



# Community College Partners with Industry to Train Next Generation of Water Operators

**CRISTINA CARBAJO<sup>1\*</sup>**

<sup>1</sup>*Department of Natural and Behavioral Sciences, Pellissippi State Community College, Knoxville, TN 37932 USA*

\**cmcarbajo@pstcc.edu*

**Abstract:** In order to meet the dire need for certified water and wastewater operators, utilities in East Tennessee approached the local community college to develop a new degree program. In 2019, the Water Quality Technology (WQT) Program was launched at Pellissippi State Community College (PSCC), funded by the National Science Foundation. An industry advisory board worked closely with the faculty to provide students with the best academic and practical experience. Local utilities continue to support the program by hosting students for on-site field experiences and paid internships. Students who have completed the program have been employed in successful careers in the water and wastewater sector prior to graduation, and those who have attempted the state certification exams have surpassed average pass rates.

**Keywords:** water treatment, wastewater treatment, program implementation, program design, small programs

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## Introduction

Nationwide, water and wastewater operators are set to retire without a strong pipeline to fill their essential positions [1]. In Tennessee, up to 50% of the current workforce is set to retire within the next five to ten years, amounting to over 1,500 open positions [2]. Consequently, several utilities united to approach PSCC, the largest community college in the state. The utilities asked PSCC to create a new program specifically designed to train water and wastewater operators to help fill the void left by the retiring workforce. With funding from the National Science Foundation, PSCC created the WQT Program. Working in coordination with an advisory board, the college designed an interdisciplinary program to prepare students for the rigorous state certification exams, which historically have low pass rates. The program includes site visits and field experiences every semester and culminates in a 90-hour internship and capstone project. The inaugural cohort of students began in the fall of 2019, and more than a dozen graduates of the program are already fulfilling these much-needed roles in East Tennessee.

## Methods

PSCC gathered an advisory board that included a dozen utility stakeholders to develop the courses and experiential learning for the WQT program. The original advisory board was comprised of individuals who approached the college with the proposal to begin the WQT Program: members of the Tennessee Association of Utility Districts (TAUD) and managers of utilities in the local area. The current advisory board consists only of managers and operators from local utilities. Based on the board's advice, the Deans of Engineering and Natural and Behavioral Sciences collaborated to choose the best course offerings available at PSCC to educate a well-rounded operator. By creating an interdisciplinary curriculum spanning natural sciences, mathematics, engineering, and water treatment, the chosen courses aim to meet the critical skills needed in a successful operator: theoretical and practical knowledge of water treatment, strong math skills, and professionalism.

A Program Coordinator, who is also the author of this current submission, was hired to develop course content and teach all nine water-specific courses. The niche nature of the subject presented challenges for the Program Coordinator, including time-intensive material creation with few traditional resources available. Past studies on small programs indicate that one barrier includes difficulty retaining faculty willing to perform all roles associated with running the program, in part due to heavy workloads or other implicit responsibilities within academia [3,4]. Additionally, the onus of voluntary but labor-intensive student mentorship, recruitment, and inclusion is placed on a small number of faculty members; in the case of WQT, one [5,6,7,8].



**Table 1. Interdisciplinary Course Requirements for the Water Quality Technology Degree**

<b>Water Quality Technology</b> Orientation to Water Operations* Regulations & Compliance Water Facilities & Maintenance* Water Treatment I* Water Treatment II* Wastewater Treatment I* Wastewater Treatment II* Applied Skills for Operators Technology Water Quality Capstone*	<b>STEM Theory</b> Precalculus Algebra Precalculus Geometry Chemistry I Chemistry II Microbiology	<b>Professional Skills</b> Leadership Development English Composition I Business & Technical Writing
		<b>Technical Skills</b> Industrial Safety Fluid Mechanics Computers in Engineering

*\*Courses with substantial field experience component*

### **Program Outreach and Structure**

PSCC collaborated with local utility representatives to create a program that was attractive to those already employed in the field. Recognizing the critical shortage of certified operators, many utilities offer tuition reimbursement for employees pursuing the WQT degree. As an added incentive, graduates often qualify for promotions and salary increases, making the degree a valuable investment for both the employer and the employee.

The degree program offers a unique advantage to state-certified operators: credit for their existing experience and certifications. Operators holding the highest level of state certification receive credit for all required water quality courses, while those with relevant safety training can receive credit for the industrial safety course. This accelerated path allows completion of the degree with roughly one year of coursework. To accommodate a variety of schedules, courses are offered online and at night. This flexibility, combined with the program's accessibility across the state, removes geographical barriers to degree completion for working adults.

### **Industry Engagement**

The active advisory board ensures curriculum and course offerings align with industry demands, producing the most well-rounded and prepared graduates. This includes updating textbooks, bringing industry experts to share their experiences with students, and developing new courses to meet direct industry needs. For example, hiring managers on the advisory board identified two program-specific courses in the curriculum, Small Water Systems and Advanced Wastewater Treatment, that were not as useful for practical job applications as had been previously anticipated. These two courses were discontinued and replaced with an Applied Skills course, which addresses the most common requests from managers: applied laboratory experience, professionalism, computer skills, and advanced water-industry mathematics.

### **Integration of Employability Skills**

PSCC has supported the program from its inception. A testament to this commitment is the WQT Leadership course taught by the college's Vice President, which is the only course she teaches each year. Coupled with the students' technical knowledge of the industry and treatment processes, including these managerial skills as part of their education is invaluable. The Program Coordinator reinforces professional development skills throughout the WQT curriculum. Students begin building essential job-search tools early in the program with a graded resumé assignment, which students utilize as they network at technical conferences and attend site



visits. Professional communication, including email etiquette and interview techniques, is also emphasized. In their third semester, students go through a mock job application and interview process, where advisory board members serve as the interviewers.

### Integration of New Technology

The Program Coordinator also looks for the latest technologies in the industry to expose students to new lab techniques and computer software. Although PSCC's campus does not have its own on-site water or wastewater treatment facilities, the author's integration of theoretical technologies allows students to prepare for abnormal conditions before encountering them in real life. By networking within the ATE community, the author was introduced to an Augmented Virtual Reality (AVR) app developed at Eastern Iowa Community College. The AVR allows students to visualize and interact with equipment not available on campus, such as troubleshooting atypical issues in large pumps or simulating field sampling techniques. Additionally, in the Capstone Course taken in the last semester prior to graduation, the Program Coordinator employs the computer modeling software developed by Hydromantis: GPS-X. Students can "build" a treatment facility in the computer program and simulate various theoretical scenarios. This allows students to predict and prepare for emergency situations without having to experience them first-hand.

## Cohort Structure and Work-based Learning



Fig. 1. Progression of the WQT Courses and Included Field Experience



## **Results and Discussion**

The WQT Program successfully completed its fifth year and has already demonstrated a positive impact on the water and wastewater industry by cultivating a skilled workforce. Nearly two dozen students previously unfamiliar with the industry have secured full-time employment and advanced within their organizations as a direct result of the concepts learned through the program. Hiring managers consistently praise WQT graduates entering the workforce for their higher level of skills and knowledge compared to their peers. The program's blend of theoretical coursework and extensive site visits equips students with a comprehensive understanding of water and wastewater treatment processes.

To date, the WQT Program has produced 13 graduates with an Associate of Applied Science degree in Water Quality Technology. A remarkable 93% of students (13 out of 14) have passed the Grade III or Grade IV Tennessee Certification in either Water or Wastewater Operations, greatly exceeding the state's average pass rate of around 20 to 30 percent [9]. To expand the program's reach, the author is exploring ways to make the program more accessible to those outside the local area, including increasing online course offerings. Some early challenges in implementing this expansion include difficulty in coordinating field experiences and addressing lower student success rates observed in asynchronous online STEM courses like chemistry, microbiology, and mathematics.

## **Conclusions**

Despite initial challenges faced by the Program Coordinator relating to workload, material creation, and coordination of field experiences, utilities have benefited from the program's achievements through the hiring of qualified operators. The key to the program's success is relying on the expertise and support of the local water industry, particularly the Advisory Board. By training the next generation of water and wastewater professionals, PSCC is directly addressing a critical community need. This program serves as the pipeline needed to replenish the workforce and train the future leaders of the water industry.

Graduates of the two-year WQT degree program have their choice of well-paying careers not only in the local area, but also nationally. Perhaps most importantly, students are feeling fulfilled in their careers and have found a rewarding way to support their families and protect their communities.



*Fig. 2. Students Lisa Sforza (left) and Jaden Goodman (right) are shown at their treatment facilities. Both passed the highest levels of state certification in their field.*



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