ASEE 2022 ANNUAL CONFERENCE
Excellence Through Diversity
MINNEAPOLIS, MINNESOTA, JUNE 26TH-29TH, 2022 ASEE
Paper ID #36777

Innovative University-Based Regional Workforce Development Experience

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Abstract

Stemming from requests from regional industrial employers primarily in the manufacturing field, an innovative, state-funded workforce development summer camp and related dual-enrollment course was developed at Austin Peay State University. The focus of the camp and course was to prepare students in their junior and senior years of secondary education for entry-level employment in regional manufacturing facilities. The five-week summer camp included an opportunity to gain OSHA-10 online training, basic theoretical and applied knowledge in engineering technology-related areas pertinent to entry-level manufacturing jobs, and the necessary soft skills needed to meet regional employers' demand. Ten students that were assessed from school districts surrounding the hosting institution participated in the first offering of the camp in the summer of 2021. Topics customized for the potential trained, operator-level employee included industrial safety; basic industrial electrical distribution and motor theory; basic mechanical drive theory; and basic industrial automation theory, including industrial robotics and programmable logic controller theory. All technical content theory was accompanied by a related lab that allowed for the application of the learned theory. Additionally, soft-skills training was provided via online vendors. Assessment of student progress was accomplished through a university-held dual-enrollment course in the form of exams and participation grades. The students enrolled in the course received both secondary and university level academic credit that could be transferred into the university's engineering technology associate's or bachelor's degree programs. While fulfilling the need of regional industrial employers, the summer camp and dual enrollment course provided a university-based learning experience that would better inform the student of future career path opportunities. Due to COVID-19 complications in recruiting targeted students, many of the 10 students participating in the camp did not intend to follow the manufacturing employee career pathway, although all 10 students passed the course with above-average grades. Funding for the camp, which includes scientific and safety demonstrations, is secured for the 2022 summer term, during which a more engineering-focused cohort of students will be an enrollment goal.

Introduction

Recent employment trends have shown an increase in the demand for employees for jobs in the science and engineering fields in the United States [1]. This demand for employees in science and engineering has the potential to increase due to the increasing numbers of employees at retirement age in these fields [2]. This increasing demand for science and engineering employees has led federal and state governments to emphasize career and technical education (CTE) in secondary and postsecondary institutions [3], [4]. Traditionally, CTE instruction has primarily been in the arena of one or two-year postsecondary institutions [5]; further, there has been an increasing focus on CTE in K-12 education [6]. In contrast, little evidence exists of CTE training in the traditional sense completely at four-year universities, with the exception of transfer agreements from community colleges into four-year institutions [7].

Through an innovative five-week manufacturing summer camp, the author's home university, Austin Peay State University (APSU), has provided on-ground traditional CTE instruction combined with a university-like atmosphere and a dual-enrollment course for camp participants. Taking into account regional industrial employers' requests for more trainable operator-level employees, APSU sought to offer fundamental theoretical and applied industrial manufacturing skills to junior and senior-level secondary students from regional county school systems. A state higher education agency provided funding for the manufacturing-based camp through a competitive grant award process. Additionally, regional industrial employers asked for soft skills training to promote professional behavior among young employees. Advantages afforded by APSU were new recruitment strategies for students who may not have otherwise been exposed to a university setting, university-level courses, and other STEM areas of interest outside of CTE instruction. Likewise, the camp participants benefit from these same camp features as they consider their academic and career pathway choices.

Context

Resulting from the labor and economic goals of the newly elected governor, an increased focus on CTE was promoted in the state's secondary and higher education institutions [6], [8]. Due to this focus, a series of grant proposal calls sponsored by the Tennessee Higher Education Commission (THEC) were disseminated to fund workforce development programs that would primarily serve the regional industrial partners [8]. APSU partnered with regional entities, including a technical college (the principal investigator of the grant), workforce development agency, community college, three county school systems, and seven employer partners in submitting a proposal for one of these grants, and the group was awarded total funding approaching $1 million. APSU is to receive approximately $300,000 to provide services such as the Manufacturing Technology Institute (MTI) summer camp; marketing initiatives for recruitment and awareness through social media, email, and radio; hosting of an Industrial Workforce Summit for teacher professional development and student career promotion; and host and promote student career awareness events on campus so the grant's industrial partners could present information about employment at their facilities. Most of the inclusion of these services resulted from APSU housing a robust public relations department and a significant college of education that is predominant in the region. However, the MTI summer camp was the result of the engineering technology (ET) department's presence at APSU, of which the author is a faculty member, and of the institution's ability to house students while hosting the five-week long camp.

Somewhat unique among other four-year institutions in the region, APSU offers both two-year associate of applied science (AAS) and bachelor of science (BS) degrees in varying concentrations in the ET department. One such concentration is the mechatronics concentration, which focuses on concepts such as industrial automation, including robotics, programmable logic controllers, sensors, and general actuators. Other industrial concepts taught in the degree program include mechanical, fluid, and electrical power systems, with special consideration for three-phase electrical control circuits and industrial electric motors. Regarding lab components for the individual ET degrees in the mechatronics concentration, the AAS degree relies more heavily than the BS degree on purpose-built trainers and a curriculum supplied in part by the training equipment manufacturer. Regional industrial employers have consistently been receptive to this type of hands-on training that has been a feature of the degree program since 2019 and is

typically seen in technical and community colleges. This desire for training similar to that offered by the AAS mechatronics concentration degree from regional industrial partners guided the direction of the technical curriculum for the summer camp. Just as importantly, soft skills, or qualities such as promptness, courtesy, responsibility, and work ethic, ranked highly among characteristics that industrial partners sought in young employees.

In conversations with the ET department, one prominent regional industrial employer remarked that the company would invest money and time training young, operator-level employees only to have them consistently arrive at work late or not at all. Further, this lack of personal responsibility was a reoccurring theme that regional employers were experiencing with young semiskilled employees. The industrial partners desired training in these areas of soft skills in an attempt to instill personal responsibility in the potential employee pool. In addition to obtaining the technical knowledge required for operator-level industrial employees, APSU took these desires for soft skills training seriously when proposing a manufacturing-based summer camp for junior and senior-level secondary students. The last required elements of the summer camp were industrial safety training and the opportunity to receive an earned credential. The earned credential was a request sent by the local workforce development agency. These remaining elements were somewhat combined by including enrollment into an online OSHA-10 certification course. Specific industrial safety concepts such as those associated with industrial robotics and electrical systems were also included in the taught technical material. The means of organization and offering of the taught technical, safety, and soft skills material were determined based on typically successful course formats at APSU, and the most suitable class format for the technical content was that of the dual-enrollment course.

Receiving both secondary and university-level credit through the successful completion of the dual-enrollment course during camp attendance was considered an attractive proposition for students in the secondary school junior and senior levels. Dual-enrollment courses also positively impact APSU by increasing enrollment while recruiting full-time university students when they graduate from their secondary education system. Thusly, the author developed a dual-enrollment course focused on industrial workforce preparation. While the initial grant proposal was written in a manner that separated the soft skills portion of instruction into a different session than the dual-enrollment course during the camp, these skills were ultimately combined into the dual-enrollment course as an online component from a third-party vendor. This inclusion of soft skills training into the course resulted from COVID-19 restrictions leading to the departure of the dedicated personnel responsible for that training. COVID-19 restrictions also led to the modification of the choice of recruitment methods for the camp participants and the overall structure of the camp’s schedule.

The MTI camp was initially designed to include junior and senior-level secondary students from a chosen set of county K-12 school systems. Participants were to be recommended by teachers and counselors in these school systems, and recruitment had begun in earnest in the late fall of 2019, along with planning for housing and enrichment activities such as science demonstrations during the camp. However, after the cancellation of the camp in the summer of 2020 and shifts to virtual learning in the spring of 2020 due to COVID-19 restrictions that continued into the fall of 2020, a different approach to the recruitment of participants for the camp was attempted. In an attempt to streamline the process of student recruitment and registration for the MTI summer

camp, APSU chose to enroll students from an existing Upward Bound (UB)summer residential program. The UB program is part of a federally funded TRIO program hosted by APSU. Enrichment activities were coordinated as part of the UB program. At the same time, all technical content, including basic industrial concepts needed for entry-level operator employees, OSHA-10 training, and soft skills training, was covered in the dual-enrollment course in which many UB students participated.

Approach

With the UB personnel handling most of the non-technical aspects of the summer camp, the author's contribution to the MTI summer camp was as developer and instructor of the dual-enrollment course held for five weeks during the camp. The course met Monday through Thursday for approximately three hours in a morning session. Friday was reserved for off-campus enrichment field trips coordinated by the UB program. The course began with 14 students, of which most were traditional UB students. The exception was one student who had previously participated in the UB program and was allowed only to take the dual-enrollment course while staying in a traditional dormitory with the regular university student population. This arrangement was a feature of UB that allowed students that had graduated from their secondary school system to gain university credit. The dual-enrollment course could replace an introduction to ET course required for all degrees in the author's ET department. Additionally, one student withdrew from the course in the second week due to unknown reasons. Also of note for the MTI camp participants was that while 13 were present in the dual-enrollment course classroom, only 10 students received a grade for the course. The THEC sponsored grant funded the tuition for all students in the dual-enrollment classroom, but some of the students failed to meet the GPA requirements to be officially enrolled in the course. This accounts for the three students that did not receive credit for the course.

Since only 10 students received dual-enrollment or university credit for the course, the assessed number of participants for the camp, and thus the nominal number of participants for the camp, was considered to be 10. Further, since the UB program was chosen as the source of MTI camp participants, many students did not express an interest in technical STEM areas such as engineering, computer science, physics, mathematics, or chemistry. An informal poll of the students in the course revealed that most students favored the psychological or biological sciences. While this was not ideal for a targeted selection of students to train for entry-level operator positions in industrial facilities, this characteristic did lend itself to one of the innovative aspects of the MTI camp. That aspect was exposure to the manufacturing field for unfamiliar students. In terms of gender, eight of the 10 students were female, which held no influence on the structure or content level of the course. Overall, technical content was in the form of lecture, lab, and online learning methodologies.

The course was generally divided into technical content modules that contained a lecture and a lab component, with these modules roughly aligning with each week of the course. The first week began with general industrial, electrical, robotics, and mechanical/manufacturing safety concepts. The applied aspect of the module was to be in the form of personal protection equipment (PPE) demonstrations coordinated with personnel other than the author. Due to scheduling issues, these demonstrations did not take place. However, the opportunity to learn

about PPE was covered with the OSHA-10 training. Subsequent modules included industrial electric motors and electrical distribution; industrial robotics; and programmable logic controllers; pneumatic and hydraulic systems; and belt, chain, and gear drive mechanical systems. This theoretical content was presented at a level of minimal mathematics mastery due to the varied mathematics instruction each student had completed. Much of the theoretical knowledge was in the form of conceptual ideas such as basic physical phenomena needed to understand the fundamental operation of industrial equipment. Concepts such as voltage, current, and resistance; basic digital concepts such as binary number systems and logic gates; robot configurations and servo feedback systems; pressure and flow relationships; and belt, chain, and gear reduction ratios were covered. These theoretical ideas were reinforced by lab exercises that demonstrated concepts and provided an opportunity to practice the skill. These exercises were primarily completed with the aid of purpose-built trainers and, in the case of robotics, actual Universal Robotics robots were programmed. These activities appeared to capture the enthusiasm of a portion of the non-STEM interested students in the course, which was a positive result. The remainder of the classroom time for the course was filled time to work on the online OSHA-10 training and soft skills training modules, both of which were provided by third-party online vendors. In terms of assessment for the course, midterm and final exams, along with separate classroom and lab participation grading, were used to assign the ten students a final grade for the dual-enrollment course. It should be noted that the students' final course grades did not include assessments for the OSHA-10 or soft skills training as these components were deemed to need more time outside of the course to complete.

Observations and discussion

All ten students passed the course with an "A" letter grade, with seven of the ten students receiving a final numeric grade of above 95%. These above-average grades can seemingly be mostly attributed to the high-achieving students that participated in the course. The original dual-enrollment course was developed in a fashion to allow lower-achieving students means to successfully complete the course while gaining the necessary skills to enter an operator-level industrial manufacturing position. This mismatch in curricular material and the students' academic abilities highlights an issue with the camp partially due to the COVID-19 restrictions. The original target participant for the MTI camp was a student that was not necessarily high-achieving and had a CTE interest. However, participants of UB who completed the dual-enrollment course were towards the higher end of academic ability. Additionally, the dual-enrollment program required an above-average GPA for participating students. Although this issue skewed the target student participant, it did inadvertently add to the innovative nature of the MTI camp by exposing students that exhibited little interest in technical STEM areas to industrial theoretical and applied concepts which had the potential of opening up new career paths for these students including via the traditional pure engineering or ET university pathway.

Another observation related to using UB students for the MTI camp was that it detracted from a portion of the camp's original design, which was innovative recruitment and career exposure for students that would not normally consider a traditional four-year institution educational and career pathway. Participants of the summer camp that would have been recruited through surrounding secondary school teachers and counselors had COVID-19 restrictions not been implemented may have benefitted more from the university setting of the summer camp.

Moreover, these students would have been exposed to other STEM programs at APSU through the various STEM-based science demonstrations performed during the MTI camp.

Final observations from the MTI camp were that employment statuses for the student participants were unavailable to the author. Definite participant employment data would have to be collected via survey after participant graduation from their secondary school, which was outside of the intended scope of this description of the MTI camp experience. All but one of the students were entering their senior year of secondary school in the fall of 2021 and had yet to graduate at the time of writing this article. Informal polling of the students while in the course showed that only one student had made serious plans to pursue a CTE-based career. This student was planning on attending a technical college in the fall of 2021 then attending a two or four-year institution. Lack of employment data and placement in actual operator-level positions within industrial partners' facilities has yet to be an issue since the original funding grant only required the offering of the camp and support services for the educational partners involved in the grant, such as the public relation services hosting. The last observation in the context of the structure of the MTI camp was that the soft skills training would have been better executed as originally planned. The soft skills portion of the camp's content was to be presented by personnel on-ground that had professional backgrounds in those areas, but those personnel subsequently departed association with the grant.

Conclusion

Based on the decline of workers in the science and engineering-based fields in the United States in recent years, with more expected to retire [1], [2], state governments have been emphasizing CTE training at the postsecondary level [3], [5]. In TN, the governor put forth grants through THEC that would build upon this focus. As a recipient of a funded state agency-sponsored grant, APSU set forth to offer an advanced manufacturing summer camp-based experience for students in their junior and senior-level secondary education. This camp was innovative in that it offered operator-level CTE training to secondary school students through an on-ground, five-week summer camp complete with a university-level, dual-enrollment course. This nontraditional setting for CTE training offered the additional benefit of exposing CTE interested students to a traditional four-year degree path by providing experiences associated with that pathway, such as university housing and exposure to varied STEM degree pathways through targeted science demonstrations.

While COVID-19 restrictions led to the cancellation of the MTI camp in its first year in the summer of 2020 and partnering with UB students in the summer of 2021 for its first offering, the camp was completed with all grant requirements being met. Through lecture, lab, and online training components, 10 of the 13 students attending the camp were assessed and received secondary and university academic credits. Online training featured the opportunity to complete both OSHA-10 and soft skills. All 10 students received a passing grade for the course. To offset the issues caused by COVID-19 restrictions, students not normally exposed to manufacturing concepts with the UB group were given a chance to experience a potential career pathway that may have been not considered. In the future, a more successful approach may be to adhere to the original plans of student recruitment for the camp via secondary school teachers and counselors. This may better match student CTE interests and the summer camp's curriculum. The MTI

summer camp is funded and expected to be offered a second time in the summer of 2022, although student registration has not yet been completed.

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