

# Stacking Educational Credentials in Ohio

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Pathways Through Postsecondary Education  
in Health Care, Manufacturing and Engineering  
Technology, and Information Technology—  
Technical Appendix

LINDSAY DAUGHERTY, JENNA W. KRAMER, DREW M. ANDERSON,  
ROBERT BOZICK

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## About This Appendix

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This is the technical appendix to the report titled *Stacking Educational Credentials in Ohio: Pathways Through Postsecondary Education in Health Care, Manufacturing and Engineering Technology, and Information Technology*, available at [www.rand.org/t/RRA136-1](http://www.rand.org/t/RRA136-1).

The study was undertaken by RAND Education and Labor, a division of the RAND Corporation that conducts research on early childhood through postsecondary education programs, workforce development, and programs and policies affecting workers, entrepreneurship, and financial literacy and decisionmaking. This study was sponsored primarily by the ECMC Foundation but was also supported by funding from the U.S. Department of Education's Institute of Education Sciences (grant number R305H190033).

More information about RAND can be found at [www.rand.org](http://www.rand.org). Questions about this report should be directed to Lindsay Daugherty at [lداughter@rand.org](mailto:lداughter@rand.org), and questions about RAND Education and Labor should be directed to [educationandlabor@rand.org](mailto:educationandlabor@rand.org).

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## Abbreviations

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CIP	Classification of Instructional Programs
HEI	Higher Education Information System
IT	information technology
MET	manufacturing and engineering technology
OTC	Ohio Technical Center

# 1. Data

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## Data Sources

To conduct this study, we relied on data from several administrative sources that are linked together in the Ohio Longitudinal Data Archive. The archive is housed at the Center for Human Resource Research, an interdisciplinary research center at Ohio State University. The data archive consists of individual-level records from state agencies that oversee kindergarten through grade 12 education, postsecondary education, and the unemployment insurance system. Individuals can be tracked across different state data systems using unique identifiers generated for this purpose. The Center for Human Resource Research provided the data to RAND with masked identifiers that were used to merge information for individuals across different files.

Higher Education Information System (HEI) files provide data on student demographics and credential attainment at Ohio's public community colleges and universities. Data on student demographics and credential attainment at Ohio Technical Centers (OTCs) are provided in a separate set of files. Using these two data sources, we constructed a student-level data file that consisted of all individuals enrolling in public postsecondary education programs in Ohio between the 2004–2005 and 2014–2015 academic years.

Because Ohio uses these data when determining where to deliver public benefits and who qualifies for state funding, the data are reported with a high degree of accuracy and fidelity. We encountered very few missing measures in the database. The exception was information related to non-credit “clock-hour” certificates reported by community colleges and universities. We know that there is some underreporting but did not have a good way to assess the severity of the missing data issue. Because of the structure of the credential attainment data, any missing enrollment records are conflated with nonenrollment, and we may be slightly underestimating the number of stackers and rates of stacking.

From these data, we defined a sample of students who had earned a certificate (as defined in the next section), and then we defined measures of stacking and credential attainment.

## Constructing the Sample of Stackers

Our focus in this report was on students who earned an initial certificate and then earned an additional certificate, associate's degree, or bachelor's degree. Ohio institutions offered two types of certificates: credit-bearing certificates (earned at community colleges and universities) and clock-hour certificates (earned primarily at OTCs). *Credit-bearing certificates* included short certificates that required fewer than 30 credit hours of coursework (often characterized as certificates less than one year) and long certificates that required 30–60 credit

hours of coursework (often characterized as 1–2-year certificates). *Clock-hour certificates* were identified as completed courses of study at the OTCs that resulted in an industry credential.

We began by constructing a sample of individuals who earned a certificate between the 2004–2005 and 2012–2013 academic years. We counted students earning either type of certificate as having earned a sub-degree postsecondary credential. These first-time certificate-earners are the population of students that we consider as being eligible to *stack* credentials (i.e., then earn one or more additional credentials).

We restricted our examination of first-time certificate-earners to students earning a certificate in one of three fields: health care, manufacturing and engineering technology (MET), or information technology (IT). We identified the field of each student’s initial certificate using two-digit Classification of Instructional Programs (CIP) codes, which are developed by the U.S. Department of Education to identify academic and technical programs at the postsecondary level. We defined each field as follows (two-digit CIP codes corresponding to fields are in parentheses):

1. Health care fields encompassed health-related knowledge and skills (34), health professions and related clinical sciences (51), and health care residency programs (60).
2. MET fields encompassed engineering (14), engineering technologies/technicians (15), and precision production (48).
3. IT fields encompassed computer and information sciences and support services (11).

## Identifying Students Who Stacked Additional Credentials

To qualify as a stacker in our study, a certificate-earner must have earned a second credential during the period of observation. We considered stacking to have occurred if a student earned another certificate (as defined earlier), an associate’s degree, or a bachelor’s degree.

We defined *stacking* as earning any type of additional postsecondary certificate or degree in any field. Conversations with key stakeholders in Ohio suggested that valuable stacking was sometimes taking place across fields (e.g., students stacking general management degrees on top of technical field-specific certificates), and we believed that it was important to capture the full picture of stacking that was taking place among certificate-earners. Findings on the degree to which certificate-earners were stacking within and across fields are presented in the main report.

Both the level of stacking and the fields of stacked credentials are outcomes we measured. In the analysis, we continued to classify students based on the field of the initial certificate, and we report whether any additional credentials earned were in the same field or a different field. We also report the highest level of credential earned, recognizing that some students will stack an associate’s degree or bachelor’s degree on top of the initial certificate.



## Constructing Cohorts

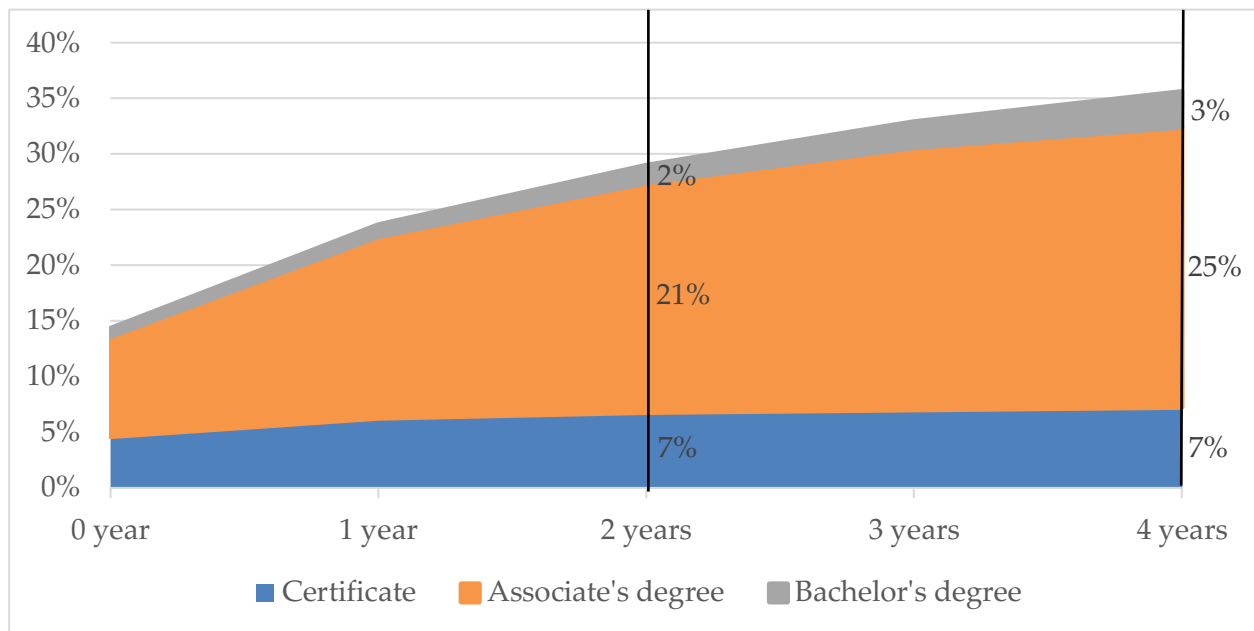
To allow us to examine trends over time, we assigned certificate-earners to cohorts based on the second year of the academic year when each student's initial certificate was earned. For example, the 2009 cohort is the pool of students who first earned a certificate in the 2008–2009 academic year.

Stacking is a dynamic process, so, to make consistent comparisons over time, we had to determine a standard time frame over which to observe students' stacking behavior. Figure A.1 shows that, among those who first earned a certificate between 2005 and 2011, approximately 30 percent had earned a second credential within two years, and approximately 35 percent had earned a second credential within four years. There are trade-offs in determining which time frame to use: Waiting four years after the initial certificate allows us to observe a more complete and representative group of stackers, including those who take breaks for employment between credentials. Limiting the time frame to two years after the initial certificate is valuable because it allows us to look at a more recent set of cohorts. To balance these considerations, we used a two-year window when examining how many and which types of students were stacking (to ensure that we could capture more-recent completers of these programs), and we used a four-year window to examine the subfields and levels of certificates completed, as well as how students progress through stackable credential programs.

These two groupings allow us to balance our analysis of stacking between observing more cohorts for a shorter period and observing fewer cohorts over a longer period. Alternatively, observing students for five or six years would increase the rates of stacking, but only slightly. Cutting off the cohorts after just one year would allow for inclusion of the 2014 cohort but would ignore a significant amount of stacking that occurs in the second year after earning a credential. Observing all students for the same period would allow for more years of observation only for earlier cohorts, making their rates of stacking artificially high.

Because our data set extended through 2015, the cohorts that can be observed for two years are the 2005 cohort (i.e., those earning first-time certificates in the 2004–2005 academic year) through the 2013 cohort. The cohorts that can be observed for four years are the 2005 through 2011 cohorts.

**Figure A.1. Percentage of First-Time Certificate-Earners Who Earned an Additional Credential, by Number of Years Between the Initial Certificate and the Additional Credential Earned and the Highest Level of Credential Earned**



SOURCE: Author calculations based on HEI and OTC data in the Ohio Longitudinal Data Archive.

NOTE: This figure presents the percentage of the 27,509 individuals who earned an initial certificate in one of the three fields between 2005 and 2011 and then earned one or more additional credentials up to four years later. We report these percentages by the number of years since completion of the initial certificate and the highest level of credential earned (another certificate, associate's degree, or bachelor's degree).

## Describing Stackers: Key Data Elements

In this section, we describe some of the key measures we used in our descriptive analysis.

### *Race/Ethnicity*

To determine whether stackable credential programs have the potential to serve a more diverse population of students, we focused on two types of underrepresented populations. We first examined black and Hispanic students, comparing the representation of these groups in certificate programs and the groups' completion rates with those of white students. We derived indicators of race and ethnicity from Ohio administrative data that defined individuals as identifying in one of nine categories: American Indian, Asian or Pacific Islander, black or African American, Native Hawaiian or other Pacific Islander, Hispanic/Latino, multiracial, nonresident alien, unknown, or white. We focused our comparisons on the three largest demographic groups: black, Hispanic/Latino, and white. Approximately 10 percent of individuals had an unknown race/ethnicity, and we excluded these individuals from our

calculations for this demographic comparison. For some subgroup analyses (e.g., credit analysis), we further collapsed these race/ethnicity groups to white and non-white.

We did not conduct formal statistical testing when comparing subgroups because we were examining the full population of individuals who stacked educational credentials at public Ohio postsecondary institutions during the period. Formal statistical testing is typically conducted when using a sample to make inferences about a larger population.

### *Age Group*

The second subgroup of interest was adult learners, which we defined as individuals aged 25 or older at the time the first certificate was earned. We constructed an indicator for age by subtracting an individual's year of birth from the year in which he or she earned the initial certificate or degree. The data consistently reported only year of birth. Day was not present, and month was inconsistently reported.

### *Institution of First Enrollment*

We identified the type of institution of a student's initial certificate as an OTC, community college, or university. The institution indicator in the administrative data uniquely identified public institutions in the state. We used a crosswalk to develop an indicator for OTC, community college, or university in our analytic data set.

### *Stacked Credentials from One or Multiple Institutions*

We identified whether individuals earned their stacked credentials at one or multiple institutions. We used credential award indicators from the administrative data to identify whether individuals earned a credential at more than one institution during the period of observation. We could not identify when individuals moved from one OTC to another OTC, so our results in this subanalysis cannot account for OTC transfers.

### *Terms of Enrollment*

We identified the number of terms of enrollment as being a count of all terms in which each student attempted credits (whether or not they earned the credits) at a public institution in the Ohio administrative data. We were specifically interested in measuring the terms of enrollment up through the term in which a student completed an associate's degree. It is worth noting that, prior to 2012, some community colleges used a quarter system, so colleges may be reporting on quarters or semesters; therefore, we count enrollment in the autumn, winter, spring, and summer terms, as defined in the administrative data. We did not have access to comparable data on terms of enrollment at OTCs, so we account for terms of enrollment only at community colleges and universities in this measure.

### *Credit Hours Earned*

We identified the number of credit hours earned based on the total credit hours earned across all semesters of enrollment at public Ohio community colleges and universities for uniquely identified individuals in the Ohio administrative data. We were specifically interested in measuring the credit hours earned through the term in which a student received an associate's degree. This measure focuses on credit hours reported by community colleges and universities because instructional hours are reported differently for OTCs and could not be converted directly to facilitate inclusion.

### **Making Comparisons with Other Credential-Earners**

To compare students who stacked credentials with students who did not stack credentials, we constructed a comparison group: students who earned an associate's degree without first earning a certificate. We restricted this group to individuals who earned an associate's degree between 2005 and 2013 and had not previously earned a certificate. We limited the fields of the degree using the same two-digit CIP codes that we used to construct the sample of certificate-earners and stackers.

## 2. Additional Findings

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Here, we include additional tables referenced in the main report. First, we examined the total number of certificates and degrees awarded each year to determine whether certificates had grown at a faster rate than degrees. We found that certificates awarded in Ohio (in any field) increased by 150 percent between 2005 and 2015, while associate’s degrees increased by 44 percent and bachelor’s degrees increased by 26 percent.

**Table A.1. Number of Credentials Awarded, by Level and Year**

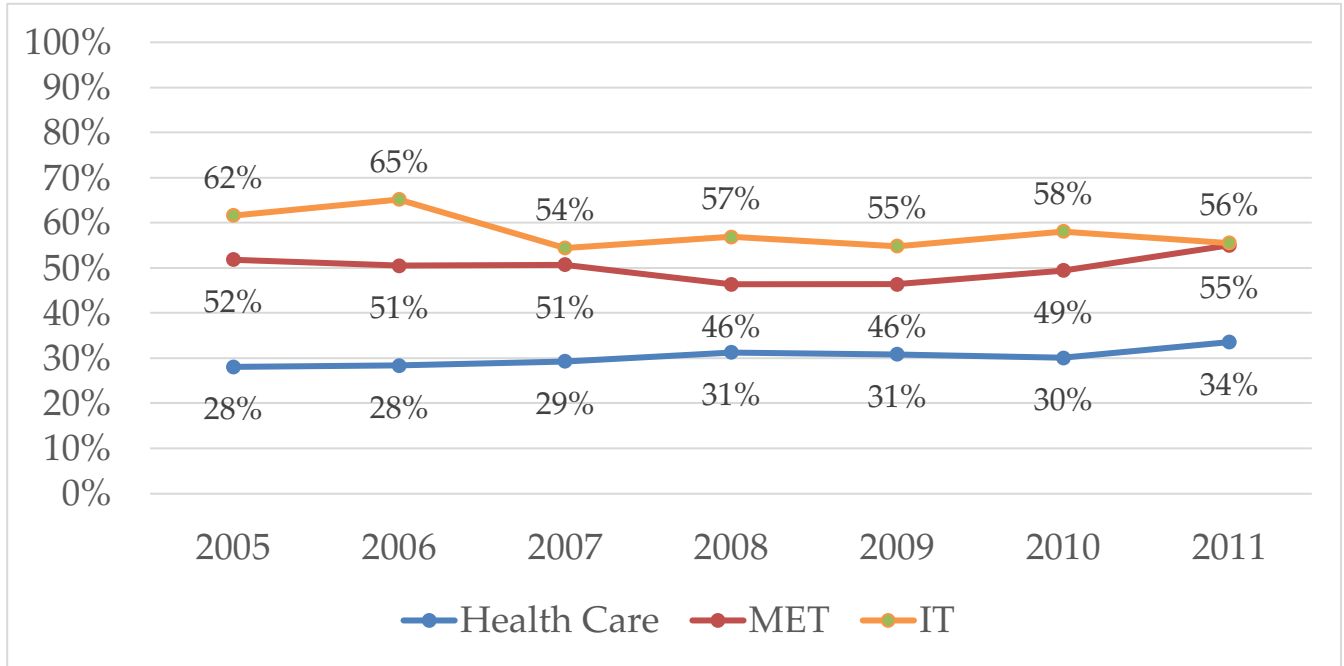
Year	Certificates		Associate’s Degrees		Bachelor’s Degrees	
	Number Awarded	Percentage Change	Number Awarded	Percentage Change	Number Awarded	Percentage Change
2005	5,694		17,849		38,668	
2006	6,268	10	18,687	5	39,643	3
2007	6,504	4	18,662	0	39,590	0
2008	6,038	-7	19,541	5	39,640	0
2009	6,629	10	19,481	0	39,738	0
2010	8,491	28	21,106	8	41,794	5
2011	8,541	1	22,560	7	44,555	7
2012	10,445	22	26,042	15	49,779	12
2013	10,956	5	24,158	-7	46,415	-7
2014	12,779	17	24,277	0	48,406	4
2015	14,239	11	25,691	6	48,915	1

SOURCE: Author calculations based on HEI and OTC data in the Ohio Longitudinal Data Archive.

NOTE: Counts reflect the total number of credit-bearing certificates, associate’s degrees, and bachelor’s degrees earned by year across Ohio postsecondary institutions. Percentage change represents the magnitude of change in a given category relative to the prior year.

In the main report, we show changes in the degree to which students stacked credentials within two years of completing an initial certificate (Figure 3 in the main report), which allowed us to follow cohorts of students who completed a certificate as late as 2013. However, we wanted to examine whether the patterns would look different if we allowed a longer window of time for stacking. Figure A.2, which follows cohorts of students who completed a certificate as late as 2011, suggests that the patterns across fields and across time were similar, although the four-year window yields smoother trends.

**Figure A.2. Percentage of First-Time Certificate-Earners Who Earned an Additional Credential Within Four Years, by Field**



SOURCE: Author calculations based on HEI and OTC data in the Ohio Longitudinal Data Archive.

NOTE: The figure presents the percentage of individuals who earned an initial certificate in each of the three fields between 2005 and 2011 and then earned an additional credential within four years. In this figure, the years represent the academic year ending in the year listed (i.e., 2005 is academic year 2004–2005). Calculations for health care are based on the following numbers of certificate-earners, by year: 2,100 (2005), 2,313 (2006), 2,910 (2007), 2,929 (2008), 3,100 (2009), 3,828 (2010), and 3,830 (2011). Calculations for MET are based on the following numbers of certificate-earners, by year: 436 (2005), 564 (2006), 678 (2007), 597 (2008), 713 (2009), 1,041 (2010), and 847 (2011). Calculations for IT are based on the following numbers of certificate-earners, by year: 185 (2005), 178 (2006), 204 (2007), 218 (2008), 206 (2009), 315 (2010), and 317 (2011).

Next, we examined the demographics (by race/ethnicity and age group) of first-time certificate-earners and stackers to determine whether there were differences among groups based on where they earned the initial certificate and where they stacked additional credentials. We found that, in most groups by initial institution and field, students who stacked credentials were generally less likely to be non-white or adult learners than first-time certificate-earners were (Table A.2). The exception was MET certificate-earners at OTCs; among this group, non-white students were better represented among stackers.

**Table A.2. Select Demographics of Stackers, by Field and Type of Institution at Which the Initial Certificate Was Earned**

	Overall		Health Care		MET		IT	
	First-Time Certificate-Earner	Stacker	First-Time Certificate-Earner	Stacker	First-Time Certificate-Earner	Stacker	First-Time Certificate-Earner	Stacker
<b>OTCs</b>								
% Non-white	14	10	13	9	27	35	17	—
% Adult learner	53	47	53	47	59	55	61	—
<b>Community colleges</b>								
% Non-white	19	18	18	18	20	19	21	18
% Adult learner	68	61	69	60	66	60	70	65
<b>Universities</b>								
% Non-white	19	15	21	20	9	8	18	12
% Adult learner	68	54	72	60	43	33	71	62

SOURCE: Author calculations based on HEI and OTC data in the Ohio Longitudinal Data Archive.

NOTE: The values in this table represent the percentages of non-white and adult learner students who earned an initial certificate in each of the three fields and overall (three fields combined) between 2005 and 2011 (first-time certificate-earners) and then earned an additional credential within four years (stackers), distinguished by the type of institution at which the initial certificate was earned. Calculations for first-time certificate-earners are based on the following numbers of students, by field and institution: 4,086 (health care, OTC), 16,179 (health care, community college), 745 (health care, university), 274 (MET, OTC), 4,440 (MET, community college), 162 (MET, university), 71 (IT, OTC), 1,318 (IT, community college), and 234 (IT, university). Calculations for stackers are based on the following numbers of students, by field and institution: 664 (health care, OTC), 5,467 (health care, community college), 281 (health care, university), 31 (MET, OTC), 2,281 (MET, community college), 132 (MET, university), 15 (IT, OTC), 755 (IT, community college), and 167 (IT, university). We do not report the results for IT stackers who earned the initial certificate at an OTC (indicated by —), because the calculations would be based on fewer than ten students.

In the main report, we examined the number of credit hours earned and terms of enrollment as measures of how efficiently students were moving through stackable credential programs. In Table A.3, we break those findings out by students who stacked credentials at the same institution and students who stacked credentials at multiple institutions. We found that students who stacked credentials at multiple institutions earned more credit hours and enrolled in more terms than did students who stacked credentials at a single institution.

**Table A.3. Cumulative Number of Credit Hours Earned and Mean Number of Terms Enrolled for Associate’s Degree–Earners, by Field, Race/Ethnicity, Age Group, and Whether the Degree Was Stacked with a Certificate at One or Multiple Institutions**

	Credit Hours Earned			Terms Enrolled		
	Stacked Credentials to the Associate’s Degree Level, Single Institution	Stacked Credentials to the Associate’s Degree Level, Multiple Institutions	Associate’s Degree Only	Stacked Credentials to the Associate’s Degree Level, Single Institution	Stacked Credentials to the Associate’s Degree Level, Multiple Institutions	Associate’s Degree Only
<b>By field</b>						
Overall	102.2	118.8	85.8	10.6	12.9	9.4
Health care	107.7	119.8	87.7	11.4	13.0	9.8
MET	93.3	121.7	81.4	9.3	13.2	8.3
IT	93.8	83.9	80.4	9.7	9.7	8.4
<b>By race/ethnicity</b>						
White	103.5	116.5	87.0	10.6	12.5	9.4
Non-white	97.1	132.4	80.6	10.7	15.0	9.4
<b>By age group</b>						
Adult learner (aged 25+)	97.4	115.8	82.3	10.7	13.7	9.7
Younger learner (aged < 25)	109.6	121.9	93.0	10.5	12.1	8.8

SOURCE: Author calculations based on HEI and OTC data in the Ohio Longitudinal Data Archive.

NOTE: The values in this table represent the average number of credit hours earned and the average number of terms of enrollment for (1) individuals who earned an initial certificate in one of the three fields between 2005 and 2013 and then earned an associate’s degree within two years at a single institution, (2) individuals who did so at multiple institutions, and (3) individuals who earned only an associate’s degree in one of the three fields (i.e., did not stack on top of a certificate) in the same time frame. Calculations for individuals who earned a certificate and associate’s degree at a single institution are based on the following numbers of students, by subgroup: 4,806 (health care), 2,256 (MET), 971 (IT), 6,315 (white), 1,371 (non-white), 4,941 (adult learner), and 3,092 (younger learner). Calculations for individuals who earned a certificate and associate’s degree at multiple institutions are based on the following numbers of students, by subgroup: 472 (health care), 62 (MET), 28 (IT), 477 (white), 83 (non-white), 287 (adult learner), and 275 (younger learner). Calculations for individuals who earned an associate’s degree without first earning a certificate are based on the following numbers of students, by subgroup: 62,958 (health care), 17,541 (MET), 8,062 (IT), 71,629 (white), 13,038 (non-white), 59,635 (adult learner), and 28,926 (younger learner).