Voices of Student Apprenticeship: Exploring the Unique Needs and Perspectives of Community College Students

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Abstract

This paper explores student perspectives on a paid and credit-bearing technology apprenticeship program offered by a community college in a large metropolitan area. The program is offered in collaboration with a large non-profit organization that brings together local branches of Fortune 500 companies to offer apprenticeship positions in the software engineering technology field. The goal of this paper is to describe how technology apprentices enter existing Communities of Practice (CoP's) at their partner companies. In doing so, the paper will explore apprentices' perspectives on their company environments, work roles, team structure, and learning processes. By highlighting the insights of student apprentices, the authors hope to motivate further programmatic improvements, and to help others become familiar with the unique needs and perspectives of this student population. During the most recent cohort of the apprenticeship program, the authors recorded the feedback that apprentices shared, as well as their own observations of the program, which formed the foundation of this work The apprenticeship program described here has both high rates of student acceptance and high rates of conversion to full-time roles following the program, and thus can serve as a model program for others interested in promoting student apprenticeship.

Introduction & Background

The U.S. Department of Labor projects that employment in the technology field will grow by 14.6% from 2021 to 2031 [1]. However, there is a significant skill gap between the requirements for tech roles and the availability of skilled workers. Many companies struggle to find qualified candidates, despite the rigorous technology curricula offered by colleges [2]. This skill gap disproportionately affects underrepresented groups in the technology industry. The New York Jobs CEO Council aims to support faculty in local community colleges to expand and strengthen apprenticeship programs in the New York City area [3]. These programs can help reduce the skill gap, particularly for underrepresented students. The author has received funding from the Perkins Grant department to support its apprenticeship program, which helps students gain professional experience and refine their program applications.

The apprenticeship program emphasizes situated learning in professional communities of practice to maintain alignment between education and industry. It has been integrated with traditional college coursework, leading to an exploration of teaching methods that better reflect real-world practices. The program offers students benefits such as professional training, mentorship, and the opportunity to "earn and learn" while completing their degree. Additionally, it may lead to full-time employment with the partner company after the apprenticeship [4].

The apprenticeship program began as a pilot program in a few NYC community colleges and was later expanded to other campuses. The Engineering Technology department was the first to launch the program. The Engineering Technology department initially partnered with two major corporations to offer apprenticeships to students in one Associate of Applied Science major within the Engineering Technology department. The goal was to place students in corporate apprenticeships leading to full-time employment as Software Engineers or in related technology roles. The ideal candidate was someone who was eligible to work in the United States, in good academic standing, interested in technology, and enthusiastic about working in a corporate environment at a major company. Overall, three cohorts of students have completed the program, and over 59% of them have secured full-time employment at the companies they apprenticed with.

Previously, the authors participated in a year-long training program to revise the curriculum of engineering technology colleges. They found that while technical knowledge is emphasized, soft skills are often neglected. Partner companies pointed out that new graduates lack these essential soft skills, which are crucial for success in entry-level roles. Based on this, the pedagogy was revised to simulate an industrial job environment and incorporate problem-based and project-based learning [5]. This approach aims to train students in both technical skills and soft skills, which are equally important for career advancement. Some of these changes have been implemented for the current cohort, and some are still in the process of being implemented for future students.

In this paper, the author aims to convey students' opinions and perspectives regarding the apprenticeship program, which is a key factor in a successful program. Most apprentices are young adults, and for many, this is their first professional job, and so they require significant support to succeed in a corporate environment. Therefore, accurately reflecting the true opinions of apprentices to partner companies is crucial to ensuring these apprentices are set-up for long term success at those companies, given the companies' investment into those students during the apprenticeship program.

In the following paper, the authors will explore the preparation and application stages, as well as the technical and social elements involved in apprenticeships within partner companies. The paper will also include apprentices' perspectives on each of these aspects.

Apprenticeship Preparation and Application Process

The development of the apprenticeship program in partnership with the college has also involved the creation of a career development pipeline to promote the apprenticeship program and prepare students to apply. The following procedure was used to prepare the apprenticeship cohort under discussion here. During the summer prior to the apprenticeship, a full list of all students in the accepted major(s) was requested from the school and was filtered by GPA and course credit completion. Then the remaining students were individually reviewed for program eligibility, and individual outreach was conducted over the summer to form a cohort of interested and eligible apprenticeship applicants.

Toward the beginning of the Fall semester, a member of Career Services responsible for coordinating the apprenticeship program began conducting individual meetings with students. These sessions were typically 45 minutes in length, and each eligible applicant had a minimum of three individual sessions with the career services specialist. During these sessions, students developed and/or revised both a resume and a cover letter, which they later used to apply for the apprenticeship program. Eligible apprentices also practiced interviewing and networking strategies. Further, the career services specialist was available to answer additional questions from students throughout the application process, and to share our resources and related opportunities. This was important in order to address any unexpected obstacles that students may face. An in-person apprenticeship information session was also held prior to the application deadline, with support from the Jobs Council. This event served to further promote the apprenticeship program, and also provided eligible applicants with the opportunity to network directly with representatives from the partner companies. Multiple apprentices later shared that these early interactions with company representatives were one significant factor in deciding which partner company they would prefer to work at. One group networking session was held just with the eligible applicants prior to the Information Session, so they were confident and prepared to engage with the visiting professionals.

Apprentices submitted their applications separately to each partner company involved in the program. Following that, each company had discretion to offer interviews to eligible apprentices. The application for this cohort was due October 31st, with interviews being conducted throughout November, and apprenticeship offers being made in early December. As part of the interview process, some companies included an initial screening interview, all companies conducted a behavioral interview, and most companies also conducted a technical interview. The technical interviews varied by company, however the most common was a standard format where the applicant was asked to solve a coding problem and share their thought process aloud in discussion with the interviewer. Some companies, however, did use asynchronous logic or coding assessments (such as Hacker Rank), or required students to build and give a presentation related to technology.

Once students were accepted into the apprenticeship program, they also participated in a January Bridge Program during the winter session. This program was funded through the NY Jobs CEO Council, and ran similar to a bootcamp experience, with students attending five hours a day and five days a week, on a hybrid schedule. This bootcamp allowed apprentices to fill in specific skill gaps based on what would be required at partner companies; develop their professional mindsets and abilities to quickly learn new skills; and form stronger relationships with one another that would serve as ongoing systems of support. Apprentices also engaged in a service-based learning project to strengthen which allowed them to experience working and creatively problem-solving under less structured conditions. Finally, during the apprenticeship itself, students participated in a one credit synchronous online support course to provide additional guidance and allow students to share and reflect on their apprenticeship experiences, both individually and collectively.

Technical Elements of the Apprenticeship Program

Apprentices took on a variety of different work across partner companies. Most apprenticeship roles were in the software development field, however there were also some apprenticeship roles offered in Networking as well as in IT Support. Within the Software Engineering space, almost all teams employed an agile methodology, where apprentices were actively engaged in daily scrum meetings and project sprints. Jira was frequently used as a project management tool to support agile processes (for example, maintaining a project backlog, to-do list, and in-progress activities). This was also the system whereby most tasks were assigned to apprentices. Multiple apprentices using Jira at their partner companies said they would have benefited if Jira were used in their college courses as well. In contrast, the Networking and IT Support teams tended to utilize a ticketing system for ongoing operations rather than a project management methodology like agile.

Interestingly, apprentices utilizing a ticketing system seemed to be able to successfully take on more "bite-sized" tasks at a quicker rate. For example, an apprentice working in Networking was completing over 30 tickets a day within the first month, and an apprentice in IT Support was imaging upwards of 100 computers in a week. Comparatively, apprentices working in Software Engineering generally required more time and support both to begin their initial projects and to make consistent daily progress. Part of this may be the nature of each of these specialties, with tasks in Networking and IT Support being more concrete and well-defined and tasks in Software Engineering tending to be more open-ended and amorphous. In fact, Agile project methodology is likely used so ubiquitously within Software Engineering precisely of the need for a supportive framework within which to approach these types of complex, multi-faceted projects.

Representatives from partner companies and from the college have agreed that students could benefit additional practice utilizing an agile approach prior to the apprenticeship, and based on that feedback agile is currently being implemented within multiple courses as part of a broader project-based learning approach. Software Engineering apprentices may also benefit from

intentionally being provided with more "bite-sized" tasks earlier in the apprenticeship, and from scaffolded experiences breaking larger tasks into smaller daily tasks and estimating how long those tasks will take. Once apprentices have the experience of successfully utilizing the agile model with support early in the apprenticeship, they may have greater success maintaining this approach as they take on more substantial projects with greater independence. Additionally, daily stand-up meetings represent an important way for companies to monitor apprentices' early rate of progress, and apprentices may benefit from greater accountability and feedback during these meetings.

There were also several additional factors that affected when and how software engineering apprentices began their initial projects. Many apprentices had limited experience using Git and GitHub or other version control systems for collaborative coding. These skills were necessary to access and modify existing company code repositories and took apprentices time to learn. For many apprentices, this was also their first time combining multiple different coding languages, database and web tools, and advanced libraries, and setting up their integrated development environment (ide) with the necessary API's and dependencies also took time and training. Finally, apprentices in various roles required different forms of company logins and permissions to begin their work. If possible, it may be beneficial for apprentices to begin having their company accounts set up after accepting the position but prior to the start of the apprenticeship (e.g. during the January Bridge Program).

Most of the Software Engineering projects that apprentices worked on contained at least some elements of Front-End development. These tasks often required apprentices to create some form of data dashboard representing financial information. This was often a particular point of pride for apprentices, who could then point to specific visual elements that they were able to build. This was especially impactful when the GUI element the apprentices worked on went into use at the partner company. Even when this was not the case though, project demos gave students the opportunity to share-out and receive feedback and recognition on their work. React and Plotly were two of the most common technical tools used for front-end development among apprentices at partner companies (although apprentices likely benefited from existing knowledge of HTML and CSS). For back-end development, most apprentices were using either Java and Springboot or Python and the Pandas library. SQL was also frequently used, as many tasks involved processing (and then displaying) large amounts of data.

Social Elements of the Apprenticeship Program

Apprentices were placed into a variety of different team structures within their partner companies. At one company, all apprentices were placed on a single team and worked together on a 'learning project.' During that project, apprentices cycled through three rotations that exposed them to different types of roles and tasks at the company. Throughout, apprentices still interacted regularly with company employees, for example learning from appointed mentors and

team leads, and presenting formal project demos. At another company, all apprentices were again placed on a single team, but were working on a novel project as part of an existing company team. Finally, at two other partner companies, apprentices were placed onto different existing teams within the company, rather than working as a group with other apprentices.

Interestingly, when apprentices were placed on teams primarily composed of other apprentices, they seemed to benefit from additional structure and support, particularly around norms for workflow and team collaboration. When apprentices were integrated into existing teams, the pre-existing team structures being implemented by more experienced employees tended to provide this scaffolding and lessened the need for explicit support in this area. Additionally, for the program overall and especially when apprentices were integrated into existing teams, the immersion element of the program took on special significance. Both in this cohort and in previous years, apprentices on primarily remote teams have struggled in this respect, and so teams with significant in person presence at the local workplace tended to be more effective for apprenticeship placement. Across teams, many apprentices chose to come in-person more days a week than were required, further emphasizing the importance of the immersion element of the apprenticeship program. Finally, the benefits of this immersive experience were immediately notable for some students, who noticed a change in their own professional communication and presentation within just the first few weeks of the program.

Across all partner companies, there were certain key figures that influenced apprentices' learning and development. Each apprentice had a team leader that they worked closely with. This person was often also the scrum-master for the project, and the one that would assign tasks to apprentices and evaluate apprentices' work (e.g. at project demos). All apprentices also had access to an assigned mentor from their partner company, who could provide them with broader workplace guidance and some degree of technical support. Finally, apprentices also typically worked closely with a member of the HR department – generally the same person at the partner company who served as the primary point of contact for the apprenticeship program. This person supported apprentices in onboarding to the workplace, and often checked in with them semi-regularly throughout the apprenticeship program.

Apprentices also had many opportunities to engage informally with other members of the partner companies. At most companies, apprentices had the ability to reach out to other employees for "coffee chats," which gave them a quick way to connect and get to know a wider range of coworkers. Additionally, apprentices were frequently invited to specific networking functions, which took a variety of forms. Some apprentices were invited to "happy hours" where they had the opportunity to interact with many coworkers in a less formal setting. Other times, apprentices were invited to volunteering events with their companies, or to professional events (e.g. a Innovations in Tech summit or a tour of a Server Farm). Finally, apprentices had the opportunity to join cultural events and affinity group meetings, which often gave them an opportunity to relate and connect with the company at a deeper level.

There were also some interpersonal challenges that arose during the course of the apprenticeship. Among apprentices, inter-personal challenges were most pronounced when apprentices were working primarily with one another and were working on active company projects (which tended to be less structured than learning projects). Companies were able to address this by including more explicit guidance on effective collaboration during the program. In particular, apprentices may benefit from direct guidance on norms for work ownership and submission using collaborative coding platforms such as GitHub. Additionally, it is important to note that many of the interpersonal challenges between apprentices revolved around perceived competition with other apprentices for full-time roles following the apprenticeship program. Even when companies explicitly assured them this was not the case, anxiety around full-time offers remained a significant source of stress, and apprentices may benefit from greater transparency and explicitness around the conversion process and their goals for the apprenticeship. Finally, since some apprentices knew each other from their school prior to the apprenticeship, there were cases where apprentices needed to reformulate these relationships for a professional workplace.

There were also inter-personal challenges that arose between apprentices and existing employees at the partner companies. Most often these challenges were related to power dynamics inherent to the apprenticeship. In a number of cases, there was misalignment on program goals between the partner company and the local team leaders, especially regarding skills expected of bachelor's versus associate students. As a result, multiple comments were made both to apprentices and to school representatives indicating that apprentices would require a bachelor's degree to be successful at the company, which went against one of the primary program tenets. This could be discouraging for apprentices, and also cast doubt on the integrity of the program. For the next cohort, the Jobs Council is providing training to company representatives, and especially team leaders, to address this issue and prepare them more broadly to work with the target student population. More rarely, there were also instances where comments about race, ethnicity, or gender were made which left apprentices feeling uncomfortable or even at times discriminated against in the workplace. While these sorts of situations can arise in any workplace, apprentices are especially vulnerable to these types of occurrences. Firstly, many are younger individuals, for whom this is there first time in a corporate workplace and may not know the appropriate channels for addressing these instances, and secondly, many apprentices may not feel comfortable raising these issues at all for fear that it will negatively impact their full-time offer following the program. Due to these issues, it is important for companies to provide explicit HR guidance to apprentices, and to create a reporting channel that feels safe to apprentices and free of perceived repercussions.

Results

In the most recent apprenticeship cohort, ten students from the authors' college applied to the apprenticeship program. Of those students, eight were offered apprenticeship roles and went on

to participate in the program, working across four different partner companies. Of the eight apprentices, seven out of eight were either already offered or are on track for full-time employment following the apprenticeship program (at the time of writing this paper). Three apprentices received job offers directly following the program, and four students received extensions to the apprenticeship. At one partner company, the apprentices completed an additional summer internship before being offered full-time roles and have now started as full-time employees. At a second partner company, two apprentices from our school (as well as those from other colleges), were offered an eight-month extension to the apprenticeship, which those students are still in the process of completing. For those companies that gave full-time employment offers without an extension, these offers were generally made within a few months following the completion of the apprenticeship to align with internal company timelines, and generally required some additional interviewing on behalf of apprentices.

The extensions companies offered following the program had the added benefit of allowing students to experience a different field, department or team within the organization. For multiple apprentices, this proved to be a highly beneficial process. Some were able to identify an unexpected or more specific area of interest. For example, students were able to pivot from software development and data analytics (which were more common during the initial apprenticeship in this cohort) into project management and IT support, respectively. At another company, apprentices who had found the specific team culture of their original teams challenging to adapt to were able to thrive on a team that was a better match for them personally. Taken together, the results from this year's cohort continues a trend of increasing full-time conversion each year following the apprenticeship program. [6]
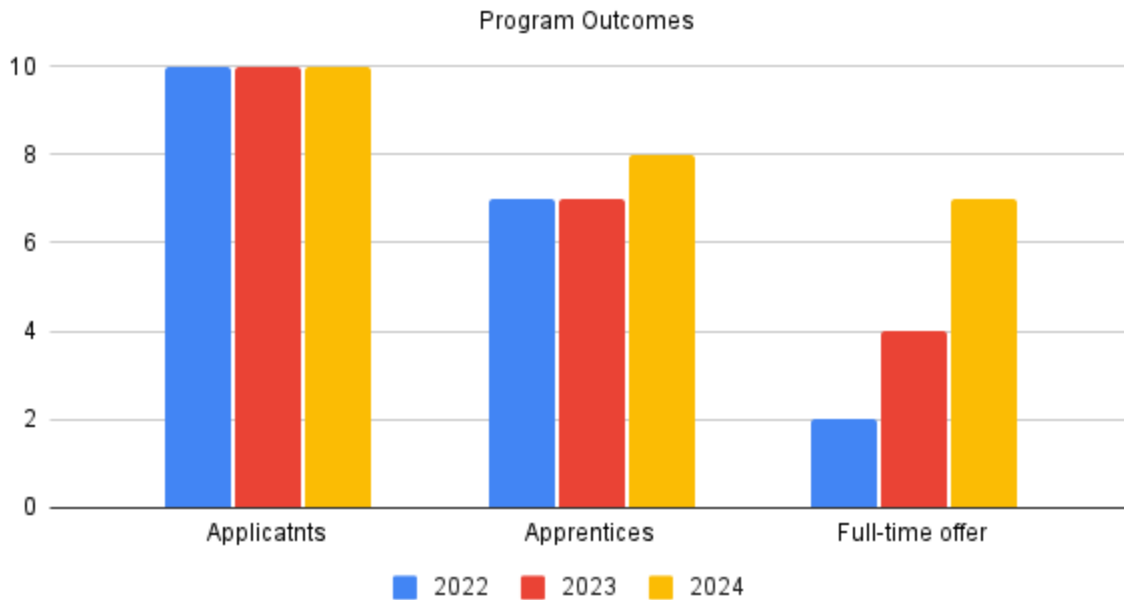
Figure1. Our apprentice program outcomes for three consecutive years

Conclusion & Future Work

During this apprenticeship cohort, our college received consistent positive feedback on how our students were prepared for the program, both with regards to their application materials and interviews, and their performance during the program itself. This was also reflected in the percentage of applicants from our college that were offered apprenticeship roles, and the number of apprentices that went on to receive full-time roles at their partner companies. In large part, this was due to the personal relationships and support in place for students. At our college, multiple professors within the department are closely involved with and supportive of the apprenticeship program, as well as workforce preparation more broadly. This support takes the form of implementing new course strategies and content based on company feedback; teaching the January Boot Camp prior to the apprenticeship and Apprenticeship Support Course during the program; supporting students with scheduling and substitutions to be eligible for the program; and developing strong partnerships with professional organizations (such as Amazon Web Service). Apprentices also received additional support from the Career Services Specialist responsible for coordinating the program at the college, which allowed for greater levels of individualized student support, and was made possible by funding from The Perkins Grant. Finally, representatives from the human resources departments of each partner company as well as from the Job Council itself met regularly with college representatives. This allowed for enhanced program alignment, updates on apprentices' progress, and ability to problem-solve

issues as they arose. The personal connections that underpin the success of the apprenticeship program also provided valuable insights into students experience in the program and served as the foundation for the content of this paper.

Looking to the future, one major goal is to continue expanding on the initial success of the apprenticeship program, to make the opportunity available to a greater number and wider range of students. The Jobs Council is consistently working on recruiting additional employers to participate in the program, and the college is also currently in the process of expanding apprenticeship program eligibility to additional majors. As the program continues to expand, it will be important to maintain high levels of individualized support. Some strategies currently being considered include implementing broader career supports for all technology students and streamlining apprenticeship preparation into a pre-apprenticeship program.

Acknowledgements

References

[1] Krutsch, E. (2022, December). *Computer Science Education Week: Explore In-Demand IT Jobs*. Computer Science Education Week: Explore In-Demand IT Jobs | U.S. Department of Labor Blog (dol.gov)

[2] Jarvis, D. (2023 August). Tech Talent Is Still Hard to Find, Despite Layoffs in the Sector. Deloitte Insights. Tech talent gap | Deloitte Insights

[3] New York Jobs CEO Council. New York Jobs CEO Council - Strengthening New York City (nyjobsceocouncil.org)

[4] Chicago Apprentice Network. (n.d.). *Bridging The Gap Between Talent and Opportunity - An apprenticeship playbook to help companies address skills and training gaps to provide under-represented groups access to professional jobs*. Chicago-ApprenticeNetwork_BridgingtheGap_Digital_Final.pdf (illinoisworknet.com)

[5] Lam, R. K., Seo, D., Drini, M., & An, G. (2022, November). *Soft Skills Enhanced Project-Based Pedagogy in the Community College Reflecting Apprenticeship and Industry Need*. 2022 ASEE Middle Atlantic Section Fall Conference, Penn State, Harrisburg, PA.

[6] An, G., & Seo, D., & Mannes, D., & Lam, R. K. (2023, October), *Promoting Successful Technical Apprenticeships: Aligning Industry and Education Needs to Improve Employment Outcomes for Community College Students Paper* presented at 2023 Fall Mid Atlantic Conference, Ewing, New Jersey.