2023 Annual Conference & Exposition
Baltimore Convention Center, MD | June 25 - 28, 2023
The Harbor of Engineering Education for 130 Years
Paper ID #38041

Board 226: Building Data Center Career Pathways Through K-12 Industry Externships

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Building Data Center Career Pathways Through K-12 Industry Externships

Introduction. Data centers are centralized clusters of computing hardware that serve as the backbone of online services and cloud computing. Data centers are rapidly growing to meet increasing demand and are forecasted to double in capacity in the next 10 years. In particular, the northern Virginia region is home to the largest US data center market. The rapidity of this growth necessitates a trained engineering technology workforce to build, operate, and maintain these critical facilities. Despite this need, the pathways to these careers remain underdeveloped, with limited stakeholder awareness of the opportunities and weak networks of collaboration between institutions.

Northern Virginia Community College's (NOVA) Data Center Operations (DCO) Tech project is funded by National Science Foundation's (NSF) Advanced Technological Education and is intended to strengthen data center and engineering technology career pathways in the region. The project has the following components: a) an engineering technology bridge program for high school students, b) a career development & leadership program to prepare existing students for the job market, and c) an externship for K-12 counselors to expand their knowledge and awareness of the industry and student opportunities. This paper investigates the extent to which the K-12 externship improved participant knowledge of regional career pathways in the data center industry and fostered intentions to change professional practice.

Project Rationale. Enterprise and economic activities that rely on internet services (e.g., cloud-based computing, online commerce, video and audio streaming) require significant data center infrastructure to ensure continuity of services. In order to provide these services, data centers require large capital investments, ongoing operational maintenance, and the engineering workforce capacity to support these. In Virginia, data centers are expanding rapidly due to favorable economic conditions created by tax incentives enacted by the state legislature. From 2009 – 2018, total capacity investments exceeded $20B, with the majority of that growth centered in the northern Virginia region. In 2018, these investments led to a total of 14,644 jobs at data centers themselves, with 45,290 additional positions with affiliated industries (e.g., consulting, construction)[1]. The jobs created as a result of these investments will offer a high average salary at entry levels ($62,500), which compares favorably to starting salaries for college graduates with a 4-year degree in Virginia [2][3].

However, despite the high wages associated with these jobs, institutionalized pathways to data center careers do not exist. In 2020, 50% of data centers report "significant difficulty finding qualified candidates for open jobs," up from 38% in 2018 [4]. Employers report that the sector is largely invisible, with low levels of public familiarity with data center careers. Low Underrepresented Minority (URM) participation, especially among women, may make retention more difficult and limits the potential pool of applicants [4]. Surveys of K-12 educators echo these sentiments, suggesting little student or educator knowledge of data center career pathways [5]. Apart from NOVA's own Data Center Operations credential, there are no accredited degree programs at 2-year colleges in the US.

Externship Rationale & Structure. K-12 students have access to structured career development and guidance through counselors and career centers embedded in their schools. In high schools, individualized contact with counselors makes up the bulk of formal career education that students receive. The externship was designed with three goals in mind: 1) specifically targeting HS counselors in Prince William and Loudoun counties, where most data centers are located, 2) emphasizing hands-on or active participation, 3) encouraging building professional networks. Table 1 provides an overview of the externship.

Component	Description
Micron Technologies Tour **In-person, 4 hours**	Tour of advanced chip manufacturer Micron Technologies, including clean room, power & electric, and water systems. Tour concludes with a Q&A from Micron recruiters and educational coordinators.
Stack Infrastructure Tour **In-person, 4 hours**	Tour of boutique data center Stack Infrastructure, with an emphasis on the industrial control components required to maintain facility operations. Tour concludes with a discussion of the NOVA Data Center Operations program.
NOVA Fab Lab Tour **In-person, 4 hours**	Tour of the digital fabrication lab and NOVA's engineering technology classrooms. Facilitators introduced NOVA's degree programs formally, then conducted a group discussion of how to better reach students with opportunities.
Plan of Action **Asynchronous, 2 hours**	Participants create a plan explaining what they learned from the externship, how they will apply that knowledge to their practice, and how NOVA can deepen the partnerships

Table 1: K-12 externship components and descriptions.

Recruitment for the externship began in January 2022, with tours of Micron and Stack Infrastructure scheduled in April and May. The last session at the Fab Lab was in July, with plans of action due by the start of the 22-23 school year. In total, 18 educators completed the externship. 16 of the participants were counselors, career advisors, or Career and Technical Education (CTE) instructors, and all participants worked predominantly with high school students.

Results. Participants completed a postsurvey that collected their level of industry knowledge, confidence advising students, and impressions of relevant industry skills both before and after the externship. Respondents could provide qualitative comments on each of these three dimensions. The survey instrument was created by the researchers and used Likert-scale responses. Participants rated their knowledge of the industry and career pathways and confidence in advising students prior to the externship as low, with a mean of 2.1 and 2.7 respectively. Self-reported confidence went up significantly post intervention, up to 4.4 and 4.6.

Plan of Action. Educators' plans of action included three prompts worded as questions: a) what they learned through participating in the externship; b) identifying three actions they could take to share the information they learned, and c) how NOVA and / or industry partners can deepen connections between institutions. Participants' written plans of action were read and analyzed using thematic data analysis. Four themes were identified (barriers to implementation, plans for implementation, industry / institutional knowledge, desire for collaboration). There were 14 codes among the themes (table 2).

Table 2: Themes and codes from externship participants' plans of action	
Barriers to Implementation (n = 11, 61%)	
Administrative knowledge (n = 3, 27%)	"It's hard to highlight the specific steps students need to take: HS classes, applications they need to complete, forms etc" [1]
Lack of hands-on activities (n = 7, 63%)	"…it's hard to talk to them about it when students learn by seeing and doing" [2]
Industry working conditions (n = 2, 18%)	"These jobs are high pay but not attractive. It doesn't match the lifestyles of young adults fresh out of high school." [16]
Industry / Institutional Knowledge (n = 15, 88%)	
Industry need for talent (n = 15, 100%)	"I didn't realize the extent of the need for talent at Micron and all the data centers and am eager to let me students know that NOVA students are getting hired quickly, often prior to finishing their programs." [5]
Technical / operational details (n = 3, 20%)	"A Data Center needs power and heat, thus the building needs a balance of controlled power and cooling energy." [4]
NOVA programs & credentials (n = 7, 46%)	"They [students] can prepare for a good-paying career in the technology field in their community in a short time and with much lower or no student loan debt." [11]
Plans for Implementation (n = 16, 94%)	
Parental engagement (n = 9, 56%)	"The first action is to inform parents of the opportunities…." [14]
Sharing with colleagues (n = 10, 63%)	"I plan to share the resources from this externship with my counseling department when I return to work this August." [11]
Direct student discussion (n = 10, 63%)	"…share information with students about the different program pathways and available degree options during yearly senior conference meetings." [7]
Dual enrollment (n = 5, 31%)	"It would be great to work with the school system to eventually offer DE courses…if certified teachers become available." [9]
Collaboration with NOVA (n = 16, 94%)	
Professional development (n = 9, 56%)	"NOVA presentations directly to teachers throughout the school division to be able to best support questions and provide clear and common messaging…" [8]
Field trips (n=4, 25%)	"We'd like to collaborate this upcoming year to take a group of students to Micron (and the Fab lab if possible!) so they can see up-close what they could be doing." [12]
Presentations from NOVA staff (n = 9, 56%)	"A representative from these programs could join a parent information night to briefly cover these programs offered at NOVA." [3]
Dedicated NOVA staff member (n = 3, 19%)	"Seek staffing support from NOVA for one NOVA employee to support questions, presentations, information, outreach, etc. within the division." [8]

Discussion and Conclusion. Responses from participating educators are emblematic of attempts to introduce new career pathways in the absence of existing mindshare. As hypothesized, educators were largely unaware of regional career pathways in data centers and therefore reported little confidence in introducing these careers to students. Post-intervention, educators were largely positive about the potential for DCO, praising the potential for high starting salaries, regional demand, and the low cost of credentials. Similarly, most plans identify multiple ways to share information with community stakeholders (i.e., students, parents). Plans are largely in-line with the typical role that counselors occupy within a K-12 institution.

The barrier to entry and collaboration with NOVA themes demonstrated the extent to which institutional and pedagogical capacity is limited. The most mentioned barrier is the lack of existing age-appropriate curriculum for these fields. Given that students choose career pathways based on their perceived self-efficacy, information sessions alone may not sway a student to action. These issues are compounded by a lack of credentialed teachers and dual enrollment programs, which are more available in adjacent but distinct fields (e.g., IT, Cybersecurity).

Suggestions for future collaboration with NOVA also show the same issues with capacity. Counselors likely do not have the time to develop additional materials and would instead require significant support from NOVA faculty and staff. The repeated requests for a full-time NOVA staff member dedicated to providing career education support for schools belies the low levels of resources available. Other identified codes highlight the importance of high levels of ongoing NOVA support to fill gaps in educator knowledge and expertise.

While the externship was effective at making participants aware of in-demand regional careers in data center operations and engineering tech, analysis reveals the gaps in educator capacity to implement structural change. While this analysis is specific to the northern Virginia region, institutions of higher education (IHE) struggling with recruitment for other in-demand but invisible fields (e.g., photonics, supply chain automation) can likely draw inferences to their own service regions and contexts. Moving forward, NOVA is making ongoing investments in developing HS curriculum, extending PL options for in-service teachers, and has secured funding to credential dual enrollment instructors. Taken together, these actions will continue to develop pathways to data center and engineering technology careers.

References

[1] A. F. Mangum, D. Zorn, M. Arel and K. Driebe, "*The Impact of Data Centers on the State and Local Economies of Virginia*," 2020.

[2] N. Patil, “13 honest data center technician salaries in 2018,” CBT Nuggets, 2019. [Online]. Available: https://www.cbtnuggets.com/blog/technology/data/13-honest-data-center-technician-salaries-in-2018.

[3] M. Schneider and B. Vivari, "The earning power of graduates from Virginia's colleges and universities: How are graduates from different degree programs doing in the labor market?," *American Institutes for Research*, 2012.

[4] R. Ascierto and A. Lawrence, "Uptime institute global data center survey 2020," Uptime Institute, vol. 2, 2020.

[5]Magnolia Consulting, 2022