Journal of Research in Technical Careers
May 2023, Vol. 7, No. 1

Pathways to Credentials: Does the Timing of Earning an Industry Certification in High School Influence Postsecondary Educational Outcomes?

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Earning industry certifications helps people prepare for jobs in a range of careers. Doing so in high school may help students prepare for college as well. Using administrative data on two cohorts of first-time 9th graders in Florida, we examined whether earning a certification was associated with postsecondary enrollment and degree attainment and whether the timing of the certification influenced that relationship. Earning a certification in high school prepared students for success in both 2-year and 4-year colleges. However, the patterns of certifications and college enrollment and degree attainment differed based on when students earned the certification. For early earners the certification was more closely associated with enrollment and attainment at 4-year colleges; for later earners, the certification was closely associated with enrollment and attainment in 2-year colleges.

Keywords: career and technical education, industry certification, college access

Introduction

Jobs that pay livable wages increasingly require educational attainment beyond a high school diploma. Formerly low-skilled jobs now require more skills, and middle-skills jobs in areas like health, advanced manufacturing, and information technology require additional training (Holzer, 2015). Thus, those without high school diplomas, and high school graduates without any postsecondary training, struggle to attain middle-class status because of unemployment and lower earnings. Society loses out on the financial return of a well-educated

population in the form of lower tax payments and more reliance on social support programs (Baum et al., 2013). However, although employers face a critical need for worker training, many scholars agree that not all students need to be steered into 4-year degree programs (Perna, 2013; Sparks & Waits, 2011). Carnevale et al. (2017) found the share of good jobs—which they defined as full-time, paying at least $35,000—for workers without BAs has declined overall since 1991, particularly in blue-collar industries. Industries such as healthcare, business, computer operations, and architecture have seen the demand for workers exceeding the supply (Restuccia et al., 2018), and appropriate training could help people better prepare to get these jobs.

In recent years, many high schools have implemented policies focused on improving career and technical education (CTE), which seek to integrate academic and technical instruction (Stone, 2017). In 2015, the Every Student Succeeds Act (ESSA) included CTE in its definition of a "well-rounded education," and as states set standards for academic subjects, they must also set standards for CTE (Every Student Succeeds Act, 2015). Research has shown that CTE can benefit students in high school and subsequently. Taking more units of CTE was associated with on-time high school graduation (Gottfried & Plasman, 2018) and college enrollment, particularly in 2-year colleges (Broderson et al., 2021).

The educational benefits of CTE course taking may depend, in part, on when a student takes these courses. Students can take CTE courses in different high school grades, and one study examining the timing of CTE courses found that taking them later in high school (11th or 12th grade) reduced the likelihood of dropping out of school. Conversely, taking CTE in earlier grades (9th or 10th grade) did not influence the likelihood of dropping out (Gottfried & Plasman, 2018).

Industry certifications are one recognized standard for assessing CTE skills. Industry certifications are independent nationally recognized credentials awarded by businesses or associations, which demonstrate proficiency with skills for a given job. One earns an industry certification by preparing for and taking an examination that tests practical and academic understanding of the concepts and methods used in a particular career (U.S. Bureau of Labor Statistics, n.d.). In Florida, some industry certifications earned in high school can yield college credits (Florida Department of Education, 2020), and students may see ways to build on their industry certifications by continuing into college.

In recent years, states have expanded policies and programs promoting certification attainment for high school students (Education Commission of the States, 2020). However, little is known about the educational value of these credentials. Different independent vendors develop and score industry certification examinations, and they typically do not release their test results to a common database. Therefore, comprehensive data linking certifications and academic outcomes have not historically been available. There are no reliable national data on the number of certifications earned (Sykes et al., 2014). States face challenges in accessing industry certification data from multiple vendors (Dalporto, 2019); therefore, few states have managed to link earning industry certifications to students' academic outcomes. However, in some states, the state longitudinal data system includes information about industry certifications and permits examining the outcomes for those who do earn certifications. Initial research on the academic outcomes of earning certification indicated that some certifications were positively associated with postsecondary enrollment and attainment (Giani, 2022; Glennie et al., 2021).

Little research has examined whether the timing of earning certifications influences academic outcomes. As students progress through grades, their thoughts about college and careers are

likely to evolve. Students in earlier grades may be more exploratory in their pursuit of certifications while students in later grades may have clearer occupational goals and pursue certifications aligned with those goals. Thus, the timing of earning an industry certification may be associated with the relationship between the certification and subsequent postsecondary outcomes. This paper examined whether outcomes for early certification earners differ from those of later certification earners. Specifically, it examined the following study objectives:

1. To examine the relationship between earning an industry certification in high school and enrollment and attainment in 2-year and 4-year colleges.
2. To determine whether the timing of earning an industry certification (that is, whether it was earned earlier or later in one's high school career) was associated with enrollment and attainment in 2-year and 4-year colleges.
3. To explore the factors that contribute to any differences in postsecondary outcomes between early and late certification earners.

Literature Review

Benefits from Obtaining Job Skills in High School. Traditionally, high school students have obtained job skills through taking courses in their school's CTE programs or participating in internships and school-based enterprises. In high school, many students enroll in individual CTE courses or programs of study. In 2013, 88% of public high school graduates earned some CTE credits, with an average of 2.6 credits (Arbeit et al., 2017). From 1992 to 2013, the average number of credits earned in public services, healthcare, agriculture, and computer/information technology increased (Liu & Burns, 2020). In addition to preparing students for future jobs, concentrating in CTE in high school was associated with academic benefits such as high school completion (Bonilla, 2020; Broderson et al., 2021; Gottfried & Plasman, 2018) and college enrollment and degree attainment, particularly in 2-year colleges (Broderson et al., 2021; Dietrich et al., 2017; Dougherty, 2016; Phelps & Chan, 2017).

Learning job-relevant skills can influence academic achievement through a variety of mechanisms: self-efficacy, course relevance, engagement, and student-teacher relationships. Career and technical education courses focus on experiential learning with hands-on applications of knowledge (Clark et al., 2010). In classes that focus on creating or fixing a relevant product, students gain experiences in which they can master different tasks. That mastery may enhance their self-efficacy. Self-efficacy then influences their motivation and academic engagement toward setting a course of study (Bandura, 2006). With job skills training, students can more easily see the relevance of their course activities, which may give them a greater sense of purpose in their studies (Stone & Lewis, 2012). As students approach learning in order to increase specific knowledge and skills, they rely more on cognitive learning strategies, which increases their overall academic performance (Dweck, 1990). As CTE courses typically have less lecturing and more hands-on instruction, students interact more directly with their teachers and their peers in the classroom. These more direct interactions can foster stronger teacher-student relationships, which were found to be associated with high levels of academic engagement and satisfaction with student life (Loera et al., 2013). In a study of instructional approaches in career and technical education classes, students who spent most of their class time in meaningful hands-on activities were more academically engaged than those in instructor-led classes (Holik, 2019).

Combining career preparation with academic preparation also increases students' educational and career aspirations (Rowan-Kengon et al., 2011). Curricula that combine a

variety of career experiences give students a sense of purpose, especially for those who are disengaged with school (Hyslop & Imperatore, 2013). In CTE courses, particularly those that prepare students for certifications, the learning goals are specific and explicit. Through hands-on learning, students can tell whether they have mastered the required materials. A survey of high school seniors found that a higher rate of CTE students reported making plans about the future jobs they wanted and participating in after school activities to learn more about those kinds of jobs, such as volunteering or touring a business (Mobley et al., 2017). Further, students with certain and accurate beliefs about educational requirements for expected jobs have higher rates of postsecondary enrollment and persistence than those with uncertain, inaccurate beliefs (Morgan et al., 2013).

Policymakers and businesses view earning certifications as a key to providing students and workers with highly relevant job training that leads to rewarding career tracks (Goodman et al., 2014). Policies and programs promoting certification attainment for high school students have exploded in recent years. Some states have seen huge increases in the number of high school students earning certifications (Goodman et al., 2014), and as of 2016, 42 states offered K-12 pathways leading to a certification (National Center for Education Statistics, 2016).

Like CTE courses, industry certifications provide job training, yet they can benefit students academically as well. In some cases, high school students who earn certifications get college credit (Castellano et al., 2005; Goodman et al., 2014). Within the limited existing research on the influence of industry certifications, studies have shown that earning an industry certification in high school was associated with college enrollment, persistence, and degree attainment, particularly in 2-year colleges (Giani, 2022; Glennie et al., 2021).

Industry certification exams are designed by industry organizations for job applicants, who are typically adults; therefore, mastering skills associated with certification exams may require problem-solving and critical thinking skills. These cognitive strategies are essential for success in college (Conley, 2012), and a student who develops those skills can use them in other high school or college courses. Earning a certification requires making an effort beyond the academic requirements of CTE course-taking. It involves taking and passing a nationally recognized standardized assessment. Taking the certification exam is not a requirement to pass the course, but some students choose to take on this additional educational challenge. By taking this opportunity for success, students may engage in learning more fully, enhance their self-efficacy, and develop specific career aspirations as they approach other educational challenges.

Florida's Career and Professional Education Act. In 2007, the Florida legislature passed the Florida Career and Professional Education (CAPE) Act to provide rigorous and relevant coursework that can lead to industry certification and college credit. The linkage between coursework and certification exams may enhance the academic benefits of earning certifications in high school. The CAPE Act promotes statewide planning between business and education to help attract high-value industries to the state. With this Act, Florida incorporated certification exam taking into its state longitudinal data system (Advance CTE, 2021).

A central component of the Act is its focus on state-approved industry certifications considered critical to Florida employers. The Division of Career and Adult Education within Florida's Department of Education selects a subset of these certifications for use at the secondary level. These certifications must be achievable by secondary students, require a minimum of 150 hours of instruction, and have been offered for at least one year in a school district. With the CAPE Act, students and their parents do not register for exams, pay examination costs, nor

coordinate scheduling the exam and getting to a testing location. Further, before taking the exam, students have taken courses that should prepare them to pass the exam (Glennie et al., 2017).

In Florida, industry certifications took on increased importance for schools in 2009–10 when they were incorporated into the state's high school grading and funding formula. Under the CAPE Act, schools get points in the School Report Card for the percentage of students who passed an industry certification on Florida's Industry Certification Funding List, approved by the State Board of Education (Florida Department of Education, 2022). This policy change was associated with enormous growth in the number of awards, with 954 awards in 2007-08, 66,320 in 2014–15, and 123,839 in 2017-18, when the students in this study had just graduated (Florida Department of Education, 2018).

Industry certifications are nested within job-specific areas, or career clusters, which group occupations by associated skills or products. The first cohort of students who entered high school with the CAPE Act in place graduated in 2010-11. The Florida Department of Education approved industry certifications within a set of career clusters such as Agriculture; Architecture & Construction; Arts, Audio/Visual Technology & Communication; Business Management & Administration; Health Science; Hospitality & Tourism; Information Technology; Manufacturing; and Transportation & Distribution (Florida Department of Education, 2021).

Each career cluster contains multiple certifications. The Florida Department of Education lists all awarded certifications, by career cluster, on its website (Florida Department of Education, 2021). Certifications within a cluster prepare people for skills associated with certain kinds of jobs. For example, Architecture & Construction has certifications that prepare people for jobs involved with planning, building, and maintaining structures, such as apartment buildings or roads. Arts, Audio/Visual Technology & Communication certifications are for individuals seeking jobs in arts and design, entertainment, and media and communications. The Health Science career cluster certifications are for those pursuing jobs that involve medical care for people or animals. Certifications in Hospitality & Tourism prepare people for jobs in lodging, and tourism services, and certifications in Information Technology are for individuals who plan to work with computer hardware, software, or network systems (Torpey, 2015).

Initial studies of outcomes of certifications have found that earning industry certifications, particularly in some career clusters, can influence postsecondary outcomes. For 11th and 12th grade students, industry certifications were positively associated with 2-year college enrollment and attainment, but negatively associated with 4-year college enrollment and attainment; however, some individual career clusters were not associated with postsecondary outcomes at all (Glennie et al., 2021). Other research suggests that some career clusters, such as Information Technology, Health Science, and Arts, Audio/Visual Technology & Communication, were associated with better postsecondary outcomes, but others, such as Hospitality & Tourism, were associated with worse postsecondary outcomes (Giani, 2022). The extent to which certifications in career clusters are linked to postsecondary outcomes may depend on the requirements of different jobs. For some occupations, an industry certification suffices, and a college degree is not necessary; for others, work qualifications require a postsecondary degree. For example, within Architecture & Construction, someone getting a Carpentry certification would not need any postsecondary education to get a job constructing or building structures. However, someone wanting to be an architectural drafter would benefit from having not only an industry certification, but also a postsecondary degree that would give them skills in mechanical design and product simulation. Someone seeking a job as a civil engineer

would benefit from having many of these certifications but would typically need a 4-year degree for this occupation.

This paper examined the association of earning an industry certification with enrollment and attainment in 2-year and 4-year colleges. It examined this association over all certification earners and then separately for early certification earners, who earned a certification in 9th or 10th grade, and later earners, who earned a certification in 11th or 12th grade.

Data and Method

Data Sources. Data came from the Florida Department of Education's Education Data Warehouse, a longitudinal dataset that tracks students through high school and Florida public colleges. Data included demographic characteristics, educational progress, and indicators of earning a certification in high school. To obtain data about college enrollment and degree attainment outside of Florida's public postsecondary educational institutions, we incorporated National Student Clearinghouse data on postsecondary enrollment and attainment. Analyses examined outcomes for two cohorts of first-time Florida 9th graders, following them to three or four years after 12th grade. Cohort 1 entered 9th grade in 2012-13, and Cohort 2 started 9th grade in 2013-14. The original dataset included all public-school students in Florida who were first-time 9th graders in these years (442,656 total). Data were limited to on-time high school completers, who comprised 67% of the original sample (243,497) because this paper focuses on college outcomes. The data file goes through the 2019-20 academic year, four years after on-time high school completion for Cohort 1, and 3 years after completion for Cohort 2. Analyses of degree attainment focused on Cohort 1, which has four years of postsecondary data.

Table 1 presents the baseline characteristics of the students in the analytic sample of high school completers after the creation of the comparison group (described below). As schools routinely collected these data and reported them to state departments of education, none of these measures had missing data. Slightly more than half of the students were female. About 41% of them (100,548) were White, while 32% (77,302) were Hispanic, and 21% (50,555) were Black. Many in the analytic sample faced some sort of challenge: 56% (136,934) were economically disadvantaged, 23% (54,834) were English language learners, 3% (5,966) had a physical disability, and 8% (19,629) were identified as having some sort of mental disability. However, 40% (98,493) had taken an advanced class, such as Algebra I, in middle school. As these measures may influence certification earning and postsecondary educational outcomes, we used them to create comparison groups (described below) and controlled for them in all models to better isolate the effect of industry certification on postsecondary outcomes.

Table 1

Characteristics of the Analytic Sample (N=243,497)

Characteristic	Proportion
Female	51.9
White	41.3
Black	20.8
Hispanic	31.7
Other race/ethnicity	6.2
Economically disadvantaged	56.2
English Language Learner	22.5
Academically gifted	9.2
Physical disability	2.5
Mental disability	8.1
Advanced courses	40.4
Out of School Suspension	6.7
Percentage of days in attendance	95.9

Source: Florida Department of Education, PK-20 Education Data Warehouse

The Florida Department of Education maintains records for every industry certification examination taken by high school students. In this study, *industry certification* is a dichotomous variable coded 1 for having earned a certification and 0 otherwise. Industry certification exams are standardized assessments developed by industry organizations to measure job skills. Florida high school students take the same industry certification exams as would any other certification-seeker anywhere in the country, and these exams are scored by the same industry organizations offering the exams, and not by Florida high school staff. As such, the industry certification indicator used in this analysis is assumed to be a reliable and valid indicator.

For each student who takes an exam, data include the certification examination title, its career cluster, and whether the student passed. The certification records do not provide numeric scores for each attempt. The industry certification data include the date of the certification exam, which permits the identification of *early* earners (9th or 10th grade) and *late* earners (11th or 12th grade). In these analyses, those who earned certifications in both the early and late period have been excluded to ensure that categories are mutually exclusive. About 29% (70,229) of students in the study sample earned an industry certification at some point in high school. Students most

frequently earned certifications in 11th or 12th grade, but about one-third of them did earn certifications in 9th or 10th grades (Table 2).

Table 2

Number and Percentage of Students Earning a Certification During High School, by Timing (N=243,497)

Timing of Earning Group	Number of students earning a certification	Percent of students earning a certification
Overall	70,299	28.9
Earned certification in Year 1 or 2 (not in Year 3 or 4)	20,712	8.5
Earned certification in Year 3 or 4 (not in Year 1 or 2)	39,615	16.3
Earned certification in Year 1 or 2 AND in Year 3 or 4	9,972	4.1

Source: Florida Department of Education, PK-20 Education Data Warehouse

Key outcomes included *postsecondary enrollment* and *postsecondary degree attainment*, each of which was delineated by 2-year or 4-year college. In these analyses, enrollment and attainment were each measured with variables that have three mutually exclusive categories. Enrollment measures college enrollment at any time within three years of high school graduation. This variable has values for *no enrollment*, those who never enrolled in any postsecondary educational institution; *2-year enrollment*, those who ever enrolled in a 2-year institution; and *4-year enrollment*, those who ever enrolled in a 4-year institution. Those who enrolled in both 2- and 4-year educational institutions were counted as 4-year enrollments. Postsecondary degree attainment indicates completing a degree within four years of high school graduation, defined only for Cohort 1. This variable was coded *no degree*, for those who earned neither a 2-year nor a 4-year degree; *2-year degree*, for those who earned a 2-year degree; and *4-year degree* for those who earned a 4-year degree. A person who earned both a 2-year and a 4-year degree was coded as having a 4-year degree.

For each outcome, we compared:

1. students who earned any type of certification with those who did not earn a certification.
2. students who earned certifications at different times in high school with those who were non-earners at those times in high school.

These analyses allow us to estimate the overall effect of receiving a certification and whether the effect of certification varies by timing.

Analytic Approach. To address these study objectives, we used longitudinal data from two cohorts of Florida's high school students employing a quasi-experimental design called propensity score analysis. Analyses were conducted using Stata statistical software, version 17.

A robust analysis of the influence of certifications on outcomes requires comparing certification earners to others who had similar demographic characteristics and middle school experiences but did not earn a certification. Propensity score analysis is a selection-on-observables design to identify members of the comparison group by using covariates to adjust for selection into treatment (Guo & Fraser, 2014). In this study, the propensity score was an estimate of the probability of earning an industry certification. Earning an industry certification in high school, the treatment, was regressed on observed characteristics, which were measured before students had the opportunity to earn an industry certification. These observed characteristics were measured when students were in middle school and could not have been affected by this program. They included demographic characteristics of ethnicity, gender, economic disadvantage status, and English language learner status as well as academically gifted and physical and mental disabilities. Measures included 8th grade academic indicators: having taken advanced classes, attendance, and out of school suspension. The models included school-level variables such as locale, size, racial/ethnic composition, and charter and magnet statuses.

We used logistic regression to estimate propensity scores, which were in turn used to create inverse probability weights (IPWs). The strength of using IPWs is that it balances the treatment and comparison groups. After this process, the analytic sample size was 243,497. These weights permit comparing certification earners to similar non-earners based on baseline characteristics. Table 3 presents the baseline equivalence table for the overall model, and the first four columns (unweighted means) show statistically significant differences between those who pursued a certification and those who did not. Certification earners were less likely to be female, Black, or disabled, but more likely to be gifted. The unweighted statistics in Table 3 show statistically significant differences in the means for those groups. Forty-nine percent of certification earners were female, compared with 53% of non-earners. Similarly, 20% of certification earners were Black compared with 21% of non-earners. Five percent of certification earners had a learning disability, but 9% of non-earners did. Eleven percent of certification earners were gifted, but 9% of non-earners were gifted. Given that these factors are associated with postsecondary enrollment and success, it was essential to appropriately weight these data so the two groups look similar, as they do in the second four columns of Table 3. After weighting, none of the differences between certified students and those without certifications were statistically significant.

People selected not only whether to earn a certification, but also when to earn it, so we repeated this process to create analytic samples by timing of certification (early or later) to ensure that the comparison groups reflected each separate decision. In sum, we used three different analytic samples: overall, early earners, and later earners. Covariate balance was achieved in the weighted sample for each of these models, with no single covariate in the weighted sample differing by more than 0.04 standard deviations between the treatment and comparison groups for any model and no mean absolute standard difference differing by more than 0.01 standard deviations for any model. Overall, the mean absolute standardized difference for all covariates was reduced from 0.09 standard deviations on average in the unweighted sample to just 0.001 standard deviations in the weighted samples. Across all models, the average mean absolute standard difference across all covariates was reduced from 0.107 to 0.002, with the largest mean absolute standard deviation in the weighted models being 0.004. (Results not shown in table.) All models included these student characteristics: race/ethnicity, sex, economic disadvantage (free or reduced-price lunch status), English language learner status, gifted status,

physical disability status, learning disability designation, and advanced middle school course taking, such as Algebra 1. Models accounted for these school characteristics: locale (suburban or rural compared to urban), charter school status, magnet school status, total enrollment, percent Black, percent Hispanic, and percent other race/ethnicity.

Table 3

Weighted and Unweighted Means for Certification Earners and Non-Earners (Overall)

	Unweighted Stats (before IP Weighting)				IPW Weighted Stats (after IP Weighting)		
	Cert Mean (1)	No-Cert Mean (2)	P-value for (1)-(2) Diff.	Effect Size for (1)-(2) Diff.	No-Cert Mean (3)	P-value for (1)-(3) Diff.	Effect Size for (1)-(3) Diff.
Student characteristics							
Female	48.6%	53.2%	0.000	-0.092	48.6%	0.995	0.000
Black	20.2%	21.0%	0.000	-0.020	20.3%	0.762	0.001
Hispanic	30.7%	32.2%	0.000	-0.031	30.7%	0.872	0.001
Other race/ethnicity	6.5%	6.1%	0.001	0.015	6.4%	0.862	0.001
Economically disadvantaged	56.0%	56.3%	0.201	-0.006	56.1%	0.760	-0.001
English language learner	22.6%	22.5%	0.366	0.004	22.6%	0.823	0.001
Gifted	10.7%	8.6%	0.000	0.072	10.6%	0.717	0.002
Disability, physical	2.0%	2.6%	0.000	-0.043	2.0%	0.796	-0.001
Disability, learning	5.2%	9.2%	0.000	-0.157	5.2%	0.992	0.000
Advanced course taking (8^{th} grade)	39.5%	40.8%	0.000	-0.028	39.6%	0.719	-0.002
Out-of-school suspensions (8^{th} grade)	4.9%	7.4%	0.000	-0.104	4.9%	0.850	-0.001
Attendance (8^{th} grade)	96.2%	95.9%	0.000	0.076	96.2%	0.803	-0.001

Table 3 (continued)

Weighted and Unweighted Means for Certification Earners and Non-Earners (Overall)

	Unweighted Stats (before IP Weighting)				IPW Weighted Stats (after IP Weighting)		
	Cert Mean (1)	No-Cert Mean (2)	P-value for (1)-(2) Diff.	Effect Size for (1)-(2) Diff.	No-Cert Mean (3)	P-value for (1)-(3) Diff.	Effect Size for (1)-(3) Diff.
School characteristics							
Enrollment, 9th-12th grades	1990	1952	0.000	0.047	1987	0.393	0.004
School pct 9th-12th, Black	23.3%	20.5%	0.000	0.134	23.4%	0.256	-0.006
School pct 9th-12th, Hispanic	30.8%	31.1%	0.010	-0.012	30.8%	0.771	0.001
School pct 9th-12th, other	5.5%	6.0%	0.000	-0.137	5.5%	0.546	0.003
Suburban school	62.6%	61.8%	0.000	0.017	62.5%	0.668	0.002
Rural school	13.7%	14.0%	0.017	-0.011	13.6%	0.840	0.001
Charter school	3.6%	6.6%	0.000	-0.139	3.6%	0.897	0.000
Magnet school	46.3%	38.4%	0.000	0.159	46.2%	0.876	0.001
Cohort year	46.7%	50.5%	0.000	-0.075	46.8%	0.731	-0.002
			Mean absolute effect size:	0.066		Mean absolute effect size:	0.001
						Ratio:	44.5

Source: Florida Department of Education, PK-20 Education Data Warehouse; National Center for Education Statistics, Common Core of Data Public School University

Given that industry certifications measure job-related skills, some students may be able to attain desired jobs after they earn a certification. Some jobs may require applicants to hold a certification combined with a 2-year degree. For people interested in these middle-skill jobs, enrollment in a 2-year college may be preferable to enrollment in a 4-year college. Thus, we treated postsecondary educational enrollment and attainment as nominal (not hierarchical) outcomes and used multinomial logistic regression to predict the probabilities of each enrollment and attainment outcome. We repeated these models for all certification earners, for early certification earners, and for later certification earners. Results tables report average marginal effects, which note the percentage point greater or lesser likelihood of a certification earner achieving the outcome net of other student and school characteristics. Average marginal effects are an appropriate way to express how the predicted probability of a binary outcome (college enrollment, degree attainment) changes with a change in the explanatory variable. (Norton et al., 2019). In this case, earning an industry certification is the key explanatory variable.

Findings

Within three years of obtaining their high school credential, overall, 50% (123,936) of the sample enrolled in a 2-year college and 38% (93,283) enrolled in a 4-year college. Within four years of obtaining a high school credential, 19% (23,146) attained a 2-year degree, and 16% (18,989) attained a 4-year degree.

The first study objective examined the relationship between earning an industry certification and subsequent postsecondary enrollments. We found a statistically significant positive relationship between certification earning and enrollment in a 4-year college. The probability of enrolling in a 4-year college is 4.2 percentage points greater for those who earned a certification compared with those who did not (AME = 4.2). However, we found no statistical relationship between certification earning and enrollment in a 2-year college.

In terms of earning degrees, certification earners had a greater likelihood of earning a 2-year or a 4-year degree than similar students who had not earned certifications. The effect on 2-year degrees was about three times as large as the effect on 4-year degrees (AME = 4.2 versus AME = 1.3). That is, the probability of earning a 2-year degree was 4.2 percentage points higher for certification earners than non-earners, but only 1.3 percentage points higher for earning a 4-year degree. Table 4 presents these results.

The second study objective examined the relationships between the timing of certification earning and postsecondary enrollment and attainment. Here, we found profound differences between the early earners and the later earners. The early certification earners were on a pathway to attending a 4-year college. For those who earned a certification in ninth or 10th grades, the probability of going to a 2-year college was 3.5 percentage points *less than* that of students who did not earn a certification early in high school (AME = -3.5). However, for early certification earners, the probability of enrolling in a 4-year college is 8.2 percentage points higher than those who did not earn a certification. For later earners, the probability of enrolling in a 2-year college is 3.4 percentage points higher compared with those who did not earn certifications. On the other hand, for later earners, earning a certification had no effect on 4-year enrollment. For both groups, earning a certification had a positive effect on 2-year degree attainment. Additionally, early certification earners, had a higher probability of attaining a 4-year degree (AME = 3.9), but the later earners had no such relationship.

Table 4

Impact of Earning an Industry Certification on Postsecondary Enrollment and Attainment, by Timing of Earning the Certification

Average marginal effects						
	Overall (any time period)		**Earned in year 1 or 2**		**Earned in year 3 or 4**	
	n = 243,497		n = 189,615		n = 208,936	
Enrollment	**AME**	**P-value**	**AME**	**P-value**	**AME**	**P-value**
2-year institution	0.8	0.074	-3.5	0.000	3.4	0.000
4-year institution	4.2	0.000	8.2	0.000	0.9	0.111
	n = 120,276		n = 95,558		n = 103,664	
Attainment	**AME**	**P-value**	**AME**	**P-value**	**AME**	**P-value**
2-year degree	4.2	0.000	2.3	0.000	4.7	0.000
4-year degree	1.3	0.000	3.9	0.000	-0.4	0.341

Source: Florida Department of Education, PK-20 Education Data Warehouse; National Center for Education Statistics Common Core of Data Public School Universe; National Student Clearinghouse, Student Tracker Data.

Note: Postsecondary enrollment was measured at any time within three years of high school graduation; Postsecondary attainment was measured within four years of high school graduation, and this calculation included non-enrollees. All models controlled for race, gender, economic disadvantage status, English language learner status, gifted, physical disability, mental disability, and advanced course taking, attendance, and out of school suspensions in middle school. School measures included locale, charter, magnet, size, and racial/-ethnic composition.

Certifications prepare people for jobs in different industries, which may require different levels of postsecondary education. We examined the career clusters in which students earned certifications and the specific certifications they earned. Table 5 shows the percentage of certifications earned in different career clusters by timing of certification. For both early and later earners, Arts, Audio/Visual Technology & Communication was the most popular certification earned, but the percentage of early certification earners in that career cluster was 13 percentage points higher than the percentage of later earners (51.1% versus 38.3%). Information Technology was also a popular career cluster, with the rate of earning these certifications almost three times greater for early earners than it was for later earners (34.3% versus 13.2%). Later earners had higher rates of certifications in Health Science (20%) and Hospitality & Tourism (9%). Almost no early earners gained certification in Health Science.

Table 5

Career Clusters in which Students Earned Certifications, by timing

	Early Earners		Late Earners		Difference
Career cluster	**Number**	**Percent**	**Number**	**Percent**	**Late-Early**
Agriculture, Food, & Natural Resources	319	0.9	2,561	3.9	3.1
Architecture & Construction	2,429	6.6	3,106	4.8	-1.9
Arts, A/V Technology & Communication	18,801	51.1	25,047	38.3	-12.8
Business Management & Administration	430	1.2	1,197	1.8	0.7
Education & Training	0	0.0	910	1.4	1.4
Engineering &Technology Education	479	1.3	2,095	3.2	1.9
Health Science	101	0.3	13,303	20.4	20.1
Hospitality & Tourism	1,473	4.0	6,120	9.4	5.4
Information Technology	12,613	34.3	8,635	13.2	-21.1
Law, Public Safety & Security	1	0.0	153	0.2	0.2
Manufacturing	35	0.1	840	1.3	1.2
Transportation, Distribution & Logistics	96	0.3	1,354	2.1	1.8
Total	36,777	100.0	65,321	100.0	

Source: Florida Department of Education, PK-20 Education Data Warehouse

Next, we examined the ten specific certifications that were most frequently earned by students in each group. Table 6 lists these certifications and the number of students in each group who received them. Five certifications were most frequently earned by both early and later earners: Microsoft Office Specialist, Adobe Dreamweaver, Certified Food Protection Manager, Adobe Illustrator, and Adobe Visual Communication with Premiere Pro. Three of these certifications were in the Arts, Audio/Visual Technology & Communication cluster, and one (Microsoft Office Specialist) was in Information Technology. One (Certified Food Protection Manager) prepared people for jobs in Hospitality & Tourism.

The remaining certifications among the ten most frequently earned by early earners included Adobe Visual Communication with Photoshop, Certified Internet Web Internet Business Associate, Autodesk Certified User – Inventor, Adobe Rich Media Communication

Using Adobe Flash, and Autodesk Certified User-AutoCAD. Early earners tended to concentrate on just one or two certifications. Over half of the early earners attained a certification in either Microsoft Office Specialist or Adobe Visual Communication with Photoshop, and another 13% earned Adobe Dreamweaver certification. These other most frequently earned certifications were in Arts, Audio/Visual Technology & Communication, Architecture & Construction, and Information Technology clusters.

The later earners, who earned certifications in the last two years of high school earned a wider range of certifications in a wider range of career clusters. Their most frequently earned certification was Certified Food Protection Manager (8%). Three of their ten most frequently earned certifications were Certified Medical Administrative Assistant, Certified EKG Technician, and Certified Nursing Assistant, all of which are in the Health Sciences career cluster: Only 32 of the early earners (0.0%) attained any of these certifications.

Table 6

Ten Most Frequent Certifications Earned Early and Earned Later

	Earned early		Earned later	
Certification	**Number**	**%**	**Number**	**%**
In top 10 earned both early and later				
Microsoft Office Specialist Bundle	9,420	25.6	5,125	7.8
Adobe Dreamweaver	4,646	12.6	4,538	6.9
Certified Food Protection Manager	1,389	3.8	5,512	8.4
Adobe Illustrator	509	1.4	4,594	7.0
Adobe Visual Communication With Adobe Premiere Pro	1,625	4.4	3,460	5.3
In top 10 earned early, but not earned later				
Adobe Visual Communication With Adobe Photoshop	9,825	26.7	2,109	3.23
Certified Internet Web Internet Business Associate	2,014	5.5	1,391	2.13
Autodesk Certified User – Inventor	1,251	3.4	1,040	1.59
Adobe Rich Media Communication Using Adobe Flash	1,237	3.4	1,743	2.67
Autodesk Certified User – AutoCAD	562	1.5	1,143	1.75
In top 10 later, but not early				

Adobe - Photoshop (Creative Cloud)	0	0.0	5,047	7.7
Certified Medical Administrative Assistant	11	0.0	4,619	7.1
Certified EKG Technician	19	0.1	3,287	5.0
Certified Nursing Assistant	2	0.0	3,054	4.7
Adobe InDesign	330	0.90	2,849	4.4

Source: Florida Department of Education, PK-20 Education Data Warehouse

Conclusion

Industry certifications give people a chance to hone and exhibit job-related skills. Although business and industry associations outside of the school system define the certification requirements and develop the associated assessments, incorporating certifications into secondary schools can benefit students academically. In fact, studies have shown that earning an industry certification in high school was associated with college enrollment, persistence, and degree attainment, particularly in 2-year colleges (Giani, 2022; Glennie et al., 2021).

Florida's CAPE Act has provided opportunities for students across the state to earn nationally recognized industry credentials while in high school (Florida Department of Education, 2022). This paper used Florida's statewide longitudinal data system to track the academic progress of two cohorts of first-time 9th graders, examining the relationship between earning an industry certification and subsequent enrollment and attainment in both 2-year and 4-year colleges.

These analyses show that earning a certification in high school can do more than prepare one for a job. It may prepare students for success in both 2-year and 4-year colleges. Overall, we did not find a statistical relationship between earning a certification and enrolling in a 2-year college but did find a positive relationship with enrolling in a 4-year college. These results differ from some work on CTE and college enrollment, which suggest that CTE has a stronger relationship with 2-year enrollment and degree attainment than with 4-year enrollment and attainment (Broderson et al., 2021; Glennie et al., 2021). Even though earning a certification does not influence enrolling in a 2-year institution, it does influence 2-year degree attainment. The entry barriers to 2-year colleges are relatively low, so students planning to go to 2-year colleges may not think it necessary to earn a certification. Once there, they may have been better prepared to succeed. They may have gained problem-solving and persistence skills through their experiences earning a certification that benefited them in college. Additionally, with their experience in learning job skills, they may have been better focused on what they wanted to achieve in a 2-year college.

Although certifications are focused on acquiring and demonstrating skills related to jobs, many certifications, such as those in Informational Technology and Arts, and in Audio/Visual Technology & Communication, lead to skills that could be used in many different occupations and industries. Someone with an Adobe Photoshop certification might get a job in the communications office in a hospital, a grocery store chain, or a school district. In contrast, a Certified EKG Technician is prepared for a specific job in the Health Sciences industry. A study looking at job postings across Florida did not find Arts, Audio/Visual Technology &

Communication certifications listed as a requirement for any job even though students most frequently earned certifications in this career cluster. However, earning certifications in the Health Sciences cluster was associated with local job demand for Health Sciences (Dalton et al., 2021).

More general kinds of certifications are most frequently obtained by both early and later earners. The relatively high rates of earning this type of certification may result, in part, because they are relatively easy for schools to promote and support. They do not require special technical equipment beyond computers. In Florida, teachers are required to have the certifications for which they prepare students, and it may be easier to have teachers qualify to teach these kinds of certifications.

For early earners, the certification was positively associated with 4-year college enrollment and attainment, but not 2-year college enrollment. Early earners almost always obtained more general certifications, which provide job skills but are not targeted toward a specific occupation or industry. At the beginning of high school, some students may have planned to go to a four-year college and been less focused on getting a specific job. They may have sought a more general certification that could help them prepare for a number of jobs in different industries. Further, the certification credential could be included in college or job applications. Note that analyses were limited to those who earned certifications either in the first two years of high school or the last two years and excluded those who had earned certifications in both time periods. For these early earners, these were the only certifications they obtained in high school. They did not subsequently obtain a more occupation-specific certification.

Later earners were approaching the end of high school. Some may not have planned to go to a 4-year college, and they may have been more aware of local employment opportunities. Thus, they may have sought a credential focused on a specific job. Although many of them obtained certifications in Arts, Audio/Visual Technology & Communication, and Information Technology, a far lower rate of them did so when compared with early earners. Their certification-earning was spread across career clusters, with more later earners than early earners getting certifications in Health Science and Hospitality & Tourism. Three of their ten most frequently earned certifications were in Health Sciences and one was in Hospitality & Tourism. For later earners, certification earning was associated with enrollment and attainment in a 2-year college, but not a 4-year college. These results were similar to previous findings on the influence of CTE course taking and industry certification earning (Glennie et al., 2021).

Differences in the kinds of certification students pursue may reflect their beliefs and motivations. A limitation of this study is that we do not have information about students' reasons for pursuing certifications. It is not clear why students chose to earn a certification at all, nor how they chose the timing or the type of certification. Some may have chosen a certification that is directly linked to the occupation or industry that they plan to work in after leaving school. Some may have wanted to gain technical proficiency in certain skills even though they do not plan to use those skills in future careers, or they may have thought that earning a certification would give them a recognizable marker of success. Regardless of the specific job skills obtained, this credential may signal their ability and willingness to undertake additional work to reach a goal, which would help them on future college or job applications. Future research should examine the motivation of students and their reasons for pursuing their chosen industry certifications. Additionally, this work does not have information about any activities outside of school that may have influenced their pursuit of a certification. Studies should examine the extent to which

students learn about careers and their requirements outside of school through activities such as internship, employment, or volunteering.

This study was also limited in that available data did not include information about subsequent course taking or employment. Thus, we cannot determine whether students took courses in college that built upon the certification they earned or whether they took a job directly related to their certification. Future research should examine whether students continued their studies in the area of their certification or whether they subsequently obtained related jobs. For some students, going to a 2-year college and getting a desired job may be a better choice than going to a 4-year college. Perhaps earning these certifications helped students better discern their career goals. They may have decided to continue coursework within a career cluster and pursue related jobs. Others may have realized from working on the certification that they did not want to pursue work in that area. In either case, pursuing and earning a certification may have helped them better define their educational and occupational goals. Future research should examine students' perceptions of educational and employment possibilities and whether earning a certification changes those perceptions.

In sum, earning a certification had a significant positive association with earning both 2-year and 4-year degrees. The timing of earning the certification appears to influence the relationship between the certification and postsecondary activity. The early certification earners seem to have had different goals than later certification earners. Looking at the specific certifications earned shows that these groups did pursue different certifications, which may have reflected dissimilarities in their motivation. Even with these differences, early and later certification earners experienced college success.

Acknowledgement

This work was funded by the Institute of Education Sciences (IES), grant number R305A170222. The authors are grateful for that support and the comments of Dr. Stephen Porter. Elizabeth Glennie is the corresponding author for this article. She can be reached at eglennie@rti.org; 919.541.6434, RTI International 3040 East Cornwallis Road, PO Box 12914, Research Triangle Park, NC 27709-2194.

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