



Teaching the Teachers: Expanding Impact of Technical Education Through Secondary Schools

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Ms. Ely has successfully hosted numerous teacher training programs in the areas of Logistics, Supply Chain Management, Industrial Technology and Advanced Manufacturing. Both in support of this NSF ATE award and in relation to other projects, Ms. Ely has trained secondary educators from various backgrounds all across the nation and have prepared multiple training modules as ready-made teaching solutions for multiple levels of K-12 curriculum.

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Abstract

Secondary schools are in a prime position to introduce students into careers in Supply Chain Management and Logistics. However, these teachers often lack any practical experience in the field and lack the understanding to communicate the latest trends, technologies, and career opportunities to their students. The teachers also lack understanding in how to connect these high-demand careers to their current course offerings in technology or business management. The NSF Award “Technology-Based Logistics: Leveraging Indiana’s Role as the Crossroads of America” (Awards 1304619 and 1304520) specifically addresses these concerns through building a pipeline of educational curriculum that begins with secondary education and continues through community college and four-year institutions. Through dual credit opportunities, strong linkages to potential supply chain careers are reinforced beginning at grade 10. A combination of teacher professional development, curriculum development and support, and national certifications creates an opportunity for students to enter the supply chain management and logistics industry sector. Entry points in this sector are available at a wide variety of skill levels, including high school diploma, certificate programs, and two year and four year degree programs. This paper will document best practices used in training secondary educators on supply chain management topics, including simulation and game-based instruction. It will also describe the secondary to post-secondary educational pathway, a career opportunity matrix and present associated curriculum and articulation agreements.

Introduction

Indiana has long been recognized as the “Crossroads of America” due to the large number of companies involved in logistics and manufacturing operations. Indiana’s position is being challenged, however, due to the inability of companies (especially small and medium-sized companies) to find qualified workers. A 2012 survey showed that this is a primary concern for companies.

“For the first time in the history of this survey, human resource development (i.e., workforce training) overshadowed capital investment, information technologies, and improving organizational structures and processes as the top concern of Indiana manufacturers. In fact, 85 percent of the survey respondents believe the biggest obstacle to sustained growth in Indiana manufacturing is the shortage of qualified workers.”¹

According to the Indiana Department of Labor, the field of logistics will grow by 15% over the next 10 years, in addition to the five percent of the labor force needing to be replaced due to retirement and attrition. These jobs require a bachelor’s degree and have average annual salaries of \$63,000.² While 86 percent of Hoosiers obtain High School equivalency, only 22 percent complete a bachelor’s degree or higher.³ This shows that educating high school students about career opportunities in logistics is key to increasing the number of qualified individuals in this growing field. Therefore, educating teachers, parents and students in the K-12 system is the first step in growing a labor force to meet the employer’s needs. The research leveraged ongoing relationships with regional Career and Technical Education Directors of the High Schools and

local employers by facilitating field trips to logistic centers in Indiana, giving students and teachers firsthand knowledge of what is involved in a career in logistics. The research also provided opportunities for professional development for career and technical education teachers in the K12 system, focusing on new trends in supply chain management and logistics technology.

One solution being employed by a number of special-interest groups and states with similar problems is to develop educational pathways that combine formal and informal education opportunities. This approach is designed to better prepare workers to enter high-technology supply chain, logistics, and manufacturing operations careers and to secure employment for those already there. Consequently, workforce development is at the center of a rapidly growing partnership between Ivy Tech and Purdue University's College of Technology. Developing a pathway for high school students to enter Ivy Tech and finish a 4-year degree at Purdue is at the heart of this effort.

National Science Foundation – Advanced Technical Education Grant Award

Faculty at Purdue University through the Supply Chain Management program and Ivy Tech Community College in the statewide Supply Chain Management and Logistics curriculum committee came together in writing a proposal for an NSF Award “Technology-Based Logistics: Leveraging Indiana's Role as the Crossroads of America” (Awards 1304619 and 1304520), which specifically addresses current industry concerns for future workers in supply chain management technology through building a pipeline of educational curriculum that begins with secondary education and continues through community college and four year institutions. While several of the pieces of this curriculum were already in existence, the grant provided a mechanism for additional curriculum development based on regional industry review of current curricular offerings, as well as training of secondary instructors in supply chain management curriculum developed for high school students. Several specific action items support the overall goals such as career awareness, marketing for underrepresented populations in supply chain management technology career, and collaborative learning frameworks for undergraduate students. This paper focuses on the curriculum development and professional development components of the grant, as well as the impact of these efforts.

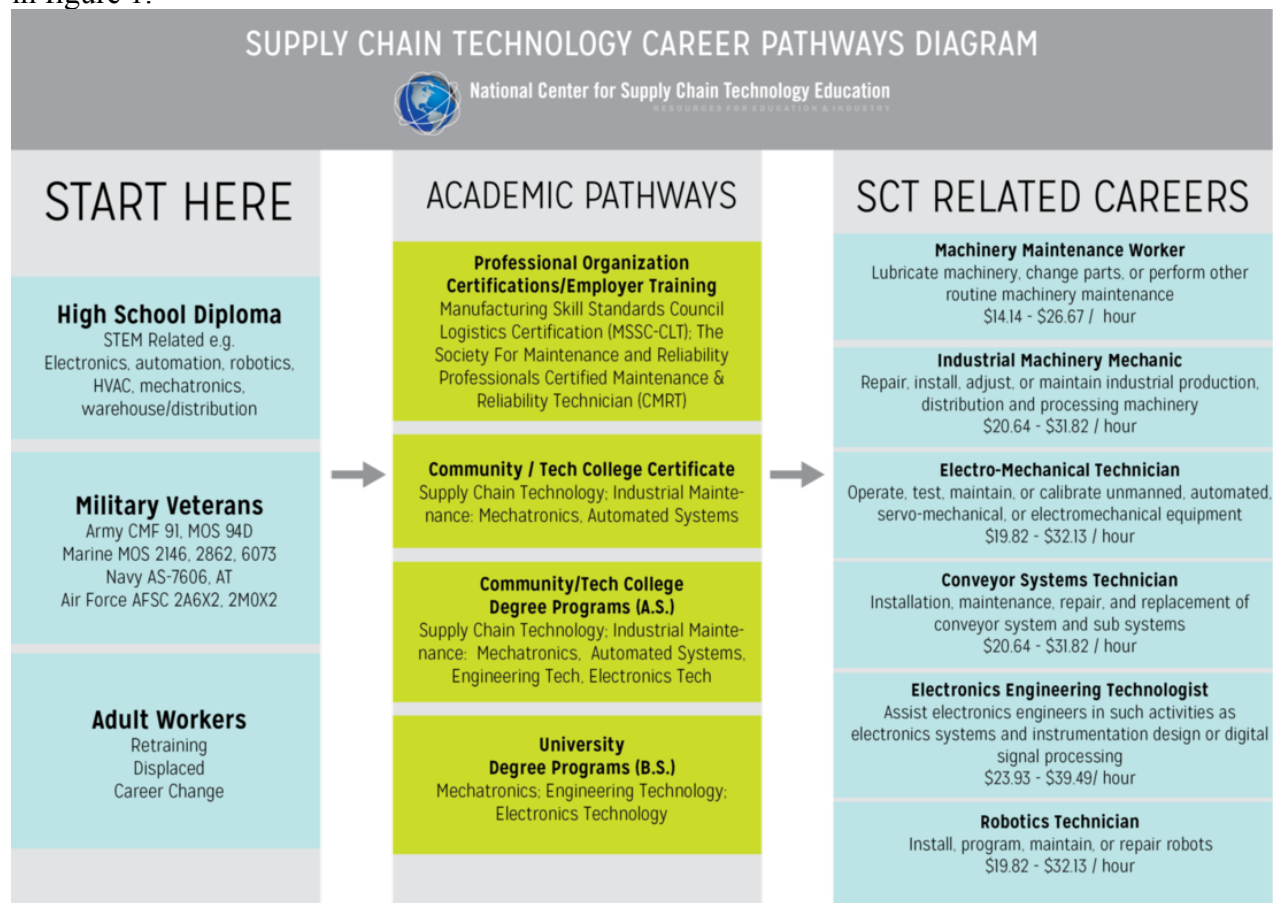
Educational Pathway Development

The current design for career and technical education pathways used by the state of Indiana “provide an aligned sequence of secondary and postsecondary courses leading to an industry-recognized credential, technical certification, or an associate or baccalaureate degree at an accredited postsecondary institution for careers that are high wage and/or high demand in Indiana.”⁴ Therefore, to create an academic and career pathway leading from tenth grade through baccalaureate studies, courses must be developed that integrate industry credentials with dual credit opportunities to colligate coursework. Ivy Tech Community College provided dual credit to high school students across the state of Indiana equaling 40 million dollars in tuition costs.⁵ These courses, often free to high school students, allow them to take college-level courses at their local high school, providing credit for both the high school diploma and a college degree. The courses have identical learning objectives and use the same textbooks, outcomes

assessments, and standards as required by the college course. High school instructors who meet the same standards required at the college campus teach these dual-credit courses.

At the community college, these same courses support the curriculum for certificate degrees, one-year degree and two-year associate of science degrees. Two year associate of science degrees that have been articulated with Indiana four year institutions such as Purdue University allow students to transfer the majority of the earned credits at the associate’s level towards a bachelor of science degree. In this specific case, the dual-credit coursework offered in Advanced Manufacturing and Logistics career pathways directly applies to either a certificate in Supply Chain Management or a two-year associate of science degree in Supply Chain Management. The two-year associate degree then transfers to the Purdue Polytechnic Supply Chain Management Technology Bachelor of Science degree. In this progression, a student’s coursework taken in tenth grade begins a career pathway stretching all the way to a bachelor’s degree or even post-baccalaureate graduate degrees.

The National Center for Supply Chain Technology Education developed a model to help illustrate how academic pathways prepare students for various career paths in Supply Chain Management fields, dependent on the educational training of the individual. This model is seen in figure 1.



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Figure 1. Supply Chain Technology Career Pathways Diagram⁶, (<http://www.supplychainteched.org/career-pathways.html>, 2015)

Ivy Tech Community College is a singly-accredited statewide system with a centralized curriculum management system. All high school coursework is standardized through the Indiana Department of Education with uniform course objectives, standards and outcome assessments. As such, coursework developed for the high school dual-credit program is delivered with the same content standards across the state of Indiana and may be applied to a college degree program at any Ivy Tech Community College campus in the state. This allows consistency of instruction but also creates an immediate impact across the state in career development in Supply Chain Management Technology careers.

For this program, the dual-credit coursework developed in logistics training also embedded the Manufacturing Skills Standards Council Certified Logistics Technician (MSSC-CLT) certification as outcome assessment for the course. Whether in high school or college, completing the certification process demonstrates an independently verified level of competency in key areas in logistics knowledge, a skill highly valued by employers. This certification has numerous industry and government endorsements, including winning the 2015 “Best National Workforce Development Program” from the Great Lakes Manufacturing Council. Across the nation, industry employers have shown evidence of providing new hires that are certified by MSSC with higher starting wages or by making the certification a “priority hiring qualification,” allowing candidates with the certification greater opportunities for employment.⁷ The certification also means dual-credit students in this career pathway earn both college credit and industry credentials at low or no cost while in high school.

While opportunities for employment in supply chain management careers exist for students possessing a high school diploma and an industry credential, such as the MSSC CLT certification, greater earning potential is available for those with higher levels of education. To better educate students about these opportunities, targeted marketing efforts are made to the high school counselors, teachers, students and parents, to help make them aware of career pathways and potential earnings for those with college credentials. While some students will proceed directly to a four-year institution, such as Purdue, nationally nearly half of all college students will begin their collegiate career through community college programs.⁸ In fact, over seventy percent of those who complete a community college credential of some kind will complete a bachelor’s degree in six years, while only 56 percent of first-time college attendees will complete a bachelor’s degree in six years.⁹ For many individuals, beginning their college career at a two-year program is not only more cost effective but also helps to ensure a successful completion of their four-year degree. As seen in figure 1, with each additional academic success, the earning potential for the individual increases, as do the potential options for career pathways within the supply chain field. The educational pathway documented here helps not only to increase the number of qualified workers to meet industry needs but also helps students to obtain higher levels of academic achievement by providing a sequenced path from high school to community college to a four year university.

With this important link between two-year and four-year colleges, articulation agreements clearly delineating the admission requirements for specific programs is critical to allow students

to transfer from a two-year institution to a four-year university as seamlessly as possible. In the state of Indiana, all two-year and four-year institutions share a thirty credit common core of general studies supporting transfer agreements, regardless of major or institution. The remaining 30 credits of a 60 credit associate of science degree depend on the specific major and program requirements. This is the portion which allows two-year and four-year schools to collaborate on common courses that have equivalent course objectives and outcomes. In this case, the Supply Chain Management Technology program of Purdue Polytechnic and the two year Supply Chain Management and Logistics program of Ivy Tech Community College coordinate course objectives in foundational areas of study, such as basic logistics and supply chain management concepts, purchasing and inventory, and lean manufacturing concepts. These and other subjects create a common foundation from which the upper-level collegiate course will build in the baccalaureate degree. While previous collaboration between faculty of the two institutions had created common areas of study, no formal articulation agreement existed previous to the work of the grant. While gathering feedback from a shared industrial advisory board about the curriculum elements, the two institutions not only documented a clear articulation for two-year students, maximizing the number of transferable credits within the Supply Chain Technology Management program, but they also created opportunities for shared project based learning opportunities. Through these efforts, a clear pathway from tenth grade through a Bachelor of Science degree has been created to support Supply Chain Management Technology and Logistics industries in Indiana.

Secondary Education Professional Development

Hands-on activities can be used as an effective tool for instruction, as it provides the learner an opportunity to listen, write, and then perform a new task, engaging various types of learning styles including visual, auditory, and kinesthetic. In using hands-on activities to train the high school teachers, they have the unique opportunity to share the perspective of their students by interacting with the material for the first time as students themselves.

In the first teacher training workshop, Purdue University and Ivy Tech Community College collaborated with Conexus Indiana for their summer teacher training required for new teachers using the HIRE Technology high school curriculum. This partnership allowed training to take place with the same teachers who were credentialed to teach the dual-credit coursework of the developed pathway, even if they were not planning on teaching the Ivy Tech curriculum in their classrooms. Following the instructional requirements of Conexus, the training focused on the certification body of knowledge for the MSSC CLT exam, which is also embedded in the dual credit course developed for the Ivy Tech-Purdue Supply Chain Management Technology pathway. While Conexus did not want hands-on activities conducted during this workshop, the researchers of the grant were able to interact with over 60 secondary educators throughout Indiana to better understand current gaps in curriculum, professional development and issues experienced in the classroom with current logistics and manufacturing curriculum. The researchers recorded the educators' concerns and integrated these gaps and challenges for subsequent training opportunities and supplemental curriculum components.

Two major obstacles were identified through these interviews. The first was an issue of secondary educators having little knowledge or experience with current technological trends in

supply chain management and logistics. The second concern was that many students who had taken previously-developed courses in logistics or manufacturing found the curriculum dull and hard to relate to, as much of the curriculum was based on e-learning materials viewed online. It was discovered that much of the students' classroom time was spent reading material presented using a computer interface, without interaction with either their teacher, peers or any type of physical interaction to demonstrate concepts being taught. These two obstacles were the primary focus of the subsequent teacher training workshops offered to dual-credit instructors teaching the high school supply chain management coursework.

The next teacher training workshops were focused on the dual-credit high school instructors who were planning on teaching the supply chain management technology course of the newly established K-12 to Bachelor Degree pathway. These teachers were identified through the existing dual credit memorandums of understanding on file with Ivy Tech Community College and contacted through the Directors of Career and Technical Education in the region. Teachers were invited to a two-day training at Purdue University, which included resources for their classroom, curriculum materials, industry tours and certification preparation. Teachers who completed both days of training were awarded a stipend for their attendance. As Supply Chain Management Technology has been coordinated through both the technology and business divisions of the high school, teachers attending the workshop may be from either discipline.

To better educate the secondary instructors in current supply chain management technologies and operations, three primary training techniques were utilized. First, secondary instructors were trained on the Purdue University campus in the Supply Chain Management Technology lab. The lab contains industry-standard equipment including pick-to-light systems, Radio Frequency Identification (RFID) systems, barcoding equipment and software, SAP Enterprise Resource Planning (ERP) software, and numerous simulation games. By hosting the educators in this lab, teachers were able to see, touch, and interact with current industry-standard equipment. While most high school do not have funding to support similar labs, these examples help the teachers to better communicate to their students how technology is being used today in Supply Chain Management.

Second, teachers were taken on an industry tour of a warehouse to see warehouse operations and the large-scale equipment in use in most modern warehouse facilities. Previous to the tour, teachers were presented common terms, equipment, and material handling concepts to better understand what they were seeing throughout the facility. Educators were also presented with a warehouse checklist, to be completed during the tour, to help connect the material discussed in lecture with the physical warehouse. This check sheet was provided as a template to the secondary teachers, allowing them to modify and duplicate this worksheet for tours taken with their high school classes. The instructors were also offered regional contacts in warehousing to help facilitate the arrangement of tours for their high school classes. Industry tours are very helpful in helping students to understand warehouse operations, however sometimes these tours have age requirements (such as requiring participants be 18 or older) that prohibit high school students from being able to participate. To help mitigate this challenge, video links to high quality warehouse operations were provided, allowing teachers to show examples of warehouse operations during their class time without requiring a field trip.

Finally, electronic resources on basic supply chain management and logistics were provided to the teachers, allowing them to gain additional knowledge and understanding of the industry. For some of the instructors, who had a background in technology, their knowledge gap involved business concepts and overall operational management. For business teachers, they may feel less comfortable with material handling equipment, logistics, and current technology. As these gaps are dependent on the individual instructor and their background, resources were assembled by content area and provided to the instructors to review on their own. These resources were also suitable to be used in the classroom and could therefore supplement instructional materials already in use by the high school instructor.

The second challenge identified involved the lack of hands-on activities used in the high school classroom to teach supply chain management technology objectives. While both Purdue University and Ivy Tech Community College integrate a formal lab course to support hands-on learning functions, most high school courses do not have the space or resources to support lab activities. Therefore, hands-on activities must accommodate a standard lecture classroom and require less than one hour to complete. Classes may vary in size from 10 students to 30 students, requiring activities to be scalable and use group activities. To assist the high school teachers with this challenge, multiple simulation games, requiring low cost materials were developed. For each simulation game, curriculum with student learning objectives, key terms and concepts, and other curricular elements were provided to the instructors. Purdue and Ivy Tech faculty led the high school teachers through each of the simulation games, teaching the instructors both how to lead the game in the classroom and discussing how to connect the games to the course objectives and existing lecture materials. Each game could accommodate various class sizes, number of groups, and could be completed in 50 minutes or less. Additionally, games utilized materials that could be easily duplicated or purchased and require little storage. Examples for each instructor were provided, as well as electronic versions of the simulation games. A simulation exercise using Lego bricks was also demonstrated. Teachers were provided with Lego materials to complete the exercise in their classroom, using up to five groups. Immediate feedback from the high school teachers was very positive and excited to integrate these games into their curriculum.

The second component in the hands on activities included interactive discussion between the various instructors and the Purdue and Ivy Tech faculty about the curriculum used in each high school classroom. This discussion allowed the high school teachers to present potential obstacles specific to their classroom, schedule, student population, or other unique characteristic. Together, the teachers and collegiate faculty worked to brainstorm ideas to mitigate or eliminate the potential problems and help facilitate better learning environments for the students. Customized solutions for each potential issue were discussed and individual curriculum areas were addressed in greater detail, dependent on the need of the instructor.

Finally, Ivy Tech and Purdue faculty presented the developed pathway from secondary educational pathways through advanced degrees. Faculty were able to help the secondary teachers understand the potential career paths at each exit point of the curriculum, as well as answer questions about how articulation agreements can impact dual credit curriculum and increase the academic potential for each student. These extended discussions better equipped the secondary educators to talk to their students about both academic and career pathways in Supply Chain Management Technology.

Anonymous surveys were administered to the high school teachers upon completion of the workshop. The workshop received a rating of “excellent” from every participant in the group. The most common suggestion for improvement was to increase the length of the workshop to include additional topics and increase discussion time. Overall, the workshop was demonstrated to be a success. An external evaluator contacted participants several months later, determining that high school teachers did feel more comfortable with the material, had integrated the hands-on activities, and felt that students were more engaged with the coursework overall. Ongoing evaluations of participants from the workshop are being conducted in accordance with the grant requirements.

Conclusion

Meeting industry needs for increased workforce talent in Supply Chain Management Technology and Operation positions requires the combined effort of secondary educators, community colleges and four year institutions. With high-wage, high-demand job opportunities at multiple exit points throughout an academic progression, secondary educators and students must be made aware of the various opportunities that exist, beginning with dual-credit opportunities offered in the high school. However, supplying high school instructors with a college curriculum is not sufficient to ensure quality in education or understanding of the career paths. To better equip secondary educators in the instruction of dual-credit coursework, teachers must have resources to meet the unique needs of the high school classroom environment. Teachers must be trained in current industry trends, familiarized with new technology and given classroom resources that adequately engage students in the material and promote higher levels of learning and understanding through engaging the verbal, auditory and kinesthetic learning styles. Once provided with the appropriate resources, teachers feel better equipped to educate their students and students demonstrate higher levels of engagement with the material.

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