions with incomplete information. Students learn to transfer existing knowledge in changing contexts while simultaneously implementing changes in the areas of personal growth and career development.

In an effort to more closely address the college to career transition, we then extended the simulated environment to support students in meeting academic goals and expectations, facilitating college and career planning and transition to the workplace. By scaffolding the learning experience, students had opportunities to master common skills while still allowing them to tailor individualized learning based on their post-secondary goals. Even though specific student goals and pathways varied, all students were expected to meet similarly rigorous standards. The specific student experiences were shaped by the students' goals, not their prior performance, and were also flexible, allowing students to alter programs to align with their changing post-secondary plans.

The following personal stories provide examples. The goals and expectations for students covered a wide range of knowledge and skills that extended beyond computer science and information technology domains. Their pathways reflect individual career interests and aspirations that were driven by state and national economic needs in conjunction with personal circumstances.

A. *Lilia's Story*

Though hesitant to accept an internship 864 miles from her family, Lilia was able to coordinate care for her two young daughters with her parents. So, after her junior year as a computer science major, she accepted a summer internship in the technology division of an international food processing company. With her daughters in trusted hands, she was able to focus on the experience and fully participate in a well-structured corporate internship program.

As with numerous other internships, at her internship exit interview, Lilia was offered a job upon completion of her degree. She had a corporate job waiting for her, with the potential for a long and successful career. It would have seemed that she would return to school, breeze through her classes, graduate, and move her daughters half way across the country to begin a career. Though she did return to school, and her classes went well, she returned from her internship, not doubting her computational skills, but rather concerned about her writing. Rather than completing a traditional capstone senior project, she worked with her faculty advisor to craft an experience that met the definition of the senior project, but more importantly focused her attention on honing her writing skills.

Lilia decided to complete a service learning project involving the creation of detailed and complete requirements and specific analysis documents for a software project supporting all organization of a local non-profit. By combining service learning, basic writing and software engineering, Lilia was able to practice professional writing in a situation that required her extant knowledge of the software development process. An unintended outcome of the experience was the opportunity for her to improve her evaluative and intentional listening skills as she elicited requirements from the non-profit's staff.

B. *Salmon's Story*

Salmon participated in a museum reservation system project as part of the graduate software engineering course. He also took the required database course, but worked on a different project. For the capstone project for the master's degree, Salmon decided to focus on the database component for the museum reservation system. His project expanded the project from the software engineering course by considering a database design for a more general-purpose system that could be used by organizations that handle reservations for a variety of types of events, including tours, room reservations, and reservations of resources. Additionally, the database provided for the storage and retrieval of membership information and staff assignment for events.

This project helped Salmon develop a variety of skills that he will use in the future. When planning the database design, he combined the requirements of the museum with those of another potential client. This required him to abstract the specific needs of each client and focus on how these specific needs could be met by a flexible and general database design. Additionally, he considered how the schema could adapt to new customers in the future. The ability to design a product that is flexible enough to meet the requirements of currently unknown customers is an important skill that is required in the corporate world. Additionally, Salmon wrote documentation for the database design that explained the design and provides a sample application with examples of how the database can be used for creating reservations and generating reports.

C. *Victor's Story*

Victor's master's project also evolved from the graduate software engineering class project, but with a quite different direction. His role focused on development of the prototype, and it was demonstrated for the class and the client at the end of the semester. The goal of Victor's master's project was to deliver a completed software application to the museum and assist the staff with setting up and rolling out the product.

Over the summer, Victor took control and responsibility for his own learning and engagement with the project. Victor worked on fleshing out the aspects of the system that the team had not included in the prototype. To enhance the functionality and usability of the software, Victor reviewed the requirements document, and incorporated several features that his class team had not included in their requirements.

By early fall semester, Victor thought that the product was nearly completed and looked forward to taking the application to the museum for testing. But the situation at the museum had changed over the summer. Personnel at the museum had changed, so the software would be delivered to a new client representative. As a result, Victor had to handle a number of changed and added requirements. Victor was able to deliver nearly all of the changes and make several adjustments to enhance usability. Near the end of the semester, Victor helped the museum's information technology specialist set up the software to run on the museum's server. Victor also created an extensive help/training video to support the software and offered to provide a rollout period for the software in case the client encountered problems.

In addition to his project, Victor served as a teaching assistant in the computer science department. Working closely with an experienced faculty member over two years, Victor took on more and more responsibility for the delivery of a freshman level computer science course. During his first semester, he assisted the faculty member with a structured lab component. During the second semester he volunteered to both lead lab and occasionally provide a lecture. Reflecting on his experience and the student outcomes, Victor experimented with novel methods for content delivery during his third semester. Finally, during his fourth and last semester, roles were reversed, and the faculty member served as his assistant.

Although Victor had considered a career in software development, upon graduation, Victor accepted an offer to teach at a local community college.

V. CONCLUSION

It is our hope that insights and stories we share will help others experiment with strategies leading to changes in the curriculum that accommodate the boarder landscape of learning required in computer science to maintain a strong, capable workforce, as the workforce needs of the country change. We suggest that these extensions to traditional experiential learning serve as strategies for deliberate and intentional cultivation of skill sets beyond those of the discipline. As a result, students are equipped to better articulate career goals, skills and abilities, and their relationship to the major. They are able to explain the connection between what they are learning in their discipline and the world of work. We propose that these experiences help students move beyond becoming lifelong learners; the experiences assist students to position themselves for lifetime employability. The experiences equip students to strategically and successfully navigate transitions. They serve to support their successful navigation of the path from college to the workplace with clarity, confidence and competence.

Finally, we suggest that although the strategies discussed have been successfully implemented at the faculty level, it is appropriate to intentionally embed career development skills that support the evolving economy into the fabric of the curriculum across the institution. The jobs are there; so is the perception of a "skills gap." There is also an experience gap - one that universities can help bridge.

REFERENCES

[1] Newsweek, "Who needs college?," *Newsweek,* pp. 60-69, 26 April 1976.

[2] J. J. Selingo, "What happens when colleges fail to prepare graduates for jobs?," 31 03 2015. [Online]. Available: http://www.washingtonpost.com/news/grade-point/wp/2015/03/31/what-happens-wehn-colleges-fail-tp-prepare-graduates-for jobs?. [Accessed 31 March 2015].

[3] National Science Board, Revisitng the STEM Workforce; A Companion to Science and Engineering Indicators 2014. Washington DC:National Science Board, 2014.

[4] The Lumina Foundation, "A stronger nation through higher education: ten-year time horizon brings goal 2025 into sharp focus," Indianapolis, IN, 2015.

[5] L. Anderson Weathers, "National dialogue to transform our higher ed system," Lumina Foundation [online]. Available http://www.luminafoundation.org/news-and-events/Diverse-Group-Of-National-Organizations-Launches-Dialogue-Aimed-At-Transforming-America's-System-Of-Postsecondary-Credentials.

[6] S. Svrluga, College VP: An Experience gap is keeping graduates from getting good jobs. Washington DC, USA : The Washington Post, The Washington Post, March 31, 2015.

[7] D. A. Kolb and B. Yeganeh, "Deliberate experiential learning: mastering the art of learning from experience," in Contemporary Organizational Behavior in Action, Upper Saddle River, NJ: Pearson Education, 2012.

[8] H. P. Boshuizen, "Expertise development: the transition between school and work," Herleen, 2013.

[9] A. P. Carnevale and N. Smith, "Workplace basics: the skills employees need and employers want" Human Resource Development International Journal*,* vol. 16, no. 5, pp. 491-501, 18 November 2013.

[10] P. Olson, "Career planning beyond the B.A.," Inside Higher Ed*,* 25 July 2013.

[11] J. Besson, "Employers aren't just whining - the "skills gap" is real," 25 August 2014. [Online]. Available: https://hbr.org/2014/08/employers-arent-just-whinig-the-skills-gap-is-real. [Accessed February 2015].

[12] O*NET, "O*NET OnLine," O*NET, 2015. [Online]. Available: https://www.onetonline.org/. [Accessed 2015].

[13] A. P. Carnevale and S. J. Rose, "The economy goes to college, the hidden promise of higher education in the post-industrial service economy," Georgetown University Center on Education and Workforce, McCourt School of Public Policy, Washington, D.C., 2015.

[14] J.F. Sargent, The U.S. Science and Engineering Workforce:Recent, Current, and Projected Employment, Wages, and Unemployment. Washington DC: Congressional Research Service, 2014. p. 38. 7-5700 R43061.

[15] M. Teitelbaum, "The myth of the science and engineering shortage," The Atlantic*.* 2014, March.

[16] K. Fischer, "The employment mismatch: a college degree sort job applicants, but employers wish it meant more," 27 April 2015.

[17] J. J. Liptak, College -to- Career Transistion Inventory, Indianapolis, IN: JIST Works, 2010.

[18] Business Roundtable, Company-led initiatives seek to narrow gap in STEM fields. Washington Dc: Business Roundtable, 3 December 2014

[19] P. Krugman, "Jobs and skills and zombies," 30 March 2014. [Online]. Available: http://www.nytimes.com/2014/03/31. [Accessed 7 September 2014].

[20] N. Kocherlakota, "Inside the FOMC," 17 August 2010. [Online]. Available: http://www.minneapolisfed.org/news-and-events/presidents-speeches. [Accessed 7 September 2014].

[21] Hart Research Associates, "Falling short? college learning and career success," Association of American Colleges and Universities, Washington D.C., 2015.

[22] L. Olson, "Skills for work, college readiness are found comparable.," Education Week*,* vol. 25, no. 36, pp. 1-19, 2006.

[23] Georgetown Univesrsity CEW, "Georgetown University Center on Education and the Workforce," McCourt School of Public Policy, Georgetown University, [Online]. Available: https://cew.georgetown.edu/. [Accessed January 2015].

[24] G. Fletcher, "An eye on the future," THE Journal*,* vol. 34, no. 7, pp. 26-27, 2007.

[25] K. Bryd and G. McDonald, "Defining college readiness from the inside out: first generation college student perspectives.," *Community College Review,* vol. 3, no. 1, pp. 22-37, 2005.

[26] National Association of Colleges and Employers. Job outlook 2009. New York : National Association of Colleges and Employers, 2009.

[27] D. Smith and L. Gast, "Comprehensive career services for seniors," in The Senior Year Experience: Facilitiating Integration, Reflections, Closure, and Transition, J. Gardner and G. Van de Veer, Eds., San Fransisco, CA: Jossey-Bass, 1998, pp. 187-209.

[28] D. Goleman, Working with Emotional Intelligence, New York, NY: Bantam Books, 1998.

[29] A. LaPlante, "How IS execs can fill business-skills gaps.," Computerworld, no. 25, pp. 90-97, 1991.

[30] S. Shivpuri and B. Kim, "So employers and colleges see eye to eye?," NACE Journal, no. Fall, pp. 37-44, 2004.

[31] E. Erikson, Identity: Youth and Crisis, New York, NY: Norton, 1968.

[32] J. E. Marcia, "Ego identitiy and object relations," in Empirical Perspective on Object Relations Theory, J. Masling and R. Bornstein, Eds., Washington DC, USA: American Psychological Society, 1994, pp. 59-103.

[33] R. S. Hansen, "Navigating quarterlife crisis to career and personal success: five strategies for fullfilling your dreams," 2015. [Online]. Available: http://www.quintcareers.com/quarterlife_career_crisis.html. [Accessed 16 January 2015].

[34] L. Hanneman and P. Gardner, Under the Economic Turmoil a Skills Gap Simmers, vol. 2010, East Lansing, MI: Michigan State Univeristy Collegiate Employment Research Institute, 2010.

[35] L. E. Wolf-Wendel and M. Ruel, "Developing the whole student: the collegiate ideal," New Directions for Higher Education, no. 105, pp. 35-36, 1999.

[36] A. Y. Kolb and D. A. Kolb, "Learning styles and learning spaces: enhancing experiential learning in higher education," Academy of Management Learning and Education, vol. 4, no. 2, pp. 193-212, 2005.

[37] S. Lander, "Internships.com," 2012. [Online]. Available: www.internships.com. [Accessed August 2014].

[38] Computer Science Deaprtment, "Bachelor of Science in Computer Scince (BSCS)," in The University of Texas-Rio Grande Valley Degree Requirements, Edinburg, TX: The University of Texas-Rio Grande Valley, 2015, p. 324.

[39] Engineering Accreditation Commission, "Accreditation: setting the standard worldwide," 2013. [Online]. Available: http://www.abet.org/accreditation/. [Accessed 22 August 2013].

[40] Computing Accreditation Commission, "Accreditation: setting the standard worldwide," ABET, 2013. [Online]. Available: http://www.abet.org/accreditation/. [Accessed 22 August 2013].

[41] Association for Computing Machinery, "What is CS?," ACM, 2013. [Online]. Available: https://www.acm.org/public-policy/What_is_CS_final.pdf. [Accessed 22 August 2013].

[42] L. M. Grabowski, C. F. Reilly and W. A. Lawrence-Fowler, "Emulating a corporate software development environment through collaboration between student projects in six courses," IEEE Frontiers in Education, Madrid, 2014.

[43] M. A. Laingen, Assessing engineering students' demonstration of wrokplace competencies in experiential learning environment through internships and cooperative work experiences, Ames, IA: Iowa State University, 2014, p. 168.

[44] S. J. Lopez and P. Sidhu, "State of the American workplace," Gallup, 2013. [Online]. Available: www.gallup.com/poll. [Accessed 7 September 2015].