

Technical Colleges as Pipelines to a University Degree

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Abstract—This innovative practice paper presents the development and progress of a unique pathway to an academic degree. The pathway begins at a technical college that grants technical competency certificates and extends through degrees from a public research university.

Recent reports confirm that while technical and community colleges are commonly a less costly educational alternative to four-year universities, for those who want to continue their education toward a bachelor's degree or beyond, students often encounter unexpected hurdles. Transferring courses not just for bulk credit hours toward graduation, but also to satisfy major course requirements, often goes differently than students would wish. For various reasons, transfer credit is disallowed towards degree requirements. In such a case, student work cannot effectively be applied toward a university degree unless provisions are made. This has been the case for Utah's public technical colleges. These eight geographically dispersed schools work closely with nearby high schools and with nontraditional students in their communities to provide vocational training in many fields, including Information Technology, Cybersecurity, Manufacturing and Robotics. Their vocational orientation has resulted in schools emphasizing competency-based certificates instead of hours in the classroom. Students emerging from these programs are well prepared to enter the technical workforce, but have not had an easy path for further education.

About a decade ago employers expressed a desire for these technical professionals to be able to improve their capabilities beyond entry level jobs into more

senior positions. The state legislature responded to these demands, mandating that a pathway be provided for students in select areas of study at the technical colleges to allow them to continue academic studies at Utah State University (USU), a public, research-intensive institution. In addition to the roles commonly associated with such a university, as a land-grant school, Utah State prioritizes statewide outreach into underserved areas. Since these are some of the same communities served by the state technical colleges, when needs for education beyond technical college certificates were recognized, USU was able to step into this role. Notably, it reaches underserved populations including first-generation students, rural residents, and Native Americans. As a result, USU has instituted a bachelor's degree in Technology Systems with various emphases designed to use certificates from technical colleges as lower-division technical prerequisites.

Keywords—*stackable, collaboration, outreach, pathway, certificate*

I. INTRODUCTION

Careers in information technology and its offshoots such as cybersecurity can begin from many origin points. These can be roughly condensed into three broader categories, academic training, vocational training, or self-instruction. Professionals will move among these approaches as needs arise, so a practitioner with an academic degree may take specialized training in a needed technology or complete the requirements for a professional certification. The self-taught may likewise study for and take certification exams to demonstrate technical acumen. Vocational training can be further subdivided into boot camps or courses that help achieve

these outcomes, or certificates and associate of applied science degrees from technical colleges. Each approach has its strengths, for example a degree provides theoretical underpinnings and breadth that can strengthen a professional's career longevity. Vocational training is a faster and less expensive path to a specific skillset needed for a job.

“Historically, technical and occupational associate degrees were considered terminal degrees and not intended for transfer. Associate of Arts (AA) and Associate of Science (AS) were designated as transfer degrees, and the Associate of Applied Science (AAS) degree was meant students who planned on immediate employment after graduation rather pursuing further education.” [1]

A newcomer to the field may reasonably ask which of these approaches is best? Such questions frequently appear in topical social media [2]. A common answer is often that all of these means are valuable, so for the best career advancement opportunities, do all of them. For example, one trade publication recommends, “So which one should you pick: degree or certification? Frankly, I would say you want some of both” [3]. Some universities have recognized that industry certifications combined with degrees can strengthen their graduates resumes and have begun incorporating certifications into their curriculum [4].

Could a synergistic approach to education, combining traditional vocational training from a technical college with academic education from a university, benefit students, combining the strengths of each? Beginning in 2018, a state-mandated stackable pathway [5] from the eight Utah state technical colleges to Utah State University has been providing a natural experiment testing this hypothesis.

The technical colleges in Utah are distinct from community colleges, being purely vocational in nature. There are no degrees granted by them, rather they issue certificates in technical skills that are of value to local employers. Of particular note here, each of them grant a certificate in Information Technology. There is some minor variation among the content of these certificates, but essentially consist of a sequence of courses including ones that are geared towards attaining the A+, Network+ and Security+ CompTIA certifications, along will supplementary courses in scripting, cloud computing, and Linux.

Utah State University (USU), on the other hand, is a public, research-intensive institution. As a part of its mission as a land-grant school, it has the charter to perform academic outreach to the rural portions of the state. While an alliance between a strongly academic institution like USU and technical colleges may seem unlikely, USU has long maintained a network of satellite campuses throughout the state, including in areas where the technical colleges are located. This has helped to form bonds in spite of the divergent nature of the campuses. For information technology, this took the form of articulation agreements between USU and many of the technical colleges. Following the state pathways mandate, USU created two specially designed degrees for holders of technical college certificates in IT, an Associates of Applied Science (AAS) degree, and a Bachelors of Science in Technology Systems. Within the BS degree there are Information and Computer Technology (ICT) and Cybersecurity emphases.

There are several unique aspects to these degrees. The first is that unlike most articulation agreements with community colleges, there is no expectation that there are any non-vocational courses at the technical colleges. Most such articulation agreements expect that incoming students to the University will have an associates degree, with much or all of the general education coursework completed. In contrast, in this case each institution provides instruction where its strength lies. The certificate from the technical college comes first, providing technical skills desirable to employers. The AAS degree is accomplished with one additional year of studies after the student transfers to the university, where general education and breadth coursework is completed. Since students originate from technical colleges all around the state, the coursework is online so that they can continue their studies in place.

If a student opts to continue on to their bachelors degree, two more years of coursework typical of a university education are completed, including additional technical and breadth instruction. The prerequisites required by the upper-division technical coursework is largely satisfied by the coursework completed at the technical college. In addition, the university provides 30 semester hours of credit to those who have completed their technical college certificate.

II. BEGINNINGS

Utah's first applied technical college was founded in a rural part of the state in 1968 [6]. Over the next 55 years it would be joined by seven other schools scattered across

the state. From the outset, the schools were closely tied to local secondary schools and their communities' vocational needs. As community needs changed, the colleges evolved as well in accord with advisory boards and political mandates. Since the colleges had been allowed to change according to community needs, they had become significantly differentiated. They all had computer-oriented courses of study, with variations. Under state mandate, as of 2023, core programs within the schools are being brought into at least 70 percent alignment. While some courses of study remain specific to a particular locale, others, such as Information Technology, now share a common set of outcome criteria throughout the eight technical colleges.

One of the technical colleges is located near the main campus of Utah State University. Along with some of the other technical colleges, this school had an Information Technology course of study that consisted primarily of courses that echoed the body of knowledge of the CompTIA A+, Network+ and Security+ certification exams. While students were not required to actually take the CompTIA exams, the school itself granted certificates to students who completed the courses. Students who had earned the certificates were in demand by local employers. Still, some of these employers began agitating for students who had been even better prepared for the workforce through further university education.

Through the advisory boards of the local technical college and the Utah State Board of Education's Career and Technical Education department, pressure was applied to create a path to an AAS General Technology degree at Utah's public universities. This path leveraged state Regent's Policy R473, Standards for Granting Academic Credit for CTE Course Work Completed in Non-Credit Instructional Formats [5], which had been originally developed in 2011 to allow for articulation agreements between the state technical colleges and universities, in line with movements in this direction across the country [6]. USU's AAS degree began with four emphases areas: technology systems, general business, allied health systems, and design and creative arts.

III. EXPANSION

By 2015, industry partners for both USU and technical colleges were pushing for a bachelor's degree to build on top of the AAS degree. This push led to the expansion of the degree pathway in 2017 to a bachelors degree in Technology Systems with four separate emphasis areas in: Information and Computer Technology; Technical

Management; Robotics, Automation, and Controls; and Product Development. The first articulation agreement related to IT for this degree was with Bridgerland Technical College. In the case of Information and Computer Technology (ICT) emphasis, the degree program consisted of the following [8]:

- required IT support, networking and security certificates from Bridgerland Technical College,
- university general education requirements,
- Technology Systems core classes such as technical communications and ethics,
- Lower-division technical electives
- Upper-division emphasis courses in Information and Computer Technology

In 2021, changing needs required the addition of new emphasis areas, including a Cybersecurity emphasis for the Technology Systems degree. The requirements for this degree are identical to that of the Information and Computer Technology emphasis, except that the upper-division courses are replaced with ones appropriate for cybersecurity. At this point, the articulation was expanded to include a second technical college: UBTEch.

In 2023, under the guidance of the state board of regents, an alignment was instituted between the technical colleges. As a result, there is greater uniformity between certificates issued from each individual school and a single articulation agreement with USU covers all conforming technical colleges. Some variation is still allowed, for instance the employers in one area may desire students to be trained in the Azure cloud, while employers in another area may prefer AWS. The technical colleges will be able to tailor coursework to these needs.

IV. 'STACKABLE' CREDENTIALS

The articulation agreement leading to a Technology Systems bachelor's degree with IT or cybersecurity emphasis begins with the student completing a 900-hour course of study at a Utah technical college, resulting in a certificate in Networking and Cybersecurity. This certificate corresponds roughly to a combination of the CompTIA A+, Network+ and Security+ certifications.

A large fraction of the students enrolled at the technical colleges are high school students taking courses for vocational training. Others are non-traditional students that are retraining for a career in IT. Most of these students will proceed directly into the workforce upon completing their technical college certificates, but

some of the more ambitious will continue their education at USU.



Fig. 1: The Stackable Pathway

Upon completion of the certificate and applying to and being accepted as a student at USU, 30 credit hours of undergraduate credit are applied toward the General Technology AAS (and ultimately the Technology Systems BS). In addition, the first-year technical course requirements for the Technology Systems degree are satisfied. In this way, the coursework completed at the technical college can “stack” towards the bachelor’s [Fig. 1]. This terminology is used in marketing the degree to prospective students.

Benefits to the stackable paradigm include hands-on labs and in-person instruction at the local technical colleges during the formative early technical courses. Industry in less populous regions benefits from a well-trained local workforce, up to a college degree level. This can serve as a catalyst for business and industry diversification in underserved communities.

By virtue of being accessible to students in their local communities, these stackable degrees are inherently cost-effective, eliminating residential campus housing costs. In addition, the technical college portion is often free to the student, since the local school district pays tuition and fees for high school students taking vocational courses. For students not enrolled in high school, costs at a technical college are also much lower than those at a university.

V. OVERCOMING CHALLENGES

Some challenges come from our student population's rural, dispersed nature. Often, desirable technical jobs are located in more urban locations. Fortunately, IT is ubiquitous, and even in rural areas, there is some demand for our graduates in schools, government, ISPs, and other organizations that can be found everywhere. In addition, with the uprising of remote work, there is some relief for

rural IT employment. Other ambitious students will ultimately choose to go to where there are more job opportunities.

Since the Technology Systems degree was designed from the outset to serve students dispersed across the state, all required coursework is designed to be asynchronous and online. Instructional technology incorporating virtual labs is heavily leveraged. In a few cases, physical labs are transported or shipped to student locations, as needed. There are sufficient online remote general education and elective courses available at USU to enable students to complete their Technology Systems degrees without needing to attend the main university campus.

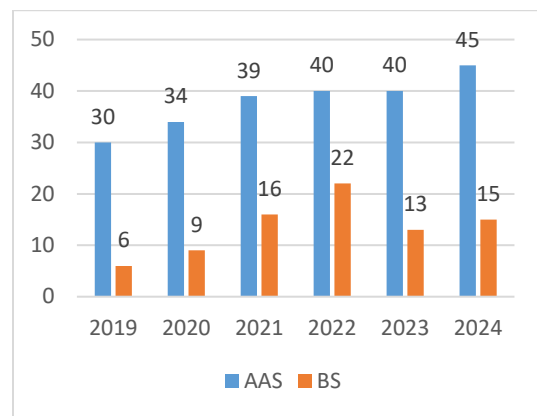


Fig. 2: Graduating Students Who Have Tech College Certificates

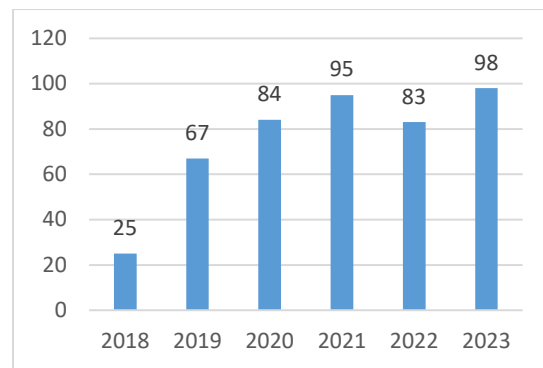


Fig. 3: All Graduating Students in Technology Systems

In practice, there is a significant cohort of students that arrive in the Technology Systems major that do not first attend a Utah technical college. This can be seen by comparing the BS graduates that had a technical college certificate in Fig. 2 to overall graduates in Fig. 3, which

shows that only about one-sixth of the graduates came into the major with a technical college certificate. The other students are frequently transfer students from other majors and departments at the University, such as engineering or computer science, or they have professional technical backgrounds. While we are happy to serve these students, many are not as well prepared for upper-division studies as those who have come through the technical college pathway. In earlier days, student preparation was assessed on an individual basis, and students were required to remediate weaknesses before proceeding to upper-division courses, often by completing ad-hoc coursework at their local technical college. While referral back to a technical college remains a viable option, beginning in 2023 USU partnered with one of the technical colleges to provide online courses for core prerequisites such as introductory networking and cybersecurity. These are equivalents to the corresponding courses that students take at the technical colleges, but are taken for lower-division credit at the university. Thus, there is now a better option for internal USU inter-major transfer students.

In addition to working to better serve the USU internal transfer students, outreach to more of the technical colleges has been expanded to raise awareness of the stackable option to extend student career opportunities.

VI. CONTINUING PROGRESS

With a six-year track record, we can now evaluate the progress of the stackable initiative. From the USU faculty perspective, the Technology Systems program has expanded from two faculty and one staff member in 2016 to seven faculty and four staff members in 2024. A dedicated ICT emphasis faculty member was among those added in 2018, and in 2021 when the Cybersecurity emphasis was created, an additional faculty member was brought in, for a total of two faculty tasked explicitly to teach the ICT and Cybersecurity emphases. With a solid technical foundation from the technical college certificates, these two faculty members can dedicate themselves primarily to teaching the upper-division technical core. Other members of the Technology Systems faculty teach in their emphasis areas, as well as teaching common coursework in areas such as technical communications and ethics.

The progress of the Technology Systems major in terms of growth of graduation rates is shown in Figure 4. Enrollments ramped up very quickly, showing strong student and employer demand. The high ratio of graduates to enrolled students [Fig. 3] is also very positive, showing

excellent student retention. With enrollments of over 200 students, the major is viable for the foreseeable future.

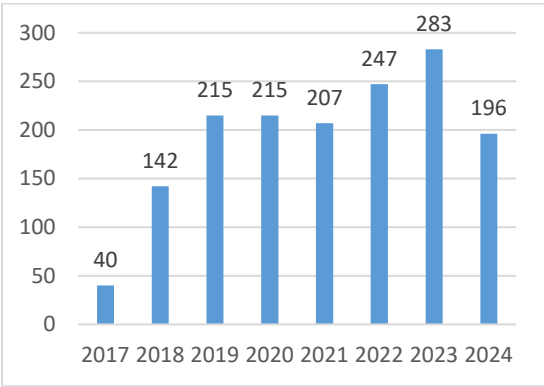


Fig. 4: Technology Systems Enrollment

As shown in Fig. 5, the combined ICT and Cybersecurity emphases within the Technology Systems major follow a similar trajectory. Enrollments are stabilizing at over 70 students. Interestingly, students that previously might have been in ICT emphasis are now dividing themselves among the two IT-centric options. Graduation rates are also appropriate for the enrollment levels [Fig. 6].

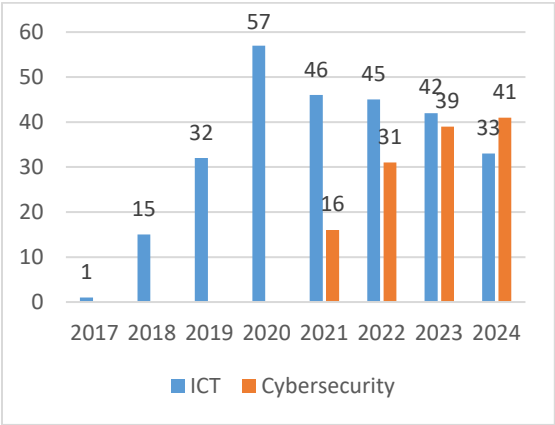


Fig. 5: ICT and Cybersecurity Enrollment

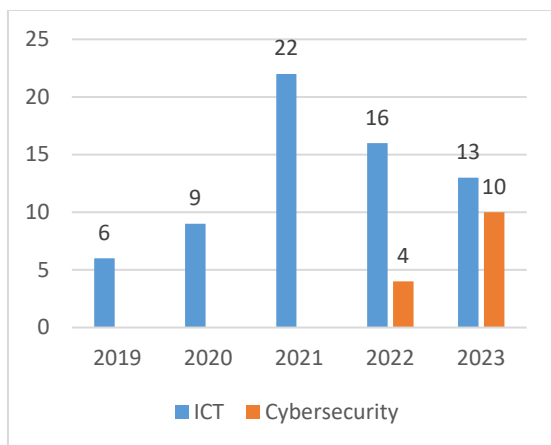


Fig. 6: ICT and Cybersecurity Graduates

Note: Cybersecurity did not begin until 2021.

There are other manifestations of the success of the stackable initiative and the resulting Technology Systems major at USU. One is in relationships that have been fostered between the technical colleges and USU, which in some cases have become remarkably close. USU faculty and staff have been active with the Technical College advisory boards, and have been making classroom presentations, judging competitions, and have been holding joint recruiting events.

Industry outreach has also been progressing, although there are challenges associated with this when much of the student population is in rural areas. Despite this, students have received internships and full-time jobs with notable partners such as The Space Dynamics Lab, Northrop Grumman, and ThermoFisher Scientific, as well as with many small businesses [9].

While the rural nature of a portion of the students in this program may on the one hand be considered a challenge, it is also a feature that is commendable due to outreach to underserved populations within the state, including the indigenous. These populations are more likely to be served by technical colleges than universities, so this pathway serves as a stepping stone to higher education [1].

The pool of students eligible to enter the major after completing technical college certificates is on the verge of exploding. The IT articulation agreement was originally between a single one of the technical colleges and USU. In the past two years it has expanded to include three others. Now, due to state-mandated technical college curriculum alignment, beginning this year all of

the eight Utah technical colleges will be able to place students into this program at USU.

Another indicator of the success of stackable degree pathways can be measured by the perceptions of former students that graduated with a university degree following receipt of a technical college certificate. In an August 2024 survey conducted by C. Boyle, graduates who followed this pathway were strongly favorable to it, with 90% saying that they would recommend this pathway (a tech college certificate followed by a university degree) to a friend [Fig. 7].

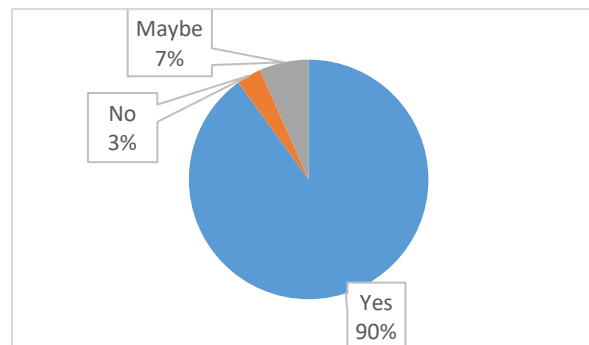


Fig. 7. Responses to “Would you recommend the stackable pathway (technical college certificate through a USU degree) to a friend or colleague?”

Some free-form responses received give good insight into the reasons behind this strong result. Many graduates emphasized the applied value of the certificate as being particularly valuable in their daily jobs, while the university degree opens doors and helps in other ways, as illustrated by this typical comment.

"Having the technical certificates has been useful to show skills in specific areas such as SolidWorks, PLC Programming, or Robotics. This helped me take on specific projects and responsibilities outside of my role to expand my area of expertise. The bachelors degree allowed me to obtain career promotions that would have otherwise been out of reach."

Other comments are indicative of the value to the rural, indigenous and first-generation college student populations that this pathway often serves, for example:

"A slower start to college helped me pin point which major I wanted to focus on. It also helped me find a career that assisted in paying for my degree."

VII. SUMMARY

A pathway from a vocational training program to a professional university degree which leverages the strengths of each institution has been developed and implemented. This pathway has been producing students that become valued members of the technical community. The articulation is notable since it is from a non-degree granting institution, yet it produces valued graduates at reduced expense and time.

Growth has been robust, and graduates are welcomed in industry. Graduates of the pathway value the combination of practical skills received at a technical college with the additional skills and recognition associated with a university degree.

At the six year mark, the articulation continues to evolve, largely due to outside forces. A similar vocational school partnership may be attractive for other IT and Cybersecurity programs.

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