Preparing Community College Students for Biotechnology Careers Through Research and Internship Experiences

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Abstract

A biotechnology training program for community college students was designed to train the local workforce in specialized skills and knowledge needed to support the growing biotechnology industry in Northwest Arkansas. The program included research training and a 10-week summer research experience to provide training in lab techniques and guidance for obtaining a STEM degree. The students were also connected to local biotechnology companies for an internship experience to provide experiences and insights into the biotechnology industry that will make them competitive candidates for jobs in the field. The program sought to address barriers of entry for community college students such as lack of confidence to pursue experiential learning opportunities and the need to balance external commitments through the development of a multi-tiered mentoring community. The multi-tiered mentoring community provided them access to peer, graduate student and faculty mentors the students could seek out for representation, guidance and encouragement throughout the program. A presurvey indicated that the students did not feel confident in their technical skills coming into the program, and a survey following their internship experience reflected a significant increase in their perception of their skills. Free response question answers highlighted the program's value to the students related to skills/experiences they obtained and their knowledge of biotechnology careers. Overall, the design of the program successfully provided community college students with a foundation to pursue a STEM degree as well as a pathway to the growing biotechnology industry in Northwest Arkansas.

Keywords

Community College, Biotechnology, Research Experience, Internship, Mentoring

Introduction

Skilled workers are in great demand in the rapidly expanding biotechnology industry in Northwest Arkansas. As new therapies continue to mature from the lab scale to commercialization, both bachelor's level engineers and skilled operators will be needed to support manufacturing processes. Ideally this need is filled by the local workforce. This brings both jobs and resources to the area and provides stability among important personnel for the company. Community college students are an excellent fit for this opportunity, given they are more likely to find a job locally than students who only pursue four-year degrees [1]. Programs are needed to increase awareness of the upcoming expansion of the biotechnology field among community college students and prepare them to pursue opportunities as they become available.

These programs need to train students in biotechnology techniques in a lab setting as well as prepare them to become competitive candidates for biotechnology jobs. An additional challenge lies in recruiting students and raising awareness of these emerging opportunities. Community college students often have additional commitments to family or work they must balance while completing their education [2]. This combination of advanced technical concepts the students haven't studied previously and their concerns with their ability to manage other commitments limits their confidence to pursue training programs that are necessary to become competitive candidates. Therefore, biotechnology training programs first must be accessible to students by addressing their concerns related to the technical concepts and external commitments, second provide training in laboratory techniques relevant to the needs of biotechnology companies, and third raise the students' awareness of biotechnology careers in the area.

This report details the biotechnology training programs offered to community college students by the Membrane Applications, Science and Technology (MAST) center and Membranes for Viral Purification (MVP) centers in an effort to train local workforce and support the growth of the biotechnology industry in Northwest Arkansas. The MAST Center is an industry-university cooperative research centers (IUCRC) while the MVP center is an NSF EPSCoR Center. Both centers involve local biotechnology companies and cutting-edge biotechnology research, offering the ideal setting for a biotechnology training program. The program has been designed to provide training in lab techniques relevant to the biotechnology industry and an internship experience with a local biotechnology company. To promote accessibility and continue to develop career awareness and professional development skills of the students, a mentoring element in the form of a multi-tiered mentoring community was emphasized in the program's design. By introducing peer and group mentoring in the multi-tiered mentoring community format, the students are provided support navigating their individual circumstances by their peers who face similar challenges. The program's goal was to create a multi-tiered mentoring community environment to address apprehensions of the students to maximize the value of the training they receive to their future pursuit of a biotechnology career.

Methods

The program was designed to provide training/awareness into both of these components by offering laboratory training in a research setting and a view into how biotechnologies are manufactured through an internship with a local biotechnology company. The research component was broken down into research training during the academic year followed by a full-time ten-week summer research experience. Students worked at both Northwest Arkansas Community College and the University of Arkansas on projects that included genetic transformations, column chromatography, ultrafiltration/diafiltration, and two-phase extraction. This research experience was balanced by a semester-long internship carried out a local biotechnology company in the semester opposite their research training during the academic year. These companies included Jupeng Biotechnologies, Pel-Freez Biologics, and Now Diagnostics. Students were able to observe the manufacturing process and equipment used by the company, including observing techniques related to their research training. They also were able to gain insights to the relationships between companies and customers that lead to new product development that are not present in an academic setting.

The program was designed to address the students' concerns that the program wouldn't fit with their existing obligations and that biotechnology research would be outside of their capabilities. This was accomplished by providing a competitive stipend during both the academic year and summer research experience, working closely with the students at the beginning of the program during their research training, and forming a multi-tiered mentoring community of students alongside a concurrent research experiences for undergraduates (REU) program. The mentoring community element sought to provide the students with representation of students with similar circumstances to their own to address concerns that they may have had related to their ability to participate and skill level. The students were also quickly connected to mentors within NWACC and the University of Arkansas to begin building skills and to give them a guide to any technical or non-technical questions they may have related to the program. Additional peer mentoring formed during the summer program also was emphasized to continue to demonstrate to them that their skill level is appropriate, as well as provide them with students who can give them insights on pursuing a bachelor's degree in STEM. This community was emphasized through regular formal and informal interactions, including monthly professional development meetings during the academic year and weekly research updates to the entire group of combined programs over the summer. Monthly sessions included presentations University of Arkansas representatives, tours of local companies, and sessions to develop posters to be presented at conferences. The multi-tiered design of this mentoring community, where faculty, graduate students, and peers, all were heavily involved with the experiences of the students as they went through the program, ensured the students had access to quality mentoring relationships and representation necessary to make the program accessible by limiting the apprehensions of the students as they entered.

The program's accessibility and value to the students were assessed through a survey and free response questions. Surveys were taken at the start of the program before the research training (presurvey), after the internship experience, and after the program's conclusion at the end of the ten-week summer research experience (collection underway). Surveys were administered by a professor not involved with the program. Both the pre and the post-survey contained approximately 60 questions where the students scored themselves related to their confidence in STEM entering/leaving the program and the skills they possessed. The students rated themselves 1-5 on the post survey, 5 being "great gain" and 1 being "little gain", on questions divided into three categories: accessibility, skill development, and career awareness. The scores for each question within each category were averaged to form a composite score from which conclusions were drawn. Questions in the accessibility category related to the confidence of students completing a research project, the level of comfort developing and discussing research projects, and their feelings of belonging in STEM. Questions in the skills category related more to the specific skills that will be valuable to their pursuit of a STEM career, including project planning, data analysis, lab techniques, reporting results, etc. Questions in the career awareness category discussed their understanding of how their work translates to real-world setting, how different disciplines are connected in an industrial setting, and their interest in pursuing different types of STEM careers. The presurvey asked questions relating to their confidence in STEM, their technical skill level entering the program, and their career aspirations. Confidence and career awareness questions were scored on a different scale asking them to "strongly" (6), "moderately" (5), or "slightly" (4) agree or "strongly" (1), "moderately" (2), or "slightly" (3) disagree with given statements. Further context was given to this survey data by asking the students open ended questions where they described the impact the program had on their future plans and skills developed they felt would be valuable to their pursuit of a STEM degree and career. Having the

students answer these questions also forced them to think critically about these items while their experiences were still fresh.

Results

Four students from NWACC completed research training, an internship experience at a local biotechnology company, and a ten week summer research experience. The presurvey data suggested that the students were excited for the experience but apprehensive about their skill level entering the program, scoring averages (standard deviation) of 4.51/6 (0.23) in confidence, 1.57/5 (0.38) in skills, and 4.23/6 (.48) in career awareness. After the students completed their research training and internship experience the scores reached 3.76/5 (0.97) in accessibility, 3.46/5 (0.85) in skills development, and 3.52 (1.06) in career awareness Inconsistencies between the pre- and post-surveys make it difficult to quantitatively interpret the change in the students' confidence levels and career awareness, but a clear growth in skills is present. Students answered free response questions asking them to describe the skills and experiences that were valuable to them after the internship experience and the impact of the program as a whole on their future plans at the end of the summer research experience. Responses after the internship experience described positive mentoring relationships that described how people with different educational backgrounds collaborated to reach a goal. They also highlighted experiences such as understanding quality assurance, the importance of meticulous data collection, and how to deal with experimental failure that aren't possible to discuss in a classroom setting. The students also described how their goals felt more achievable and worthwhile after both the internship and research experiences. The students reflected that they were more eager to pursue additional research and STEM opportunities, including graduate school specifically, after the research experience had concluded. These questions shared the same trend as the survey data that the students were able to grow more comfortable and confident as the program went on and ultimately gain skills and experiences that will help their pursuit of a STEM degree and potential biotechnology career.

Summary

This paper reports the structure of the MAST center biotechnology training programs designed to give community college students training to meet the demands of the growing biotechnology industry in Northwest Arkansas. This design sought to incorporate a multi-tiered mentoring community environment that promoted the program's accessibility to community college students, a group that typically does not participate in these types of programs. Over the yearlong program, the students were given research training and an internship experience during the academic year and a 10-week full-time research experience over the summer. Based on the results of the free response questions, the program was successfully able to provide the students with an experience they were able to become confident and comfortable with over time. This confidence and comfort translated to the development of valuable skills and experiences that provide quality training for a biotechnology career outside of the capabilities of the classroom. The program intends to track the future endeavors of these students with the hope that local jobs in the biotechnology program will be attainable for the students should they decide to pursue them. Continuing to track the students and add new students to the sample size as the program matures will address a major limitation of small sample size.

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Mr. McKean is currently pursuing a PhD in Materials Science and Engineering and plans to include engineering education as a major component of his dissertation. Mr. McKean received his MS in Microelectronics Photonics from the University of Arkansas in 2021 and his BS in Chemical Engineering from Syracuse University in 2017. Mr. McKean has served as the lead graduate student for MAST Center REU and REM programs since 2022, and has published and presented the results of the programs at numerous conferences. Mr. McKean plans to work to facilitate connections between academia and industry after receiving his doctoral degree.

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