Becoming Market-Ready: Nurturing Exceptional Students Through Early Integration of Project Management Skills in Technical Curricula

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Abstract

The need for Project Management Skills in Polytechnic programs has been vastly overlooked by universities as a method to increase student success. Despite the widespread adoption of project-based learning in polytechnic institutions, many programs overlook the necessity of teaching project management as a core course early in the curriculum. While project management courses are often offered as electives, they are rarely mandatory, and when they are, it is typically in the senior year, limiting their impact. By incorporating standardized project management tools and techniques into the curriculum early, students can immediately enhance their academic performance and gain a competitive edge in the industry upon graduation.

Keywords
project management, credentialing, outcome-based learning, transferable skills, problem solving, communication, teamwork, time management, leadership.

1. Introduction
In recent years, polytechnic programs within higher education institutions have gained significant momentum for their effectiveness in preparing students for the dynamic demands of the workforce. Embracing an integrated approach, these programs, defined by California State University as seamlessly blending experiential learning with practical, technology-driven skill development, stand in stark contrast to traditional conceptual-based education. Traditional education models often fall short in providing students with the hands-on application of learned theories. Recognizing this disparity, employers actively engage with educators through university-industry advisory boards to communicate their evolving needs, which polytechnic programs seek to address.

The contemporary academic landscape is characterized by its responsiveness to industry imperatives, with institutions regularly revising courses and curricula to better align with the ever-changing demands of the workforce. Employers increasingly seek individuals capable of making immediate contributions upon joining a team, prompting colleges to facilitate this transition. At the heart of the polytechnic model lies project-based learning, widely acknowledged for its efficacy in nurturing critical thinking skills and equipping students to tackle real-world challenges head-on.

In light of the national emphasis on STEM education, propelled by both governmental directives and scholarly discourse, the significance of integrated learning models cannot be overstated. As technology continues to shape new job landscapes, the integration of practical skills with theoretical knowledge becomes paramount.

Despite the evident benefits of project-based learning within polytechnic programs, the integration of project management courses remains an overlooked aspect. Many institutions either delay the introduction of project management courses until the final year or omit them entirely from their curricula. However, the skills imparted through project management courses not only prepare students for the workforce but also enhance their aptitude as learners. According to the Center on Education and the Workforce at Georgetown University (2020), employers prioritize skills such as communication, teamwork, sales and customer service, leadership, and problem-solving and complex thinking in prospective hires.

Similarly, Reynolds from Harvard University (2022) identifies crucial skills for college success, including time management, cultural competency, problem-solving skills, critical thinking, communication, and conflict management. Interestingly, many of these skills align with the proficiencies sought by employers, emphasizing the symbiotic relationship between academic and professional requirements.
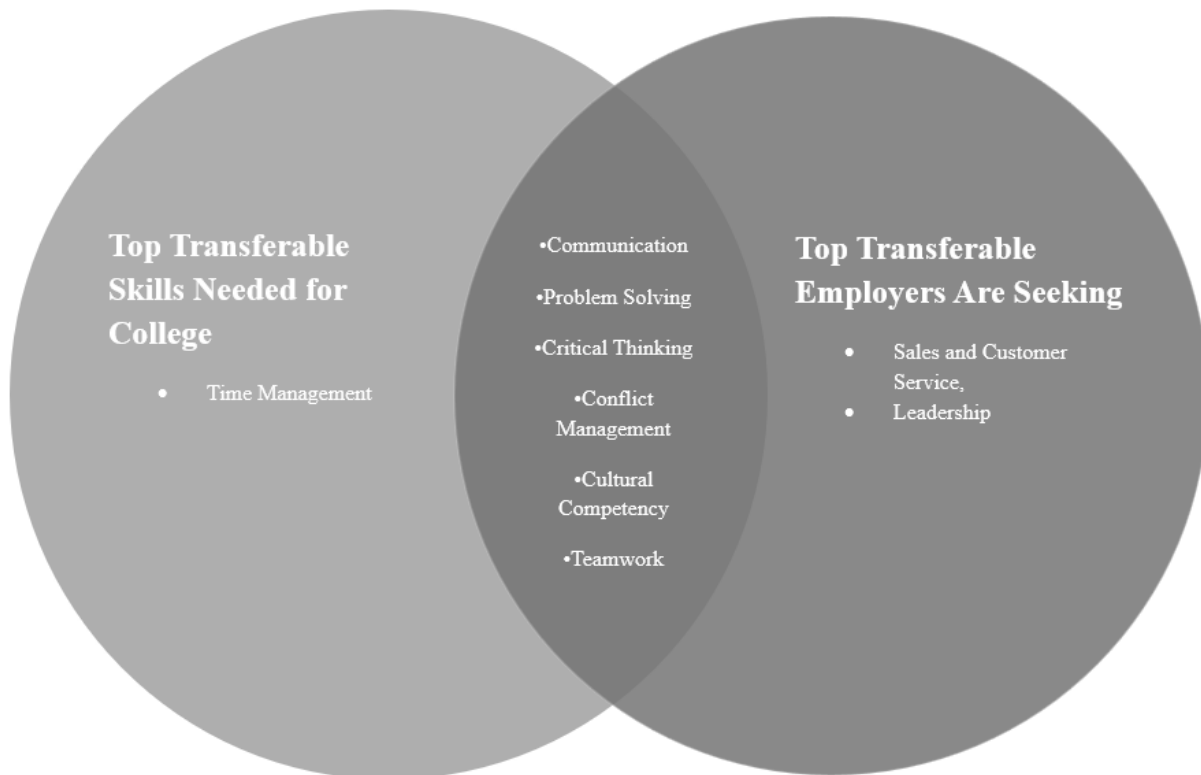
Project Management Skills Employers and Colleges and Universities are Seeking from Students
Figure 1A

Integrating project management courses earlier in the curriculum presents a comprehensive approach to skill development, enabling students to practice and hone these competencies not only in their academic pursuits but also in their everyday lives. By bridging the gap between classroom learning and real-world application, early exposure to project management fosters a seamless transition from academia to the workforce, empowering students to navigate the complexities of both realms with confidence and competence.

1.1 Objectives

The primary objective of this article is to highlight the crucial significance of early integration and inclusion of Project Management courses and curriculum within technical majors and other closely related STEM Majors. Through a comprehensive exploration, this paper aims to emphasize the transferable skills highly sought after by employers. Furthermore, it underscores the importance of project management skills as potent tools to navigate life's challenges, especially as a college student. The paper also addresses the necessity for technical programs to reassess the placement of project management courses to ensure students are better prepared to succeed in their programs and are set up for success in today's workforce.

1.2 Triple Constraint Theory

Triple constraint theory encapsulates the fundamental principle that all projects must delicately balance cost, time, and scope to achieve success. Mastering the skill of the triple constraint theory extends beyond project management into the broader landscape of collegiate life, where students are constantly challenged to navigate a range of responsibilities. From juggling coursework and extracurricular activities to managing project deadlines and financial obligations, students must hone skills in prioritization, resource allocation, and goal setting.

Mastering these essential competencies empowers students to make informed decisions, strategically gather materials, and effectively operate within project parameters. Whether it is determining the optimal allocation of time between study sessions and leisure activities or carefully budgeting for educational expenses, students are continuously having to strengthen their ability to strike a delicate balance.

Moreover, the art of making valuable trade-offs becomes paramount as students strive to accomplish tasks, adhere to budget constraints, and meet academic deadlines. These invaluable skills gained during college serve as a cornerstone for success as students transition into the workforce, where the ability to manage time, resources, and project scope is highly desired by employers.

Teaching project management skills and theories such as the Triple Constraint Theory is vital for college students to learn in their earlier years so that students can practice these skills early on and implement them within their academic and future careers. As a result, project management skills such as the triple constraint theory should be taught to students earlier in their technical programs.

Triple Constraint Theory
Figure 1.2A

The Triple Constraint Model. The Iron Triangle (McCoy, 1987; Morris & Hough, 1987; De Wit, 1988; Pinto & Slevin, 1988; Kerzner, 1989; Gray et al., 1990; Navarre & Schaan, 1990; Saarinen, 1990; Archibald, 1992; Mohsini & Davidson, 1992; Turner, 1993; Paek, 1995; Walker, 1995; 1996; Ballantine et al., 1996; Belassi & Tukel, 1996; Munns & Bjeirmi, 1996; Deane & Clark, 1997; Hatush & Skitmore, 1997; Shenhar et al., 1997; Soeharto, 1998; Wateridge, 1998; Atkinson, 1999; Baccarini, 1999; Baccarini & David, 1999; Chua et al., 1999; Turner, 1999; Andersen & Jessen, 2000; Brown & Adams, 2000; Gardiner & Stewart, 2000; Tukel & Rom, 2001; Cleland & Ireland, 2002; Westerveld, 2002; Belout & Gauvreau, 2003; Kerzner, 2005; Fortune & White, 2006; Jha & Iyer, 2007)

2. Literature Review (12 font)

In the contemporary job market, the demand for certain skills among recent graduates has been a topic of considerable interest. Adams (2014) delves into this discussion by highlighting findings from a survey conducted by the National Association of Colleges and Employers (NACE). The study underscores the primacy of interpersonal and organizational skills, such as teamwork, decision-making, problem-solving, communication, and effective planning and prioritization, over technical expertise. Adams emphasizes the importance of integrating these top five skills into resumes, cover letters, and interviews, regardless of one's major. This insight suggests a shift in employer preferences towards holistic competencies rather than purely technical prowess.

This change for employers wanting employees with more transferable skills really started in the late 20th Century. In the 1950s, most of the jobs in the United States were labeled as unskilled. However, by 1997, 60% of jobs were labeled as professional skilled jobs, requiring employees to have interpersonal skills such as communication skills, adaptability, ability to learn, and more(Imel, 1999).

In contrast, Carnevale and Smith (2013) offer a broader perspective on the evolving demands within the workforce landscape. They identify adaptability, creativity, teamwork, communication, and problem-solving, alongside fundamental competencies like literacy, numeracy, and learning-to-learn skills, as crucial for success in today's dynamic marketplace. Moreover, they stress the significance of occupational and professional competencies, as well as twenty-first-century skills, aligning with the needs of modern workplaces. This comprehensive view highlights the multifaceted nature of skills sought by employers, emphasizing both soft and technical proficiencies.

Supporting the importance of soft skills, Reynolds (2022) discusses the skills necessary for success in college, focusing on teamwork, communication, cultural competency, and other soft and life skills. This perspective underscores the continuity between skills valued in academia and those sought in the workforce, suggesting the relevance of college experiences in preparing individuals for professional roles.

Furthermore, the Project Management Institute's (PMI) research, as presented in their 14th edition of the Pulse of the Profession-Power Skills, emphasizes the enduring significance of power skills in project success and value delivery. Despite the advancements in technology, communication, problem-solving, collaborative leadership, and strategic thinking remain paramount in achieving organizational objectives. PMI's findings highlight the tangible benefits of prioritizing these competencies in project management and underscore their relevance across industries.

Chadha further supports these claims by explaining why these transferable skills should be practiced and developed while in school, so that students can become more employable(Chadha, 2006). The literature collectively suggests a paradigm shift in employer preferences towards holistic skill sets encompassing both technical and soft skills. While technical expertise remains valuable, the ability to collaborate, communicate effectively, solve problems, and adapt to dynamic environments emerges as equally crucial for success in today's workforce. Moreover, the continuity between skills valued in academia and those sought by employers underscores the importance of integrating experiential learning opportunities that cultivate these competencies throughout educational curricula.

Industry is outspoken about the skills needed to be successful in the work world. The skills needed to be successful in college tend to be less obvious , especially in active learning settings such as polytechnic curricula. The active, project-based learning environment requires more than routine study habits. The engaging, team focused nature of this model blends critical thinking, problem solving, communication, leadership, and time management.

3. Methods

The methodology employed in this study entailed an exhaustive review of more than fifty peer institutions. These institutions were meticulously selected based on their programs being labeled as polytechnic-based curricula programs or described as hands-on or project based technical programs, ensuring a robust and representative sample.

The survey phase involved an examination of individual plans of study to discover if there was the inclusion of project management courses within particular programs. Special attention was dedicated to determining whether these courses were obligatory or elective components of the curriculum. In instances where project management courses were mandatory, their positioning and academic level within the plan of study were recorded. Subsequently, the data was calculated to yield insights into the prevalence of project management course requirements across various universities, providing insights into the educational landscape regarding project management courses and curriculum with various polytechnic universities across the United States.

4. Data Collection

The evaluation encompassed eight mechanical engineering technology programs (MET), eight electrical engineering technology programs (EET), six engineering technology (ET.) programs and thirty-four total polytechnic programs. The distribution and types of programs evaluated are summarized in the graphical data section 5.2A

The analysis revealed that only 26% percent of the surveyed institutions mandated a project management course, before the fourth year of the undergraduate program. Additionally, 45% of all the programs had a requirement to take project management as a graduation requirement either in concert with a capstone course or as part of a capstone course.

In the case where project management courses were mandated, it was most often in the senior year and concurrent with a capstone course. Capstone courses are project based by design. Logic would dictate learning project management before launching a summary project such as a capstone. When courses are taken concurrently, or if project management is part of a capstone course, students have less time to use the skills they are learning. The student focus is on completing the capstone by any means not by standardized tools and techniques. The capstone typically the last hurdle before graduation. Hence the focus is on creating the assigned deliverable not learning standardized tools and techniques for the future.

5. Results and Discussion

Project management skills are not only crucial for career success but also significantly contribute to academic achievement, as evidenced by data collected from an entry-level project management course over a two-year period. Students enrolled in the project management course demonstrated enhanced time management, leadership, and communication abilities, enabling them to collaborate effectively, fulfill instructors' requirements, and navigate competing priorities.

Moreover, the importance of project management skills extends beyond traditional college-aged students. Nontraditional students, typically aged over thirty and balancing additional off-campus responsibilities, benefit immensely from honing skills such as time management, negotiation, communication, and stakeholder management. With a rising number of nontraditional students, including veterans and career changers, pursuing degrees, integrating project management courses into undergraduate curricula becomes increasingly pertinent.

Offering undergraduate students access to project management courses not only equips them with essential skills but also provides an opportunity to pursue widely recognized certifications. For instance, the Project Management Institute (PMI) mandates at least 35 hours of formal instruction before individuals can apply for Certified Associate in Project Management (CAPM) or Project Management Professional (PMP) certifications. Research indicates that such certifications confer a competitive advantage, with PMP-certified professionals earning notably higher salaries compared to their non-certified counterparts.

According to the PMI Earning Power: Project Management Survey—Twelfth Edition (2021), PMP-certified individuals across forty countries earn an average of 16% more than non-certified professionals. Additionally, recent data from a Forbes Salary Survey reveals that PMP certification holders command a 33% higher median salary than non-certified professionals, further underscoring the value of professional certifications in the job market especially in IT fields.

As the demand for project managers continues to surge, with projections indicating a need for nearly 88 million individuals in project management roles by 2027, it becomes imperative for aspiring and existing professionals to equip themselves with relevant skills and certifications. In a competitive job market, where specialized expertise is

increasingly valued, project management credentials serve as a distinguishing factor, enabling individuals to secure lucrative positions and advance their careers.
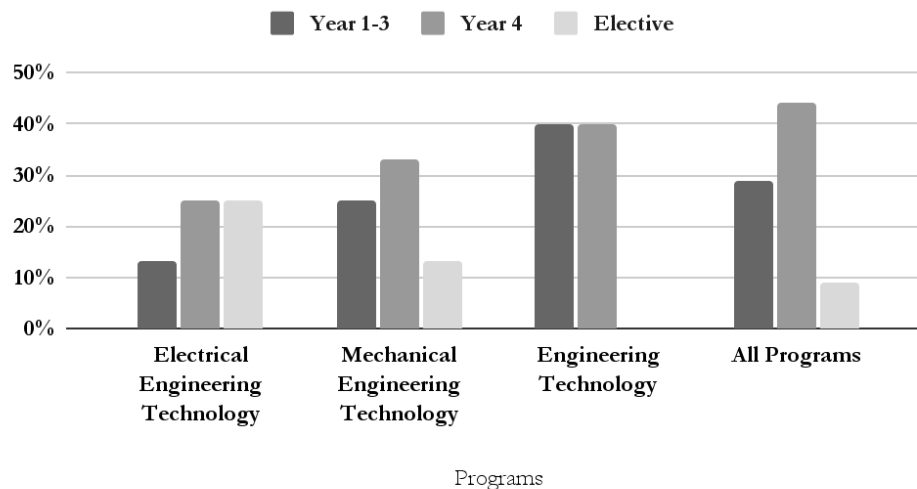
5.1 Numerical Results

Project Management Course Offerings in Plans of Study	Data
Percentage of Programs not Requiring Project Management Courses	25%
Percentage of Programs Requiring Project Management Courses in the First Year	3%
Percentage of Programs Requiring Project Management Courses in the Second Year	15%
Percentage of Programs Requiring Project Management Courses in the Third Year	12%
Percentage of Programs Requiring Project Management Courses Fourth Year	45%

5.1A General Information about Engineering and Technology Programs with Project Management Courses

5.2 Graphical Results

5.2A Where Project Management Courses are Placed in the Plan of Study for Polytechnic Programs

5.3 Proposed Improvements
To deepen one's understanding of the implications associated with integrating project management courses earlier in academic programs, future research is warranted. A comprehensive study could entail collecting data from cohorts of students who have completed project management courses prior to their senior year, against those who completed such courses during their senior year or not at all.

This prospective study would adopt a mixed-method approach, consisting of quantitative analysis with qualitative insights. The quantitative analysis would entail comparing various metrics, including GPAs, graduation rates, time

to completion, starting salaries, and perceived readiness for the workforce among the aforementioned cohorts. Concurrently, qualitative data would be gathered through interviews or surveys to gain enriching perspectives and experiences related to the integration of project management courses at various stages of the curriculum.

By scrutinizing these diverse dimensions, we can analyze the impacts of early exposure to project management courses on students' academic performance, career prospects, and overall preparedness for the workforce. Insights learned from such a study would not only enrich our understanding of pedagogical strategies but also inform future curriculum development initiatives aimed at equipping students with the skills needed to thrive in today's professional landscape.

6. Conclusion

In conclusion, the integration of a hands-on learning approach within Polytechnic Universities and programs stands as a cornerstone of effective education. Through active learning methodologies, particularly in the form of group projects, students are afforded the opportunity to engage with complex concepts while navigating real-world team dynamics and challenges. To maximize the benefits of these experiential activities, the early introduction and regular utilization of standardized project management tools and techniques are paramount to students' success in college and the workforce.

Moreover, it is imperative that technical programs embed opportunities to develop transferable skills found in project management courses. These skills, including communication, problem-solving, and teamwork, and many more represent the core competencies sought by employers in today's workforce. By ensuring that students graduate equipped with project management skills, one will not only be able to mitigate underemployment but also cultivate a workforce that is prepared to navigate the demands of the digital age.

Indeed, the value of one obtaining a STEM degree augments one's market value, reflecting the growing significance of transferable skills across diverse sectors. As technological advancements continue to reshape industries, the indispensability of project management skills—encompassing critical facets such as communication, critical thinking, negotiating, and problem-solving—will only intensify.

This positional paper serves as a catalyst for future research endeavors aimed at highlighting the benefits of integrating project management courses early and consistently within Polytechnic programs. Subsequent studies will further illuminate the efficacy of this approach, ultimately advocating for its widespread adoption across academic institutions. By embracing an initiative-taking stance in curriculum development, universities can better equip students for success in the dynamic landscapes of both academia and the workforce.

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Biographies

E. Shirl Donaldson is an Assistant Professor at the University of Michigan-Flint. Donaldson has a career spanning over three decades as a seasoned professional and accomplished researcher. With a profound understanding of the intricacies of processes and systems critical for success, Donaldson's expertise is unparalleled. Holding a Doctorate from Purdue University in Industrial Technology, she exemplifies academic excellence and scholarly rigor. Donaldson's extensive research portfolio encompasses a diverse array of topics, including Donk Racing, STEM Education, Minority Representation in Higher Education, Graduate Students in Industrial Management Programs, Rural STEM Education, and much more, demonstrating her broad-ranging intellectual curiosity and interdisciplinary approach. Moreover, Dr. Donaldson's commitment to community projects underscores her dedication to fostering positive change beyond the confines of academia, exemplifying her role as a trailblazer and catalyst for societal impact.

Vincent Johns is a Graduate Student at the University of Michigan-Flint, where his passion for STEM education has flourished over the past decade. Johns has a Bachelors and Masters from The Ohio State University in City and Regional Planning. With a rich background spanning ten years in this field, Johns has honed his expertise in informal STEM education, demonstrating an interest in exploring various topics, ranging from the impact of Four Day School Weeks to the dynamics of Informal Learning Communities. Beyond his academic pursuits, Johns holds significant leadership roles, serving as the Director of Leaders Emerging and Developing, where he nurtures the growth of future leaders, and concurrently, as the Education Director of Blacks in Technology Foundation. Through his multifaceted roles and unwavering commitment to advancing STEM education, Vincent Johns exemplifies a true catalyst for positive change and innovation in the realm of education and technology.