Pennsylvania College of Technology
A Penn State Affiliate

A Collaborative Approach to Expanding Nondestructive Testing Education Within a Welding Program

Year Four Evaluation Report – June 2024

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Acknowledgments

This year-end evaluation report is made possible with the collaboration of Mr. Michael Nau, P.I., Dr. Bradley Webb, Co-P.I., and Mr. James Colton, Co-P.I. These leadership team members met with the external evaluator during project team meetings to review activities, progress, milestones, and impediments, all of which have informed the evaluation of *A Collaborative Approach to Expanding Nondestructive Testing Education Within a Welding Program*. Dr. Webb offered feedback on evaluation metrics, tools, and protocols, and was instrumental in providing timely and thorough project records that reflect the year four implementation of this ATE grant. Appreciation is also shown to the internal and external project stakeholders who shared their experiences, recommendations, and insights during one-on-one interviews with the external evaluator.

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List of Acronyms and Initialisms

20NDT – A Collaborative Approach to Expanding Nondestructive Testing Education Within a Welding Program

ATE – Advanced Technological Education

ASNT – American Society for Nondestructive Testing

FTIC – First Time in College

HPO – High Priority Occupation

KSA – Knowledge, Skills, and Abilities

MT – Magnetic Particle Testing

NDT – Nondestructive testing

NSF – National Science Foundation

NWI – National Welding Institute

PAUT – Phased Array Ultrasonic Testing

PC Now – Penn College Now

PCT – Pennsylvania College of Technology

RT – Radiographic Testing

UT – Ultrasonic Testing

VT – Visual Testing

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EXECUTIVE SUMMARY

In May 2020, Pennsylvania College of Technology (PCT) was awarded a three-year National Science Foundation Advanced Technological Education (NSF ATE) grant in the amount of $599,816 to support "A Collaborative Approach to Expanding Nondestructive Testing Education Within a Welding Program" (referred to as *20NDT*). The project aims to address the growing unmet need for skilled technicians in NDT who are qualified to secure our nation's critical infrastructure. The findings, recommendations, and commendations that comprise this fourth annual evaluation report are based on grant-related activities and accomplishments occurring between April 2023 and April 2024.

The goals, objectives, and working framework of *20NDT* are detailed herein. The project was implemented under the leadership of Mr. Michael Nau, P.I., and two Co-P.I.s: Dr. Bradley Webb and Mr. James Colton. The commitment of the project leadership team and college administrators remained steadfast for the performance period of this grant. The college and the Naval Welding Institute (NWI) successfully completed their contractual relationship. In partnership with PCT, the experts at NWI developed the curriculum, lecture materials, and test banks for the college's NDT credentials in accordance with American Society for Nondestructive Testing (ASNT) requirements. The curriculum focuses on discontinuity, defects, and processes of NDT.

The A.A.S in NDT was officially approved in December 2021. PCT's NDT degree is the only program of its kind in the northeast U.S. Enrollment in the A.A.S. in NDT has increased markedly, from two students in fall 2022 to10 students (continuing and incoming) in fall 2024. Interest in the dual degree offerings is also on the rise, with 60% of students pursuing the A.A.S. in NDT and the B.S. in Welding & Fabrication Engineering Technology, or the A.A.S. in NDT and the A.A.S. in Welding Technology. The first graduates of the A.A.S. in NDT – three in total – were awarded their diplomas in spring 2024. Students who completed the A.A.S. in NDT accrued the requisite number of classroom hours for ASNT Level II certification in RT and UT.

The 18-credit hour NDT minor has also seen impressive growth since its introduction in fall 2020. Between fall 2020 and fall 2023, enrollment increased 81% (from 26 to 47 students). As of spring 2024, 71 students have graduated with a minor in NDT. The Radiographic Testing (RT) and Ultrasonic Testing (UT) competency credentials became available to students beginning in fall 2021. These competency credentials are structured so that each one can be completed in a single semester (among full-time students). They are standalone academic programs expected to appeal to incumbent workers looking to upskill or reskill.

The NDT faculty concluded that too many credit hours were obligated specifically for report writing, so they elected to "merge the recording course with the content course." The college's Curriculum Committee approved this change which resulted in six credit hours being eliminated,

effectively reducing the total number of credit hours from 69 to 63. All currently enrolled NDT students have been advised to update their program catalog to the new version (effective fall 2024).

The courses were held in the NDT classroom and lab, which are part of the college's state-of-the-art welding facility. The college's industry partners continue to support the lab with donations of equipment and consumables from various manufacturers. Several advisory committee members have expressed interest in being involved in periodic curriculum review for the NDT programs, providing internships for students, and serving as guest speakers for NDT classes, the summer camp, or faculty professional development engagements.

In an effort to draw more attention to the NDT program, the project team has been intentional about separating NDT from the welding program in all print and digital marketing materials. Beginning in 2023, open houses on PCT's campus prominently featured NDT as a standalone program (separate from welding). In year four of *20NDT*, NDT faculty visited a high school in Pittsburgh to conduct a classroom demonstration and generate interest in the program. Other marketing efforts included digital advertisements, press releases, and the distribution of NDT handbills to prospective students of the college's welding program. Dissemination activities of the project team included presentations at national conferences, and featured articles in industry journals and magazines.

The three-day NDT summer camp was held on campus in July 2023. The NDT summer camp is designed to attract underrepresented high school students for an immersive residential experience. The 31 participants in grades 10-12 were exposed to the topics of RT, UT, Magnetic Particle Testing (MT), Phased Array Ultrasonic Testing (PAUT), and welding through a series of concurrent workshops. Participants reported gaining an understanding of NDT and welding techniques, and increasing their awareness of NDT career pathways.

Professional development engagements for secondary school faculty include this summer's welding teacher training and the 2023 20NDT faculty externship. The first-of-its-kind faculty externship hosted 12 non-STEM teachers and counselors from across the state for one week in July 2023. Participants gained hands-on experience in welding, RT, UT, and Visual Testing (VT). The goal of the faculty externship was to broaden the participants' awareness of NDT and the program offerings at PCT, and have the newly trained faculty return to their classrooms in fall 2023 to share their knowledge and excitement about NDT with their high school students.

PROJECT BACKGROUND

PCT is already regarded as a leader in welding and NDT instruction, and this ATE grant increased the institution's profile and capacity to train traditional and non-traditional students to become NDT specialists. This project aims to serve the national interest by increasing the supply of skilled NDT technicians qualified to secure our nation's critical infrastructure.

As originally proposed, over the course of the project's first two years, *20NDT* ushered in the development of a new A.A.S. degree program and two specialized competency credentials in RT and UT. The project's objectives include: 1) develop curricula for RT and UT that lead to fulfillment of ASNT Level II classroom requirements; 2) align the two competency credentials and A.A.S. degree program to create flexible academic pathways for students; 3) enhance student learning with new equipment for teaching RT and UT, and 4) recruit and enroll high school students and incumbent workers in new pathways to earning NDT credentials.

20NDT has introduced a portfolio of specialized academic and real-world learning opportunities not previously available at the college. The new academic programs have attracted FTIC (First Time In College) students and practitioners looking to upskill and reskill. *20NDT* represents a unique opportunity to build a pipeline of graduates with the theoretical knowledge and technical skills to succeed in the field. As *20NDT* has evolved over its four-year performance period, it has grown into a model for career and educational pathways in NDT worthy of replication at other institutions. The project has been supported by an external evaluation designed to assess the significance of the initiative on the advancement of student engagement, scholarship, and workforce readiness in NDT, and the capacity-building of the college and its community stakeholders.

An expansion at the college culminated in a 55,000-square-foot welding facility featuring a designated NDT classroom and lab. In year one of *20NDT*, several significant equipment purchases were made in support of the new NDT academic programs. The college acquired seven Olympus PAUT units, a digital x-ray bed, and a dummy radiographic source. An in-person training on the new PAUT units was conducted by Olympus in year two of *20NDT*. The project's industry partners have generously donated their time and expertise as guest speakers and members of the 20NDT Industry Advisory Committee. They have also made sizeable contributions in monetary resources, equipment, and consumables for the NDT lab.

METHODOLOGY

The external evaluation of *20NDT* was designed to satisfy NSF ATE's requirement that all funded projects conduct a thorough assessment of their activities and outcomes. The evaluation has been led by Dr. Blake Urbach, Principal Consultant of Preferred Program Evaluations. Throughout the four-year performance period of *20NDT*, the evaluator drew from a combination of qualitative and quantitative data sources to provide an in-depth examination of project implementation and management processes, and inform mid-course correction. Data sources included project records, artifacts, and activity logs; curriculum/frameworks; institutional records of enrollment, performance, and completion; one-on-one interviews with a cross-section of internal and external stakeholders; campus site visits, and surveys for summer camp participants, dual enrollment students, industry partners, and high school faculty members. (Survey results dashboards can be found in the Appendix of this report.)

The evaluation aided PCT in measuring its impact – projected and unanticipated – on: 1) designing and adopting an industry-approved curriculum mapped to ASNT standards; 2) determining effective practices that promote and reinforce student success in the new degree and competency credentials; 3) assessing the fidelity of project activities and processes; 4) identifying constraints encountered that may pose threats to validity within the implementation process; and, 5) reviewing evidence of change among participating students. The evaluation has also addressed methods of recruitment and service delivery, characteristics of participants served, growth in faculty confidence and competencies, collaboration with industry partners, and changes in organizational capacity.

Ongoing assessment of the project involved routine correspondence, monthly meetings, ad hoc monitoring, survey results dashboards, and annual evaluation reports. Strategies employed during the performance period that were shown to have favorable student and faculty outcomes were used to inform subsequent changes in pedagogy and practice. Findings have been reviewed each year with the project team and shared with the NDT Industry Advisory Committee.

The external evaluator's duties and responsibilities have included evaluation oversight, alignment of data to project goals, and meaningful reporting on program impact. Using a holistic evaluation design, the evaluator strived to present a current and complete picture of the project as it took shape over the lifecycle of the grant (inclusive of the 12-month no-cost extension). From its outset, *20NDT* has been guided by a series of questions about participants, process, correction, and impact.

Evaluation Questions	
Participants:	Are incoming students and incumbent workers enrolling in the degree and/or certificate programs on par with project outcomes? How have high school students been made aware of the summer camp and dual enrollment opportunities? Are faculty satisfactorily completing train-the-trainer modules?
Process:	In what ways is the project contributing to student engagement in NDT? How has the input of industry partners been used to shape/revise the new curriculum? How have teachers modified their instruction to incorporate NDT simulations using the new equipment?
Correction:	What adjustments were necessary for the promotion of the new program offerings? What corrective actions were taken to ensure students have the requisite knowledge and skills to pass the Level I and II ASNT practice exams?
Impact:	To what extent did the degree and certificate programs produce graduates prepared for employment as NDT technicians? How has the institution's capacity grown as a result of the new program offerings? In what ways have the external stakeholders contributed to the sustainability of this initiative post-funding?

In spring 2024, one-on-one interviews were conducted with members of the project team and NDT students. Stakeholder interviews with project personnel are valued for generating a candid, extemporaneous dialogue about project implementation unobtainable through traditional surveying methods. Participants were asked to respond to a set of questions about curriculum and program design, training, marketing, collaboration, and dissemination. Stakeholder interviews with students offer a better understanding of the student experience and learning environment; gains in knowledge skill, and ability (KSA), and barriers to program completion. The evaluator spoke with three stakeholders in spring 2024.

- Dr. Bradley Webb – Co-P.I., and Dean, School of Engineering Technologies, Pennsylvania College of Technology
- One female A.A.S. in NDT degree-seeking student
- One male A.A.S. in NDT degree-seeking student

PROJECT OBJECTIVES AND OUTCOMES MATRIX

Goals and Objectives	Measures	Data Sources
Develop AAS/certificates in NDT • Fully develop 80 hours for certification in RT and UT ➡ 14 new NDT courses (including a radiation safety course) were developed and approved The curriculum was revised in 2024, resulting in the elimination of three NDT courses from the curriculum framework • Fully develop courses for PAUT ➡ PAUT curriculum was finalized in time for the initial course rollout in fall 2022 • Acquire equipment for RT and PAUT ➡ 7 PAUT units, a digital x-ray bed, and a dummy radiographic source have been purchased for the NDT lab Industry partners have donated additional equipment and consumables • Create pathways from certificates to A.A.S. to B.S. ➡ The RT and UT competency credentials have been embedded in the A.A.S. degree Two dual degree pathways have been created: one for students pursuing the A.A.S. in NDT and A.A.S. in Welding Technology, and one for students pursuing the A.A.S. in NDT and the B.S. in Welding & Fabrication Engineering Technology	• Number of new NDT courses leading to AAS and certificates • Pathways in place to share credits between certificate, A.A.S., and B.S. programs	• Document review • Curriculum/frame-works • Institutional records • Stakeholder interviews

Goals and Objectives	Measures	Data Sources
Recruit students into the NDT A.A.S. and certificate programs and place graduates in industry positions • 10 students enroll annually in A.A.S. ➡ 10 students (continuing and incoming) are enrolled in the degree program for fall 2024 Two of these students were participants in the 2023 NDT summer camp • 5 students enroll in each certificate program ➡ 58 students were enrolled in the NDT minor in spring 2024 A total of 71 students have graduated with a minor in NDT • 90% of completers are placed in an NDT position ➡ The first three A.A.S. in NDT graduates were awarded their degree in spring 2024. A post-graduation survey will be distributed to the graduates in fall 2024. The survey will ask students to report on their employment status.	• #, %, demographics of students applying for and enrolling in the A.A.S. and certificate programs • #, % who complete the program requirements and who pass the Level I and II ASNT practice exams • #, % program completers who secure employment in an NDT field • #, %, demographics of summer camp, Philadelphia summer event, and PCNOW participants who enroll in Penn College's NDT programs	• Project records and activity logs • Recruitment event participation • Institutional records • Stakeholder interviews • Student surveys
Provide faculty with train-the-trainer opportunities to improve their NDT knowledge ➡ NWI facilitated a virtual training on RT Olympus provided training on PAUT to PCT faculty PCT faculty attended training on Eddy Current PCT faculty have trained secondary school and college faculty through a variety of professional development engagements including the 20NDT faculty externship, welding teacher training, and summer workshop (in conjunction with Weld-Ed)	• Faculty ability to teach the NDT curriculum and use equipment	• Project records and activity logs • Stakeholder interviews

Goals and Objectives	Measures	Data Sources
Disseminate curriculum, lessons learned, instructional best practices ➡ Materials have been disseminated at the ATE P.I. Conference, ASNT Annual Conference, Skills USA Project-Based Learning National Conference, and AWS FabTech Trade Show & Annual Meeting Articles featuring the college's NDT program appeared in "Inspection Trends," "Materials Evaluation," and "FF Journal" The NDT program is featured in a video on YouTube, as well as the college's website and social media accounts Curriculum, lessons learned, and instructional best practices are being shared during teacher trainings regionally and nationwide	• Dissemination of project results	• Publication and presentation of materials

FINDINGS AND RECOMMENDATIONS

NDT Course and Program Offerings

NDT Credentials

The college's A.A.S in NDT degree was approved in December 2021. The curriculum for this degree was developed in accordance with ASNT standards, and focuses on discontinuity, defects, and processes of NDT. Whereas other institutions with NDT degree programs do not provide exposure to the fundamentals of welding, PCT's program graduates will have developed an understanding of each welding process and should be able to identify discontinuity in the welding process.

The college's contractual relationship with NWI for the development of a rigorous and relevant industry-driven curriculum for the NDT academic credentials has been fulfilled. Most recently, NWI provided the college with new modules specific to Eddy Current. Mr. Nau, P.I., and NDT faculty member, indicated that the labs used in the NDT courses were developed in-house at PCT. The curriculum and supplementary materials will be reviewed annually to ensure the content remains current and responsive to industry trends and demands. The feedback of the *20NDT* Industry Advisory Committee will help inform future additions and other changes.

The project team developed two "crosswalks" for degree-seeking students of NDT and welding. The first makes it possible for students to complete the A.A.S. in NDT and the B.S. in Welding & Fabrication Engineering Technology in five years, and the second enables students to complete the A.A.S. in NDT and the A.A.S. in Welding Technology in three years. The NDT degree may also be attractive to students considering other degree pathways at the college, such as machining, diesel technology, and aviation.

A full-time student can complete the A.A.S. degree program in four semesters. Each new cohort of students will begin in the fall term; there is not a staggered start date. Enrollment in the A.A.S. in NDT has increased markedly, from two students in fall 2022 to 10 students (continuing and incoming) in fall 2024. Four of the 10 students are pursuing the A.A.S in NDT as their sole degree. Three of the students are in the dual degree pathway for the A.A.S. in NDT and the B.S. in Welding & Fabrication Engineering Technology, and the remaining three students are pursuing both the A.A.S. in NDT and the A.A.S. in Welding Technology. The first graduates of the A.A.S. in NDT – three in total – were awarded their diploma in spring 2024!

Dr. Webb is seeing increased interest among females in the NDT credentials. In spring 2024, three of the four students (42%) enrolled in the A.A.S. in NDT identified as female. Interest in the dual degree offerings is also on the rise. (The dual degree curriculum maps are not published; students interested in pursuing these options are guided on course selection/sequencing by their faculty advisor.) The project team has worked proactively with the college's financial aid office to ensure students pursuing either of the dual degree options are able to make the most of their financial aid benefits.

The 18-credit hour NDT minor has also seen impressive growth since its introduction in fall 2020. Between fall 2020 and fall 2023, enrollment increased 81% (from 26 to 47 students). For students pursuing the B.S. in Welding & Fabrication Engineering Technology, the addition of nine credit hours will yield both of these academic credentials. As of spring 2024, 71 students have graduated with a minor in NDT.

The RT and UT competency credentials are embedded within the A.A.S. degree program. The RT and UT competency credentials are structured so that each one can be completed in a single semester (among full-time students). They are standalone academic programs expected to appeal to incumbent workers looking to upskill or reskill. According to Dr. Webb, the UT competency credential may be particularly attractive to students in the college's aviation program.

Instructors Mr. Nau and Mr. Hurd provide advising to NDT students on course selection, career planning, and internship opportunities. Completion of an internship is not a requirement for the A.A.S. degree. However, the NDT faculty members noted that they are proponents of undergraduate internships, and highly encourage their students to secure these positions. Although this is a student-driven activity, the college's NDT faculty and Career Services staff are available to provide guidance throughout each work-based learning experience. In summer 2023, one of the students pursuing a minor in NDT interned at Integrity TestLabs. She gained real-world experience working in the field with the RT crew setting up exposures and processing films.

NDT Courses

In year four of *20NDT*, Mr. Nau, Mr. Hurd, and the newest NDT faculty member, Mr. Tyler Frontz, taught the NDT courses for new and continuing students. The NDT course offerings for the 2023-2024 academic year are shown in Figure 1. The courses in **red** font are for first year degree-seeking students; courses in **gray** font are for second year students.

Fall 2023 NDT Course Offerings	Spring 2024 NDT Course Offerings
QAL 102 (Radiation Safety)	QAL 199 (Special Topics)*
QAL 241 (Non-Destructive Testing I)	QAL 122 (Radiographic Testing I)
QAL 103 (Governing Technical Documents for NDT)	QAL 222 (Radiographic Testing II)
QAL 124 (Ultrasonic Testing I)	QAL 227 (Phased Array Ultrasonic Testing I)
QAL 224 (Ultrasonic Testing II)	QAL 228 (Phased Array Ultrasonic Testing II)

Figure 1. (*Only offered this term. Not part of the original or revised curriculum framework.)

Beginning in fall 2022, all welding students were scheduled to take QAL 241 (Non-Destructive Testing I) during their first semester (in lieu of a computer science course). The project team made this change intentionally as a way to increase early exposure to NDT and pique student interest in the discipline. Additionally, all applicants who are waitlisted for the welding program are encouraged to "pivot" to NDT.

Dr. Webb explained that after teaching the courses in 2022 and 2023, the NDT faculty concluded that too many credit hours were obligated specifically for report writing. Thus, they made an informed decision to "merge the recording course with the content course." This change resulted in six credit hours being eliminated, effectively reducing the total number of credit hours from 69 to 63. (The eliminated courses include QAL 123, QAL 126, and QAL 229.) This reduction in credits represents a substantial cost savings for students while having no foreseeable adverse impact on student learning.

The aforementioned change has been approved by the college's Curriculum Committee and will officially take effect beginning fall 2024. In the interim (for spring 2024), this revision was paralleled by having students enroll in QAL 199 (Special Topics). All currently enrolled NDT students have been advised to update their program catalog to the new version.

ASNT Certification

Students who complete the A.A.S. in NDT will have accrued the requisite number of classroom hours for ASNT Level II certification in RT and UT. ASNT Level II certification requires 80 hours of classroom training and 1,500 lab hours. Per the original contract with NWI, the company will certify the classroom hours for 10 NDT graduates. (Students will need to accrue their industry hours for ASNT certification on the job site.)

In spring 2024, Dr. Webb determined that certifying the students' hours for ASNT will be easier to accomplish than originally thought. He explained that any ASNT Level III inspector is qualified to perform this action. It is an acceptable practice for the certifying practitioner to use student

transcripts to verify contact hours and course grades, and draft a formal letter affirming that the student has met the requirements for Level II certification. One of the members currenting serving on the 20NDT Industry Advisory Committee is an ASNT Level III inspector, and he is willing to serve in this capacity for the college's NDT graduates. Although this arrangement still needs to be formalized, it represents a much more sustainable approach to certifying the NDT students' hours once the current contract with NWI has been exhausted.

First-Year NDT Student Experience

In spring 2024, two NDT students engaged in a one-on-one stakeholder interview with the external evaluator of *20NDT*. One student noted that he first learned about the NDT program at PCT through a family member affiliated with the college. He transferred to PCT from a private school in Pittsburgh, PA. This student has completed one year of studies for his A.A.S. in NDT, and expects to graduate in spring 2025. Upon graduation his goal is to pursue a Bachelor's Degree in Engineering, Welding, or Metal Fabrication.

The other student interviewed is pursuing an A.A.S. in NDT and a Bachelor's Degree in Welding. She entered the program with dual enrollment credits and has completed her first year of studies at PCT. While she was a junior at her vocational technical school, she became familiar with NDT as a field of study. After that initial exposure, she knew she wanted to earn credentials in both NDT and welding. She took notice of PCT as the only college or university with a dual degree option of this kind. Her post-graduation plans are to find a job in welding ("an engineering-based job," specifically) and transition to NDT once she has gained a few years of field experience.

One student described the program as rigorous and explained that there is a lot of content to learn (and memorize) in a short period of time. He has found the pace to be challenging but not overwhelming. He is pleased with the amount of class time allocated to hands-on work, and feels it is giving him a taste of what he can expect to encounter in the field. The program's emphasis on experiential learning is helping the student retain the information that is covered during the lecture portion of the class. Similarly, the other interviewee communicated, "Time spent in the lab feels very productive." She remarked that digital and film x-rays take approximately 15-20 minutes to process, and the students are urged to run as many tests as they can during the class period in order to sharpen their skills. She is really enjoying learning about the different testing methods as part of the NDT coursework.

The students were in agreement that their instructor, Mr. Nau, struck the right balance between lecture (theory) and lab. One hour twice a week is devoted to lecture, and the remaining class hours are spent in the lab. The female student thought this configuration was well-suited to the

program's eight-week minimesters. The inclusion of industry guest speakers added another element of engagement to the class periods.

Per one interviewee, grades are assigned for tests/quizzes, homework, and labs. He appreciated that lab work was graded on participation, professionalism, and accuracy. Per the other interviewee, the students' overall understanding of the curriculum is assessed through weekly tests based on Mr. Nau's lectures. She noted that the students also receive grades for their vocabulary and glossary word quizzes, labs, and "official" NDT reports.

Both student interviewees spoke about the quality instruction they were receiving in their NDT courses. Mr. Nau was commended for being accessible and accommodating. One student indicated that Mr. Nau has an "open door policy" and the students can show up unannounced to request additional help. One student was pleased to share that the instructor tries to develop rapport with his students and encourages them to ask questions. Mr. Nau doubles as this student's academic advisor, and provides guidance on course selection and registration.

Both NDT students reported that their peer-to-peer interactions have been positive, as has the learning environment on campus. One student remarked that the small class size – typically six students – is a bonus because they have ample opportunity to use the equipment without having to wait for their turn. Students most often work solo but can ask a peer for assistance, as needed.

One student was very much in favor of other faculty at the college adopting Mr. Nau's approach to course materials. According to this student, instructors are realizing that expensive textbooks place an undue financial burden on some students. Mr. Nau provided an alternative to the course textbook, as well as resource packets and supplemental reading materials. This student expressed his gratitude to Mr. Nau for ensuring course materials were inexpensive and accessible to every learner.

One student mentioned that he has tried to be proactive about making connections via LinkedIn and widening his professional network. He was hoping to secure an internship in Philadelphia this summer but was unable to find an open position. He explained that, thankfully, the students are not on their own when transitioning from college to career. "Career Services helps us find employment." He recognized that ASNT certification will make him more marketable when he is ready to apply for full-time employment as an NDT technician.

When asked how their technical skills have improved during their time as an NDT student, the interviewees shared:

- How to use a variety of visual testing tools
- How to use and test welds, and compare them to known criteria in codebooks
- Liquid penetrant testing and magnetic particle testing
- Digital and film radiography
- Safety protocols

When asked how their soft skills (21st century skills) have improved during their time as an NDT student, the interviewees shared:

- I am more comfortable communicating with classmates and my instructor
- I can confidently address him [my instructor] with questions. I no longer feel so intimidated.
- I have gained leadership skills
- Time management and study skills
- Better understanding of how to network
- Writing for a technical audience

The interviewees were invited to share their ideas on how the college's NDT program could be marketed to attract more students. One interviewee suggested having current NDT students serve as "champions for the program." This would entail the students making visits to high schools and vocational schools to promote the program through a presentation, demonstration, and/or question and answer session.

NDT Lab

The NDT lab is part of the college's state-of-the-art welding facility, and is designed to offer students real-world experience. The lab is outfitted with the latest equipment (from a variety of manufacturers) for the students to hone their technical skills. The NDT lab can accommodate up to 16 students per class section. There are eight PAUT units available for students (working in pairs), and one demo unit for the faculty member.

Throughout the evolution of this project, the college's NDT lab continued to grow in both capacity and utility. Mr. Nau carries out the majority of the purchasing, and was pleased to report that the college's industry partners continue to support the lab with generous donations. PCT benefits from vendor/manufacturing educational discounts and other price breaks.

Industry Collaboration

In year four of *20NDT*, the project team continued to strengthen its partnerships with industry to further the college's NDT credentials by way of exposure, resources, professional development, and content expertise. Although the NDT Industry Advisory Committee did not have a formal meeting during the 2023-2024 academic year, the project team met with employers regularly to discuss this grant, the NDT credentials, and future student-focused opportunities for experiential learning and co-curricular engagements.

Marketing, Recruiting, and Outreach

Dr. Webb projects that as the NDT program gains even more momentum, the enrollment figures will continue to trend upward. He is an advocate for this program and openly steers PCT students (current and prospective) to NDT as "a welding-adjacent prospect." The college has continued to invest in showcasing the NDT degree program. A new NDT marketing video featuring Lycoming Engines was developed and is currently available via YouTube and other digital outlets (https://www.youtube.com/watch?v=3jWMieu0aXw).

The project team has engaged in a robust marketing campaign to attract students to the college's NDT program offerings. In year four of *20NDT*, the project team and college admissions representatives actively engaged with students at high schools, career and technical centers, and community events. NDT faculty visited a high school in Pittsburgh to conduct a classroom demonstration and generate interest in the program.

All print and digital marketing materials: handbills, featured advertisements on digital platforms, and outreach to companies in the region, highlight the hands-on learning experience for NDT students at PCT. The promotional materials also call attention to the promising occupational outlook for NDT. Perhaps most importantly, they have been designed to elevate the skilled trades beyond the prevailing "blue collar" status. Graduates of this program can expect to find high-priority, high-paying jobs across a variety of sectors.

In an effort to draw more attention to the NDT program, the project team has been intentional about separating NDT from the welding program in all print and digital marketing materials. Beginning in 2023, open houses on PCT's campus prominently featured NDT as a standalone program (separate from welding). Mr. Nau and Mr. Hurd continue to provide tours (approximately five per semester) of the NDT lab, and make themselves available to answer the program-specific questions of prospective students and their parents.

In year four of *20NDT*, other marketing efforts included:

- All prospective students who expressed interest in the college's welding program received an email about the NDT program offerings.
- All students who requested additional materials about the college's welding program were also mailed a handbill about NDT.

This ATE grant served as the impetus for Dr. Webb securing High Priority Occupations (HPOs) designation for the college's RT and UT credentials. HPOs are part of Pennsylvania's industry-driven approach to workforce development. Higher education institutions can petition their local workforce development boards to propose adding an HPO that meets the state's criteria. HPOs are eligible for state subsidies for education, making them advantageous for prospective students with limited financial means, and the educational institutions offering credentials in these recognized career pathways.

Engaging High School Students

NDT Summer Camp

PCT hosted its second annual 20NDT summer camp for students entering grades 10-12 on July 16-18, 2023. This three-day immersive pre-college experience included hands-on workshops in RT, UT, MT, PAUT, and welding. The $50 registration fee included all activities as well as meals and on-campus lodging. The Philadelphia Education Fund covered the registration fee (and transportation) for 10 low-income students to attend the camp.

A total of 31 students participated in the 2023 camp offering. One of these students was a repeat camper from 2022. Students who complete any of the college-sponsored camps are eligible to receive a $1K annual scholarship to apply to their PCT tuition. Dr. Webb was pleased to report that two of the students who attended the 2023 summer camp have enrolled in the A.A.S. in NDT for fall 2024.

On the last day of camp participants were asked to respond to an anonymous electronic survey. The survey was designed to inform the content and composition of this extracurricular program offering, and assess student engagement and learning in the discipline. Participants reported gaining an understanding of magnetic fields, metallurgy, and welding techniques for MIG and flux-core. The camp provided students opportunities to engage in real-time problem-solving, and increased their awareness of NDT career pathways. A total of 27 students responded to the survey. (The results dashboard begins on page 21 of this report.)

The 20NDT summer camp will not be offered in 2024 (this ATE grant ended 4/30/24). However, NDT and welding modules have been incorporated in this summer's Tinker Camp at PCT. Tinker Camp will host 30 participants for a four-day interactive engagement focused on engineering and manufacturing. Dr. Webb's intention is for future STEM summer camps offered by PCT to also include an NDT component.

Penn College Now

The project team began implementing this ATE grant with a keen awareness that most high school students have no exposure to the field of NDT and its associated career pathways. They decided to leverage Penn College Now (PC Now) – the college's dual enrollment initiative – in order to build the pipeline of students interested in studying NDT. Per one NDT faculty member, approximately one-quarter of the students who complete a welding course at a partner high school end up enrolling in PCT's welding program. PCT has an impressive graduation and placement rate for its welding program, and anticipates the same for students in NDT.

In year three of *20NDT*, an NDT module was added to the stick welding course for dual enrollment students. In spring 2023, four students at Northern Tier Career Center and 12 students at SUN Area Technical Institute were enrolled in WEL 114 (Shielded Metal Arc I) and WEL 116 (Shielded Metal Arc II) through PC Now. In fall 2023, a total of 19 students from three area high schools were enrolled in this course.

A participant survey was designed for the high school students enrolled in WEL 114 and WEL 116. The survey was posted to the course homepage on D2L and all students were encouraged to respond at the conclusion of the spring 2023 or fall 2023 semester. The survey asked students to rate their learning gains, level of engagement, exposure to NDT careers, and interest in future NDT coursework. Students reported gaining a variety of technical skills related to stick welding, and a better understanding of their career goals. (The results dashboards begin on page 25 of this report.)

Faculty Training Opportunities

Faculty Externship

Introducing additional high school faculty to the portfolio of NDT offerings at PCT is key to growing the program. Dr. Webb reallocated monies from this grant's travel and participant support line items to fund a first-of-its-kind NDT faculty externship. The engagement hosted 12 non-STEM teachers and counselors from across the state during the week of July 16, 2023. Participants gained hands-on experience in welding, RT, UT, and VT. Mr. Nau and Mr. Hurd co-facilitated the on-campus faculty externship. The event took place the same week as the 20NDT

summer camp, providing an opportunity for faculty and student participants to interact with one another during a structured exercise.

The goal of the faculty externship was to broaden the participants' awareness of NDT and the program offerings at PCT, and have them return to their classrooms in fall 2023 to share their knowledge and excitement about NDT with their high school students. The participants represented the disciplines of technology, math, science, aquaponics, welding, and engineering and machining. According to Dr. Webb, "The program connected teachers from all corners of our state and challenged them to develop a project that links the content learned on campus to lesson plans in their own classroom."

Eight of the 12 participants completed the lesson plan exercise and uploaded their materials to https://www.pct.edu/academics/et/ndt-grant. These resources are available for use by any faculty member (high school or college) nationwide. Participants received a $750 stipend for attending the externship, and an additional $750 stipend upon implementing an NDT lesson at their home high school. During the 2023-2024 academic year, the faculty impacted 722 high school students through their custom exercises.

Dr. Webb expressed that the 2023 faculty externship was a successful initiative. It increased the exposure of the college's NDT program statewide – greatly exceeding the college's service area. He is hopeful that in future years the faculty externship will be offered through an alternative funding source. "It will likely incorporate some components of NDT in an interdisciplinary 'integrated manufacturing' framework."

The weblink to an anonymous participant survey was distributed at the end of the faculty externship. Participants were asked to share their experience in this first-time program offering, and rate how the externship contributed to self-assessed gains in knowledge, skill, and application of the content. A total of 12 individuals responded to the survey. All 12 reported learning NDT concepts and principles, and gaining exposure to career opportunities in NDT. (The results dashboard begins on page 31 of this report.)

Welding Techer Training

In May 2024, NDT faculty facilitated the Welding Teacher Training, a two-day immersive training for 12 educators, advisors, and administrators in a welding program or at an institution with a focus on technical education or skilled trades. NDT was one of the featured topics of the training.

The goal of the training was to elevate technical education by way of:

- Developing new curricula, course content, and methods of welding instruction
- Integrating learning theories in the classroom
- Applying classroom management practices to maximize learner engagement
- Implementing evaluation and assessment technique to improve student engagement and retention
- Explore the value of certification

Weld-Ed Summer Training

ATE's National Center for Welding Education and Training (Weld-Ed) requested to partner with PCT on the delivery of instructional labs in NDT for participants of its summer training in 2023 and 2024. This professional development opportunity is designed for welding educators in secondary and post-secondary welding programs. The training to be held at PCT is titled "Fundamentals of GMAW Waveforms, Visual Inspection, and Ultrasonic Testing."

Mr. Nau and Mr. Hurd will be co-facilitating the three-day summer session in July 2024 for up to 20 participants. The registration fee of $49 covers all instruction, training materials, food, and lodging. Additionally, completers will be awarded a Certificate of Attendance by Weld-Ed worth up to 24 professional development hours (equivalent to 2.5 CEUs).

Dissemination

Dissemination activities in year four of *20NDT* included the 2023 ATE PI Conference in Washington, D.C. Mr. Nau and Mr. Colton from the project leadership team attended the conference and staffed the ATE Connects booth.

In April 2024, an article titled "Video shares exciting field of non-destructive testing" was posted to the college's website and social media accounts (https://www.pct.edu/news/article/2024/04/04/video-shares-exciting-field-of-non-destructive-testing).

APPENDIX

20NDT Summer Camp Survey Dashboard – July 2023

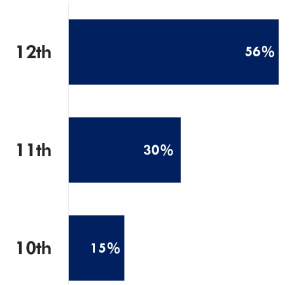
Pennsylvania College of Technology
A Penn State Affiliate

Penn College hosted its second annual 20NDT summer camp for students entering grades 10-12 on July 16-18, 2023. This three-day immersive experience included hands-on workshops in RT, UT, MT, PAUT, and welding. The $50 registration fee included all activities as well as meals and on-campus lodging.

A participant survey was designed to inform this extracurricular program offering, and assess student engagement and learning in the discipline. Students reported gaining an understanding of NDT and welding techniques, and increasing their confidence to work in a team. Several students requested a longer camp experience. A total of 27 students responded to the survey.

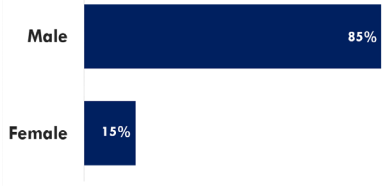
Participant Grade Level

Over half of the 14 respondents will enter 12th grade in fall 2023, and 30% will enter 11th grade.



Participant Gender

Four of the 27 respondents (15%) identified as female. This is the first time females have registered for the college's 20NDT summer camp.



Preferred Program Evaluations
"Unlocking Program Potential"

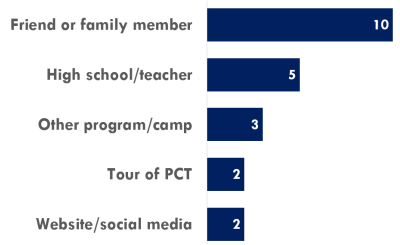
20NDT Summer Camp Survey Dashboard – July 2023

Pennsylvania College of Technology
A Penn State Affiliate

One respondent identified as a repeat NDT camper from summer 2022. Participants enjoyed staying on campus and making friends with one another. Several students would have liked more time to complete the activities and explore additional types of welding. Participants specifically mentioned gaining an understanding of magnetic fields, metallurgy, and welding techniques for MIG and flux-core. The camp afforded opportunities for problem-solving and an awareness of NDT career pathways.

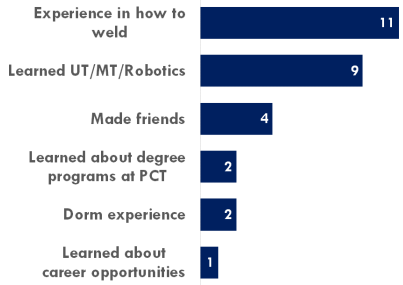
Marketing and Recruiting

Respondents learned about this camp from friends, family, teachers, and digital outlets.



Top Takeaways from Camp

Respondents learned about welding and NDT, degree programs at PCT, and career opportunities.



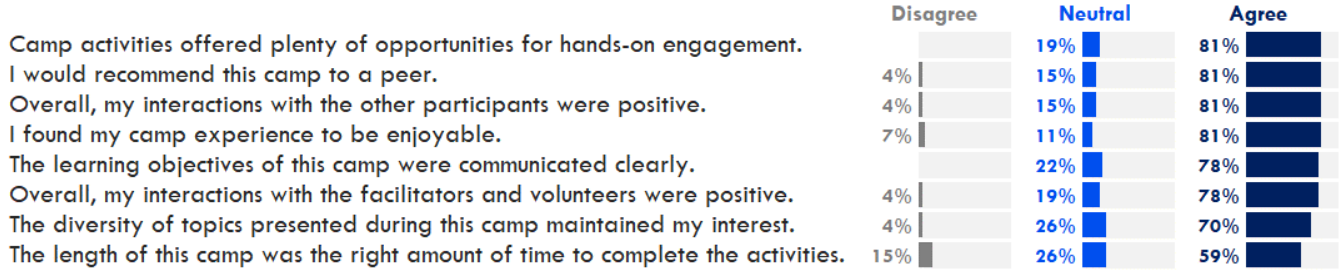
Preferred Program Evaluations
"Unlocking Program Potential"

20NDT Summer Camp Survey Dashboard – July 2023

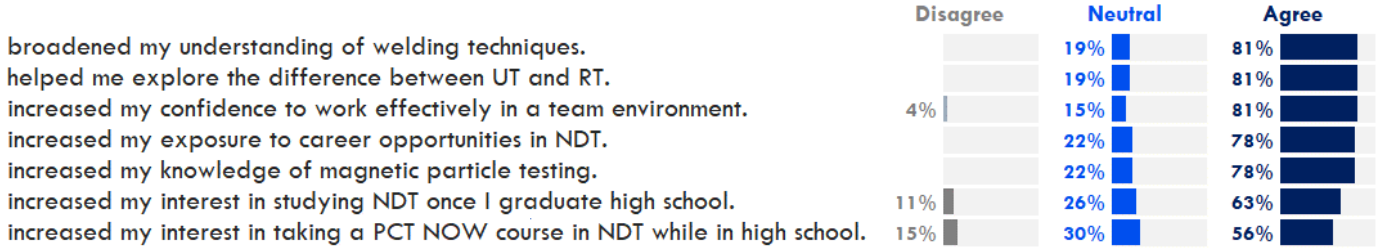
Pennsylvania College of Technology
A Penn State Affiliate

The original scale of "strongly agree" to "strongly disagree" has been condensed in the following figures in accordance with the students' responses.

Describe your experience in this camp.



My participation in this camp . . .



Preferred Program Evaluations
"Unlocking Program Potential"

20NDT Summer Camp Survey Dashboard – July 2023

Pennsylvania College of Technology
A Penn State Affiliate

What suggestions do you have for improving this camp?

"None. It was incredible"

"More free time"

"More time welding"

"Including a straight welding program that take[s] people through all the different types of welding."

"Make the sessions shorter, they felt like they dragged a bit long."

"Do arc welding as well"

"Ditch the scavenger hunt and more time to meet other campers"

"Make it a little longer."

"A concrete schedule given as soon as you arrive."

"Make it a little longer and do all the process[es] of welding"

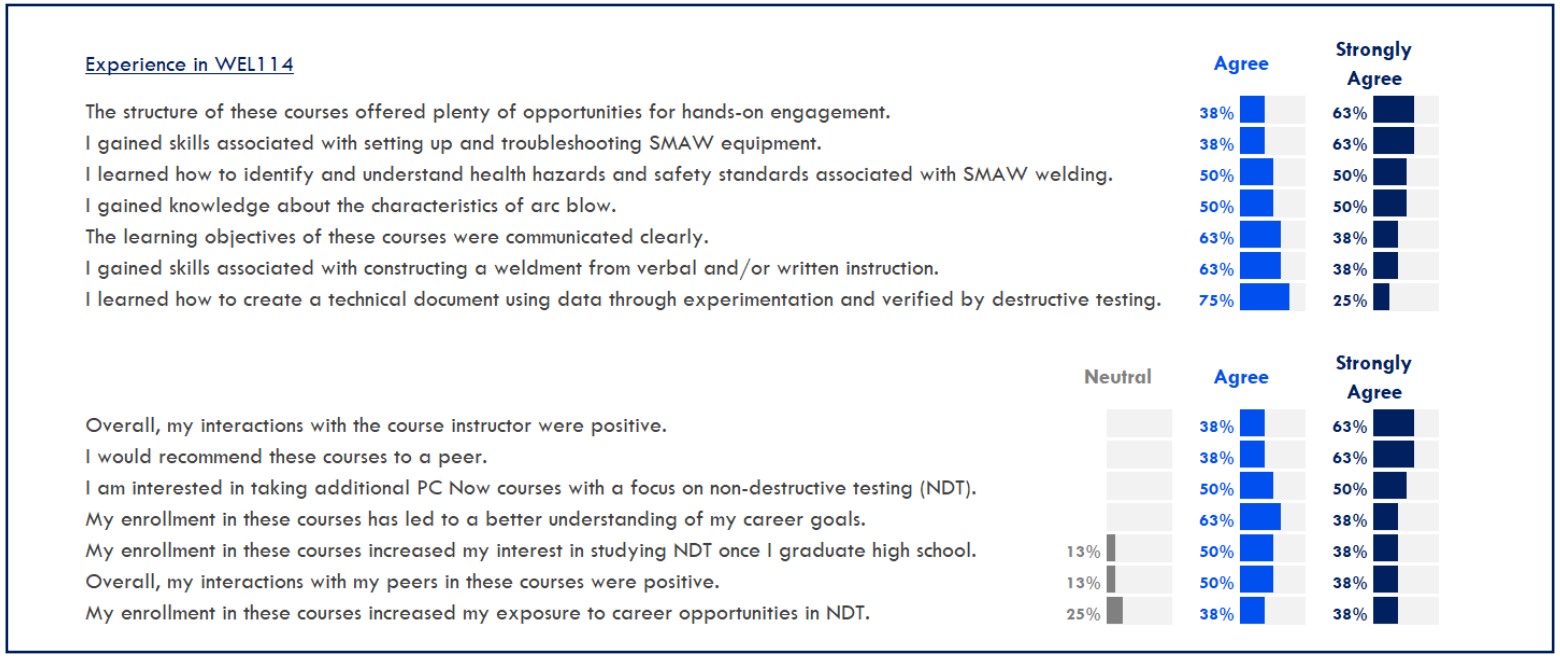
"More breaks between times"

Preferred Program Evaluations
"Unlocking Program Potential"

Penn College Now Student Survey Dashboard – Spring 2023

Pennsylvania College of Technology
A Penn State Affiliate

In spring 2023, 16 PC Now dual enrollment students were exposed to the new NDT module added to the curriculum for WEL114 (Shielded Metal Arc I). At the conclusion of the term, the high school students were asked to complete the participant survey posted to the course homepage on D2L. Eight students responded to the survey. These students had a very favorable experience in this course, and reported gaining knowledge and skills in welding and NDT. (The original scale of "strongly agree" to "strongly disagree" has been condensed in the following figure in accordance with the students' responses.)



Preferred Program Evaluations
"Unlocking Program Potential"

Penn College Now Student Survey Dashboard – Spring 2023

Pennsylvania College of Technology
A Penn State Affiliate

What are your top takeaways from completing WEL114 and WEL116?

"Safety, machine setup, troubleshooting problems"

"Safety, troubleshooting and pride in work"

"Safety, taking time to make good welds, troubleshooting issues with weld performance"

"Equipment Maintenance, machine setup, safety"

"Learning the characteristics of welding, learning how to perform clean welds, learning how to perform strong welds in all positions"

"My top three takeaways were learning more about welding safety procedures. I was able to improve my welding skill. Lastly I was able to learn how to handle equipment I had never used before."

"Safety, problem solving, being able to persevere."

"How to weld better"

"How to be safe when welding"

"What to do if you have problems when welding"

Preferred Program Evaluations
"Unlocking Program Potential"

Penn College Now Student Survey Dashboard – Spring 2023

Pennsylvania College of Technology
A Penn State Affiliate

Why did you choose to enroll in the PC Now courses WEL114 and WEL116?

"To get a head start on my career."

"To gain extra advantage for when I attend Penn College"

"To gain better knowledge in welding and to learn more about SMAW before I go to college."

"For the free credits"

"To get a jump start in my college career and gain college credit while still in high school"

"I chose to enroll in the PC Now courses for the credits provided and the experience gained."

To save money on college courses, and get a head start on my educational journey."

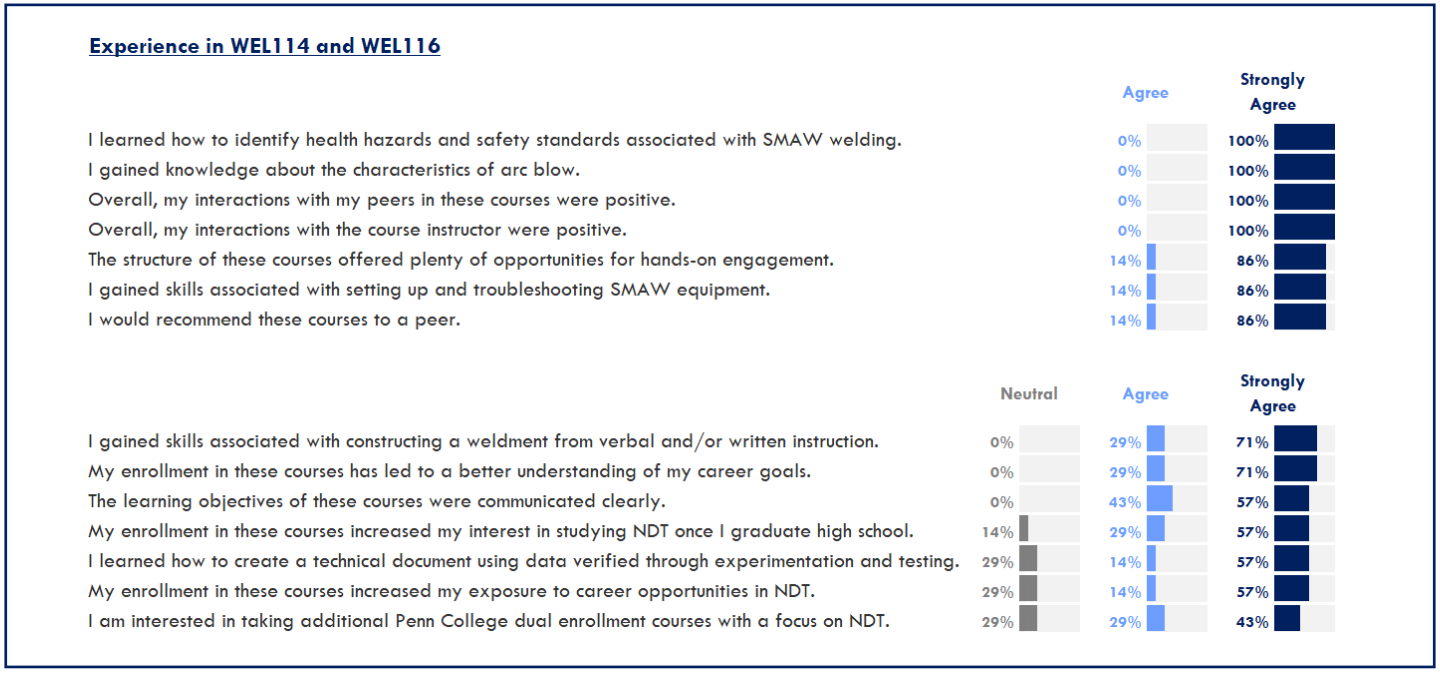
"Because I am going to Penn College next year"

Preferred Program Evaluations
"Unlocking Program Potential"

Penn College Now Student Survey Dashboard
Fall 2023

Pennsylvania College of Technology
A Penn State Affiliate

In fall 2023, 19 Penn College Now dual enrollment students were exposed to the NDT module added to the curriculum for WEL114 and WEL116 (Shielded Metal Arc I & II). At the conclusion of the term, the high school students were asked to complete the participant survey posted to the course homepage on D2L. Seven students (all male) responded to the survey. These students had a very favorable experience in the course, and reported gaining knowledge and skills in welding and NDT. (The original scale of "strongly agree" to "strongly disagree" has been condensed in the following figure in accordance with student responses.)



Preferred Program Evaluations
"Unlocking Program Potential"

Penn College Now Student Survey Dashboard
Fall 2023

Pennsylvania College of Technology
A Penn State Affiliate

What are your top takeaways from completing WEL114 and WEL116?

"To have a better understanding and to prepare myself for further challenges."

"Because I was interested in getting college credits and furthering my knowledge of welding."

"To get a further understanding of welding and everything that comes along with it."

"Because of the passion I have for welding and to better myself."

"To get college credits while in high school, and learn valuable trade skills."

"Have the option to go to college and already have a head start if I decided not to go into the workforce."

"Because I know that I would like to go to Penn college and I knew this would help me get credits."

Preferred Program Evaluations
"Unlocking Program Potential"

Penn College Now Student Survey Dashboard
Fall 2023

Pennsylvania College of Technology
A Penn State Affiliate

Why did you choose to enroll in the PC Now courses WEL114 and WEL116?

"Learning different ways to complete a objective, having better knowledge towards an objective, and figuring out problems by myself."

"I learned about the effects of welding polarities. I learned how to properly setup and use SMAW equipment. I learned about NDT which I previously had no knowledge of."

"Different welding polarities and it's connection to the penetration while welding."

"Perseverance. Hard work. Skill."

"I am now able to confidently weld using the SMAW process, I understand how to set up an SMAW machine, and I know how to weld safely without risking injury."

"How to properly distribute heat when welding, the correct OFC techniques and setup; the way welding actually works beyond face value, the theory aspect of the course."

"1. Worry about what your assignment is and not others. 2. Work hard and ask any sort of questions you are not sure about. 3. Doing anything with some sort of welding involved takes a good amount of skill."

20NDT Faculty Externship Survey Dashboard – July 2023

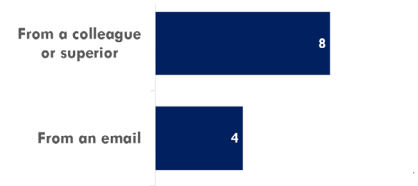
Pennsylvania College of Technology
A Penn State Affiliate

Twelve teachers and counselors were invited to participate in a weeklong "externship" at Penn College on July 17-21, 2023. The educators engaged in hands-on activities where they learned about welding, UT, RT, visual inspection, and other NDT techniques. The program challenged faculty to develop a project that links the content learned on campus to lesson plans in their own classroom. Participants received a $750 stipend for attending the externship, and are eligible for an additional $750 stipend upon implementing an NDT lesson at their home school.

A participant survey was designed to inform this unique program offering, and assess faculty engagement and learning in the discipline. A total of 12 individuals responded to the survey.

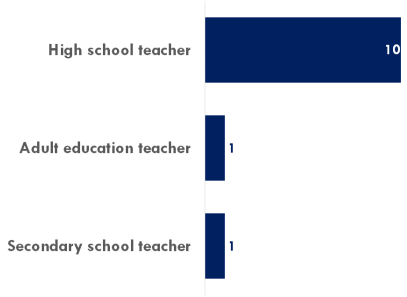
Marketing and Recruiting

Participants learned about this event from a colleague/superior or through email.



Current Professional Role

Ten of the 12 respondents (83%) identified as high school teachers/instructors.

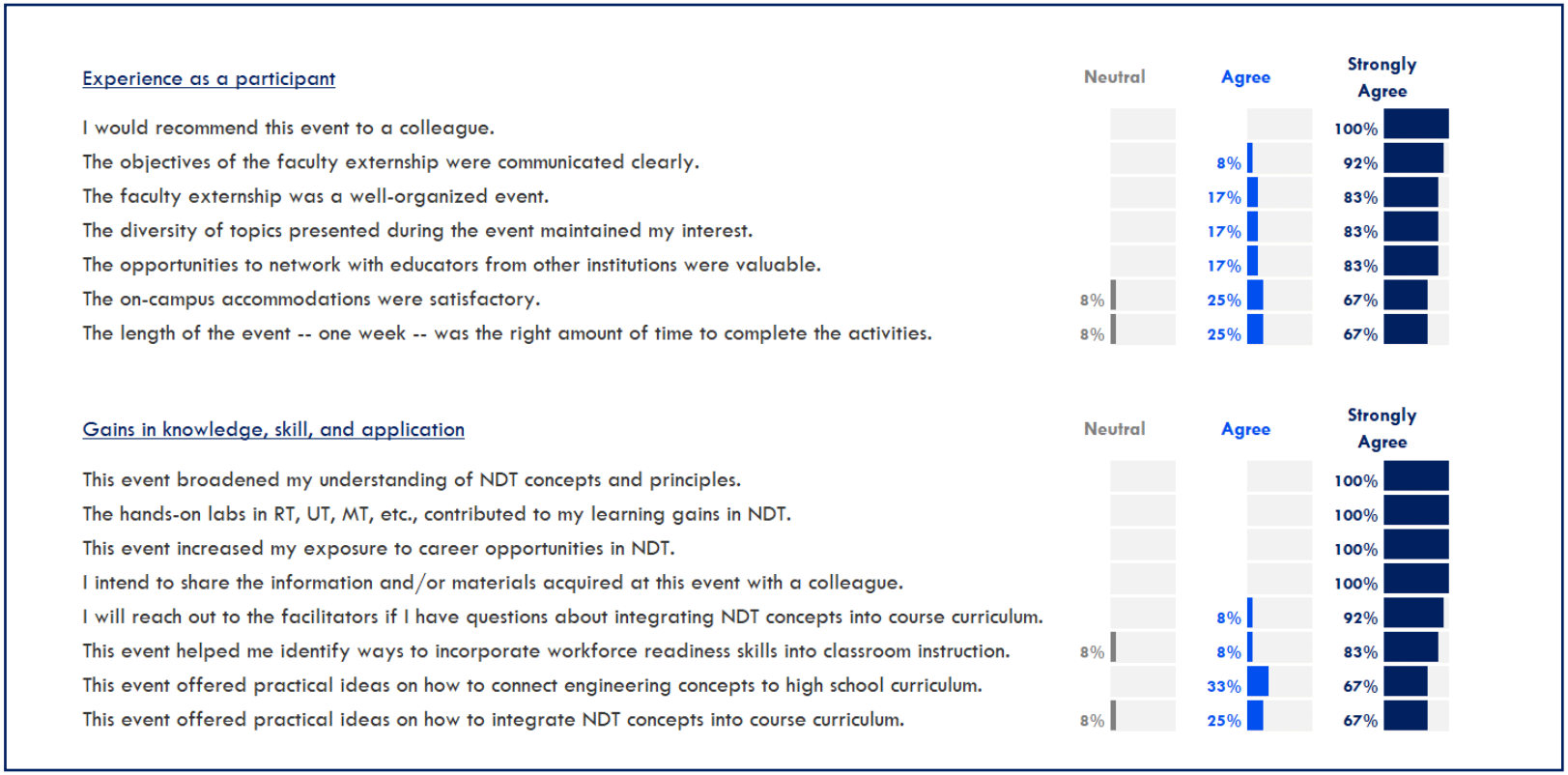


Preferred Program Evaluations
"Unlocking Program Potential"

20NDT Faculty Externship Survey Dashboard – July 2023

Pennsylvania College of Technology
A Penn State Affiliate

All 12 respondents reported learning NDT concepts and principles, and gaining exposure to career opportunities in NDT. (The original scale of "strongly agree" to "strongly disagree" has been condensed in accordance with the participants' responses.)



Preferred Program Evaluations
"Unlocking Program Potential"

20NDT Faculty Externship Survey Dashboard – July 2023

Pennsylvania College of Technology
A Penn State Affiliate

What are your top three takeaways from participating in this externship?

"1. Collaborating with new teachers will expand your teaching potential. 2. My students will fit into this notch very smoothly. 3. I have a lot to learn."

"Gaining valuable knowledge on the NDT classes."

"Learned more about the advanced processes in the GMAW process. Teaching strategies."

"Gained exposure to Penn College careers/facilities."

"Tour of Lycoming Engines was very interesting."

"NDT is a field with tremendous opportunities for students. Penn College is an excellent institution for obtaining a technical degree. Trades require motivated and intelligent people."

"1. Hands on learning. 2. Excellent instructor/student interaction on topics discussed. 3. Learned a lot about NDT industry"

"the opportunities that Penn College has to offer; "the networking with other educators around PA"

"Importance of NDT in the maintenance process"

Preferred Program Evaluations
"Unlocking Program Potential"

20NDT Faculty Externship Survey Dashboard – July 2023

Pennsylvania College of Technology
A Penn State Affiliate

In what ways do you envision applying the knowledge and skills you gained at this event to your classroom instruction?

"I will be demoing and mentioning NDT to all of my students in the forward."

"Incorporate the skills I learned with the UT setup. Have students inspect their own welds."

"Using NDT methods to demonstrate practical applications of science. Promoting NDT and Penn College to students with the appropriate aptitude and interest."

"Hopefully purchase some NDT equipment and have hands on NDT lessons with the class."

"Difficult to list just three. Concepts covered in this externship fit seamlessly into my Physics/Chemistry courses as well as career readiness opportunities. Our school offers welding and materials science courses as electives and I will be developing presentations to share with them as well. I will mainly focus on the the science behind what I learned then make the caterer connections."

"I plan to expose students to the opportunity of NDT and potentially take a field trip to a company using NDT."

"Teach a course specifically on different NDT testing in welding and how they correlate"

"Constructing a lesson or unit for NDT"

Preferred Program Evaluations
"Unlocking Program Potential"

20NDT Faculty Externship Survey Dashboard – July 2023

Pennsylvania College of Technology
A Penn State Affiliate

What suggestions do you have for improving this faculty externship?

"I personally enjoy learning more about welding, welder setup, and the theory behind it. Basically anything that I can take back to the classroom to help students."

"Hard to say covered a lot and did at a good level and pace. Don't really have anything for now."

"I was very impressed with the people associated with the program."

"Maybe integrate students and teachers together?"

"This has been an AWESOME week!!! Wish I could follow up with more in the future."

"Do more offerings"

"The staff was very eager and knowledgeable about the topics they are teaching. Thank you for the opportunity and I look forward to others or even brining the students up to do a tour."

"Possibly compare NDT testing and destructive testing."

"Incorporate a broader tour of the campus"

Preferred Program Evaluations
"Unlocking Program Potential"