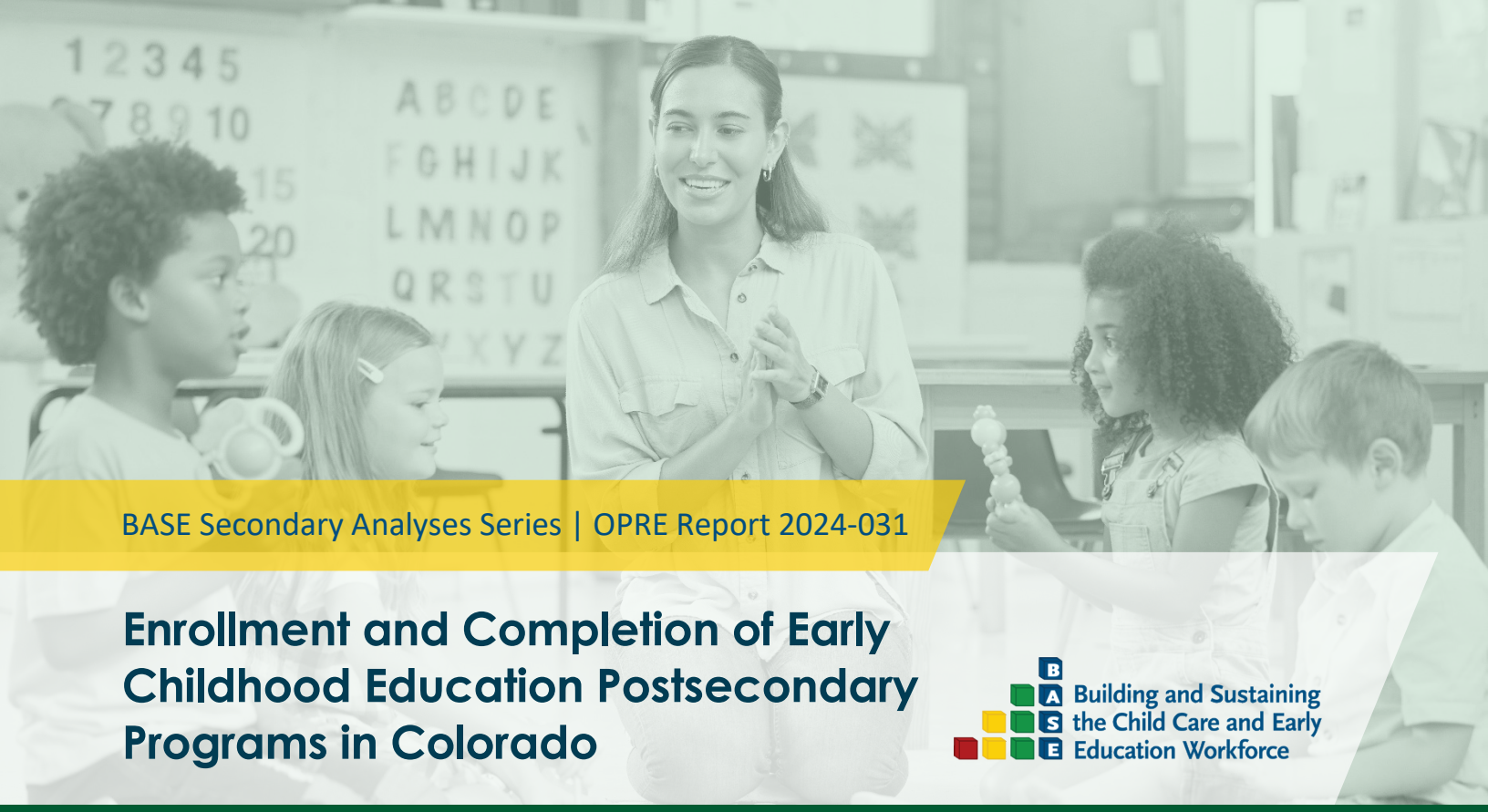

BASE Secondary Analyses Series | OPRE Report 2024-031

# Enrollment and Completion of Early Childhood Education Postsecondary Programs in Colorado

Building and Sustaining the Child Care and Early Education Workforce

Emily R. Wiegand, Shannon Guiltinan, Thao Tran, Robert M. Goerge

**Postsecondary programs in early childhood education (ECE) can provide a pathway for new educators to enter the child care and early education (CCEE) field or for the advancement and professional development of individuals already in the field.** At a time when CCEE administrators report difficulties in finding qualified applicants, the recruitment and development of educators is especially crucial.[1] Policymakers and advocates often see ECE postsecondary programs as opportunities to recruit new CCEE workers, improve the credentials of the workforce (and through that, the quality of CCEE programs), and increase wages in the industry. However, effectively addressing the challenges of the CCEE workforce in partnership with the postsecondary system requires a better understanding of how postsecondary education affects individuals' workforce experiences.

The **Building and Sustaining the Child Care and Early Education Workforce (BASE)** project aims to increase knowledge and understanding in child care and early education (CCEE) by documenting factors that drive workforce turnover and by building evidence on current initiatives to recruit, advance, and retain a stable and qualified CCEE workforce.

The Building and Sustaining the Child Care and Early Education Workforce (BASE) project aims to increase knowledge and understanding about the CCEE workforce by documenting factors that drive turnover and by building evidence on current initiatives to recruit, advance, and retain a stable and qualified CCEE workforce.[2] The project has documented limited evidence on which

[1]Roberts, Gallagher, Sarver, and Daro (2018); Bassok, Smith, Markowitz, and Doromal (2021).
[2]For more information, see: https://www.acf.hhs.gov/opre/project/building-and-sustaining-early-care-and-education-workforce-base

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strategies increase retention and recruitment and which strategies work best for different types of teachers and in different settings. There are also important gaps in knowledge about how teachers enter, stay in, and exit the field, owing to a lack of data that tracks individuals over time. This includes gaps in the knowledge base about how individuals proceed through the workforce, including how they attain credentials, and the impact of strategies to expand credential attainment.[3] A better understanding of students in postsecondary ECE programs and their education and labor force trajectories is directly relevant to the design of effective and equitable strategies that prioritize the recruitment of highly trained teachers and the ongoing professional development of the existing workforce.

This brief explores how individual-level administrative records linked across multiple state agencies can be used to observe individuals' pathways through ECE postsecondary programs, with the goal of understanding how ECE postsecondary enrollment complements work experience in developing the CCEE workforce. Using administrative data from the Linked Information Network of Colorado (LINC), the analysis explores the demographic characteristics and prior employment experiences of newly enrolled students in ECE bachelor's degree programs, and in associate's degree and comparable certificate programs in Colorado. Following these students over several years, the analysis reports on their graduation rates and post-graduation employment and wages.

This brief demonstrates both the possibilities and the challenges in examining these questions using linked data. Key findings include:

- Across ECE postsecondary programs in Colorado, the racial/ethnic distribution of the students matched the state's overall workforce.
- Students in ECE associate's degree programs and comparable certificate programs in Colorado were generally older and had prior work experience in CCEE relative to students in bachelor's degree programs.
- Only 8 percent of Colorado students enrolled in ECE associate's degree or certificate programs of similar length had completed one of those credentials within three years. Another 9 percent completed an ECE certificate requiring less than one year of credits. Of the 8 percent of students completing an ECE associate's degree or comparable certificate, a little over half were working in CCEE one year after earning their degrees, with a median annualized wage of $28,702.
- Some 21 percent of those enrolled in ECE bachelor's degree programs in Colorado graduated on time (within four years), and 43 percent graduated within six years. About three in four ECE bachelor's degree graduates were working in CCEE one year after graduation, with a median annualized wage of $32,620.

# Research Questions

This brief addresses the following research questions.

1. Who is enrolling in ECE postsecondary programs in Colorado?

[3]These knowledge gaps, and others identified through a comprehensive literature review and scan of existing strategies, are summarized in Maier and Roach (2023).

2. What percentage of ECE postsecondary students graduate? How long does it take to earn an ECE postsecondary degree?
3. Do ECE postsecondary students work in CCEE in Colorado after graduation? Are there wage increases at the time of graduation?

# Data and Methods

These analyses employed data sets created through the Colorado Early Care and Education Workforce Data Project, a joint project of the Colorado Evaluation and Action Lab (Colorado Lab) and the Colorado Department of Early Childhood.[4] The project used LINC infrastructure to combine data sets from multiple state agencies: the Colorado Department of Higher Education, the Colorado Department of Early Childhood, and the Colorado Department of Labor and Employment.

There were two primary postsecondary data sets: degrees and enrollments. The degree file included all students who received a certificate, degree, or formal award approved by the Colorado Department of Higher Education between the spring of the 2009–2010 academic year and the fall of the 2020–2021 academic year, and it included both student and degree characteristics. The enrollment file included end-of-term enrollment data on all students enrolled in Colorado public, postsecondary education institutions and participating private institutions between the spring of the 2009–2010 academic year and the fall of the 2020–2021 academic year, including student and program characteristics.

These datasets were matched to all individuals in Colorado's Unemployment Insurance (UI) wage records from the Colorado Department of Labor and Employment using Social Security numbers.[5] UI wage records identify quarterly wages paid by employers who are required to report to the state UI system, including over 90 percent of all jobs.[6] These records also show quarterly earnings at the individual level by employers' industry codes in the North American Industry Classification System. The wage data covers the first quarter of 2010 through the third quarter of 2020.

Finally, a population of postsecondary ECE graduates was matched against a data set of educators compiled from the Colorado Shines Professional Development Information System, a workforce registry. These registry data included individuals actively working in CCEE in Colorado in 2019 or 2020 and were used to provide information on their professional roles.[7]

## Cohort Selection

This analysis defines two entry cohorts to explore the pathways from ECE postsecondary programs to CCEE careers based on the types of degree programs in which students enrolled. Enrollment in an ECE program

[4]LeBoeuf, Perrin, and Kennedy (2020).
[5]Fewer than 3 percent of Colorado Department of Higher Education post-secondary records did not include a Social Security number.
[6]Abowd, et al. (2009).
[7]Individuals working in family child care homes have the role "family child care home provider." Individuals in center-based settings have more specific roles including director, lead teacher, assistant teacher, specialized leadership, and floating class support. "Specialized leadership" includes assistant directors and special educators. "Floating class support" includes substitute teachers and paraprofessionals. Individuals with multiple roles are classified according to their most senior role.

is identified using program Classification of Instructional Programs (CIP) codes from the National Center for Education Statistics.[8]

The first entry cohort is comprised of students who were newly enrolled in a bachelor's degree program between fall 2012 and fall 2013, with no prior enrollment in a bachelor's degree program in the previous three years. These students could have started their bachelor's program with an undeclared major or in a non-ECE field of study, but were enrolled as an ECE major at some point by fall of 2019. Outcomes for this cohort are complicated by the fact that colleges and universities in Colorado were prohibited from offering bachelor's degrees in ECE until spring 2012, so the students from this cohort likely represent the earliest students enrolled in new university ECE programs.[9] The entry cohort years (fall 2012 through fall 2013) were selected for the analysis in order to observe graduation within six years and employment one year after graduation. Including any student (from the 2012 and 2013 cohorts) who was in an ECE bachelor's degree program at any point between fall 2012 and fall 2019, whether or not ECE was their first or final area of study, allows for the inclusion of students who entered college while ECE programs were still being designed who later opted into these new majors. There were 246 individuals in the bachelor's degree cohort.

The second entry cohort includes students who were newly enrolled in an ECE associate's degree program or in an ECE certificate program requiring at least 30, but less than 60 credit hours (generally, more than one and less than two years of full-time enrollment). This cohort enrolled between fall 2015 and fall 2016, and had no prior enrollment in any ECE postsecondary program in the previous three years. This is the most recent associate's/certificate program cohort for which the data can describe three-year graduation rates followed by employment one year after graduation. Most of this cohort (77 percent) were enrolled in ECE associate's degree programs; the remaining 23 percent were enrolled in the ECE certificate degree program. The analysis combines these two degree types because the enrollment length is similar between programs and many of the requirements overlap. In addition, if these populations were analyzed separately, many results would not be available for the certificate program because of sample size limitations and the data providers' restrictions against disclosure. There were 1,604 individuals in this cohort.

## Stable employment and stable wages

Where this brief discusses quarterly wages, the aggregate values are limited to wages from stable (also known as full quarter) employment. Individuals have stable employment in a quarter if they were employed in that quarter as well as in the previous and the following quarters. The wages they earned in that quarter of stable employment are full quarter wages, since it represents wages earned over the course of the entire quarter. Without this restriction, aggregate wage data might include values representing partial quarter employment, such as total wages earned in quarters where individuals started or ended jobs.

[8]Specifically, the CIP codes used for this analysis include Child Care and Support Services Management (CIP code = 19.0708), Child Care Provider/Assistant (CIP code = 19.0709), Child Development (CIP code = 19.0706), Early Childhood Education and Teaching (CIP code = 13.1210), and Education/Teaching individuals in early childhood special education programs (CIP code = 13.1015).
[9]Colorado Early Childhood Leadership Commission (2013).

# Findings

## Research question 1: Who is enrolling in ECE postsecondary programs in Colorado?

**Among students in Colorado's ECE postsecondary programs, about 60 percent were White and 20 percent were Hispanic,** as shown in Table 1. This percentage of students who are White may be compared to 68 percent of the overall workforce and 57 percent of the CCEE workforce.[10] About a fifth of individuals in each cohort were Hispanic, compared to 21 percent of the Colorado workforce and 22 percent of the Colorado CCEE workforce.[11] The racial and ethnic breakdown of the two cohorts is very similar.

**Table 1.** Demographics by Cohort

| Demographic | Bachelor's Degree Cohort | Associate's Degree/ Certificate Program Cohort |
|---|---|---|
| **Race/ethnicity (%)** | | |
| Hispanic (any race) | 19.5 | 21.1 |
| White, non-Hispanic | 61.4 | 60.2 |
| Black, non-Hispanic | - | 6.7 |
| Asian, non-Hispanic | - | 2.1 |
| American Indian, Alaska Native, Hawaiian, or Pacific Islander, non-Hispanic | - | 1.1 |
| Two or more races | - | 4.3 |
| Race/ethnicity unknown | 7.7 | 4.6 |
| **Age at enrollment** | | |
| <=20 years old | 62.2 | 21.0 |
| 21-24 years old | 11.0 | 17.5 |
| 25-34 years old | 17.1 | 31.5 |
| >=35 years old | 9.8 | 29.9 |
| **Worked in child care and early education in the year prior to enrollment** | 18.8 | 46.7 |

SOURCE: Author's calculations based on Linked Information Network of Colorado data.

NOTES: Several race/ethnicity categories (as indicated by "-") were too small in the bachelor's degree cohort to satisfy the data provider's disclosure requirements, so exact numbers could not be exported. However, the combined total of non-Hispanic Black/Asian/American Indian or Alaska Native/Hawaiian or Pacific Islander/two or more races individuals is 11.4 percent of the bachelor's degree cohort.

To calculate age at entry a proxy birthdate was created based on a field that indicated age at the time of the data extract. This approach had limited precision but estimates of students' ages should be accurate to within about one year.

Percentages may not add up to 100 because of rounding errors.

**Almost half of the students in ECE associate's degree and certificate programs had worked in the CCEE field in Colorado in the year prior to their enrollment, and a majority of these students were over the age of 25 at their first enrollment.** Students in the bachelor's degree cohort looked somewhat more traditional, a term usually used to refer to students who enroll in postsecondary education immediately after graduating

[10]LeBoeuf, Perrin, and Kennedy (2020).
[11]LeBoeuf, Perrin, and Kennedy (2020).

from high school, who attend school on a full-time basis, and who are not supporting themselves financially while in school.[12] For example, fewer than a fifth had worked in CCEE prior to their first enrollment, and more than 60 percent of them were 20 or younger at first enrollment.

## Research question 2: What percentage of ECE postsecondary students graduate? How long does it take to earn an ECE postsecondary degree?

**The graduation rate for individuals in the ECE bachelor's degree cohort is 21 percent within four years and 43 percent within six years.** For comparison, across four-year public universities in Colorado, 62 percent of individuals in bachelor's degree programs from a comparable cohort graduated within six years.[13] Sixteen percent of the students from the ECE bachelor's degree cohort who earned a bachelor's degree within six years earned it in a field other than ECE (since students who were enrolled in ECE at one point but later changed programs before graduating were still included in the cohort).

**Only 8 percent of the ECE associate's degree and certificate programs cohort earned one of these degrees within three years of enrollment.** Six percent of the cohort earned a degree in the original program of enrollment, while another 2 percent of the cohort that was initially enrolled in the associate's degree program completed a certificate of comparable length (requiring more than a year's worth of credits) during the three-year follow-up window. Many of the requirements between these programs overlap, so these students could still complete the associate's degree at a later date. These rates are significantly lower than the statewide associate's degree and certificate program graduation rate from two-year public institutions in Colorado, which was 16 percent within three years of enrollment.[14]

Figure 1 summarizes outcomes for the full associate's degree and certificate programs cohort three years after the start of enrollment. In addition to the 8 percent of the cohort completing their original degree or another comparable certificate, another 9 percent of the cohort earned an ECE certificate requiring less than one year's worth of credits (<30 credits). Most of the cohort (83 percent) did not earn an ECE associate's degree or any ECE certificate within the three years following enrollment.

[12]U.S. Department of Education (2002).
[13]Colorado Department of Higher Education (2018).
[14]Colorado Department of Higher Education (2018).

**Figure 1.** Degree Status of Associate's Degree and Certificate Cohort Three Years After the Start of Enrollment


SOURCE: Author's calculations based on Linked Information Network of Colorado data.

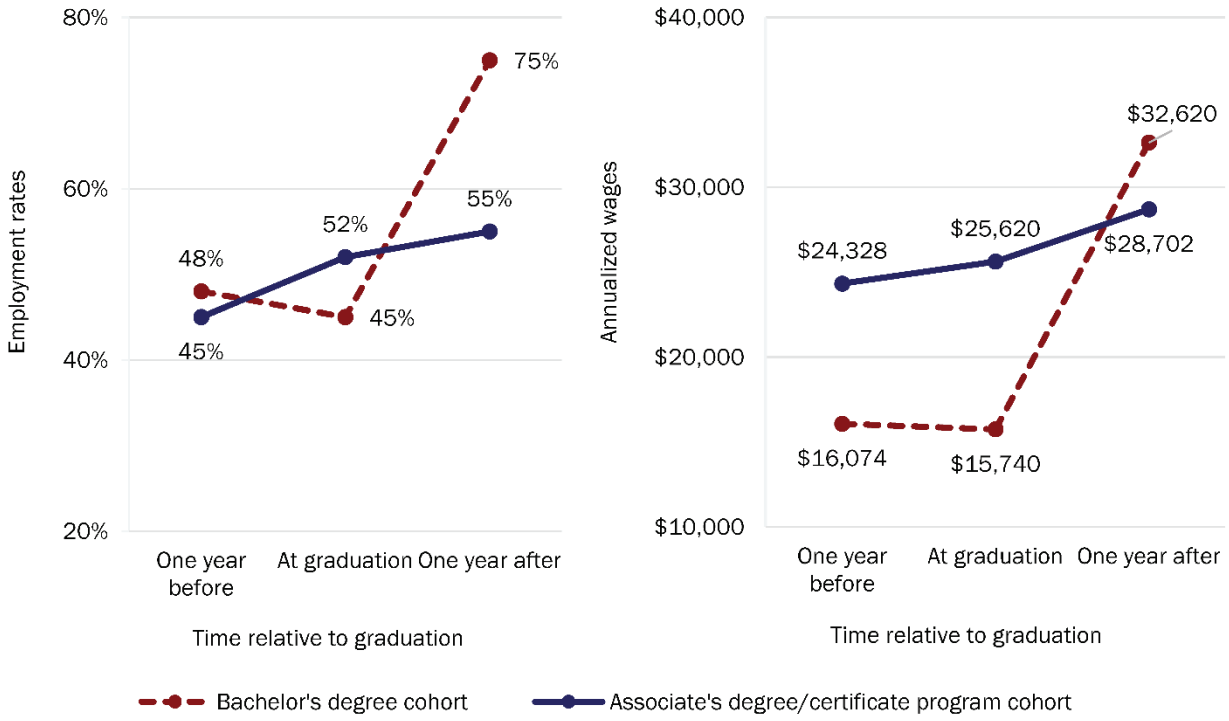
NOTES: A small number of students earned a bachelor's or master's degree in ealy childhood education (ECE) within three years. However, this group was not large enough to meet disclosure requirements and given the requirements for a bachelor's or master's degree it is likely that a student in this cohort who is able to complete one of those degrees within three years of entering an associate's or certificate program came in with transfer credit and was not accurately characterized in this entry cohort. These students are included in the population that did not earn an associate's degree or certificate in ECE in this figure.

Percentages may not add up to 100 because of rounding errors.

# Research question 3: Do ECE postsecondary students work in CCEE in Colorado after graduation? Are there wage increases at the time of graduation?

**Three-quarters of ECE bachelor's degree recipients began or continued employment in the CCEE field in Colorado one year after earning degrees.** Of the 88 students in the bachelor's cohort who graduated with their degree within six years, fewer than half were working in CCEE one year before graduation and at the time of graduation, while 75 percent were working in CCEE one year after earning their degrees. (See Figure 2.)

**Figure 2.** Child Care and Early Education (CCEE) Employment Rates and Annualized Wages for Early Childhood Education (ECE) Graduates




SOURCE: Author's calculations based on Linked Information Network of Colorado data.

NOTES: Employment status is presented for the 88 students from the bachelor's degree cohort who received a bachelor's degree in ECE within six years of enrollment and for the 128 students from the associate's degree and comparable certificate cohort who earned one of those degrees within three years of enrollment. The employment rate is the percentage of students who earned any wages from a CCEE employer in a given quarter. Annualized wages report the annualized version of the median quarterly wages for all individuals who had full quarter employment in CCEE in Colorado in a given quarter. One year before graduation, this group includes 32 individuals from the bachelor's cohort and 40 individuals from the associate's cohort. At the time of graduation, it includes 24 individuals from the bachelor's cohort and 52 individuals from the associate's cohort, and one year after graduation, it includes 51 individuals from the bachelor's cohort and 59 individuals from the associate's cohort.

**Only 55 percent of ECE associate's degree or certificate recipients began or continued employment in the CCEE field in Colorado one year after earning their degrees.**[15] As with the bachelor's cohort, the share of graduating students employed in the field increased over the year prior to and immediately after graduation, with 45 percent of these students employed in CCEE one year prior to graduation (comparable to the 47 percent of the cohort that was employed in CCEE in the year before enrollment, shown in Table 1) and 52 percent were employed at the time of graduation.

**Median annualized wages one year after graduation were $28,702 for ECE associate's degree or certificate graduates working in CCEE in Colorado and $32,620 for ECE bachelor's degree graduates working in CCEE in Colorado.** As shown in Figure 2, one year before graduation and at the time of

[15]Note that the denominator for employment and earnings outcomes for this population includes only those students who earned associate's degrees or certificates of comparable length, the degrees that were used to define this cohort, within three years of enrollment (N=128). Individuals who originally enrolled in one of these programs but received only a certificate requiring less than one year's worth of credits are not included in the denominator for these analyses.

graduation, median quarterly wages for individuals in the bachelor's degree cohort working in CCEE were equivalent to about $16,000 annually, while they were over $24,000 for comparable individuals from the ECE associate's degree and certificate cohort. This may be because students in bachelor's programs work fewer hours while in school.

**Individuals from the associate's degree and certificate cohort who could be observed in Colorado registry data three to four years after enrollment were frequently in Director roles.** The research team matched the full ECE associate's degree and certificate cohort to the Colorado workforce registry to determine what roles these individuals had in CCEE settings three to four years after their initial enrollment in an ECE postsecondary program. Those individuals who earned associate's degrees or comparable certificates from ECE programs could be matched to CCEE employment in the registry 58 percent of the time, which is similar to the CCEE employment rate shown in the wage data for this population. However, 57 percent of those who could be linked to the registry were matched to records with Director roles, despite the relatively low wages and limited wage growth demonstrated in Figure 2. Also, while only one-fourth of the individuals who did not receive an ECE associate's degree or certificate within three years of enrollment could be found in the registry data three to four years after enrollment, 44 percent of those that were found were also working as Directors. (See Table 2.)

**Table 2.** Number and Percentage of Associate's Degree/Certificate Cohort Matched to Registry and in Director Role in Fall 2019

| Population | Number of People in Population | Number (Percentage) Matched to Registry | Number (Percentage of Those Matched to Registry) in Director or Specialized Leadership Role |
|---|---|---|---|
| Received early childhood education (ECE) associate's degree or comparable certificate | 128 | 74 (58%) | 42 (57%) |
| Received an ECE certificate requiring <1 year's worth of credits | 140 | 69 (49%) | 18 (26%) |
| Did not receive an ECE associate's degree or any certificate | 1,336 | 324 (24%) | 141 (44%) |
| **Total** | 1,604 | 467 (29%) | 201 (43%) |

SOURCE: Author's calculations based on Linked Information Network of Colorado data.

Note that this brief does not include a comparable analysis for the ECE bachelor's degree cohort because of sample size limitations.

# Implications and Conclusions

Using the Colorado LINC data, this brief presents an initial analysis on the pathways of ECE postsecondary enrollment to graduation with an ECE degree and to employment in the CCEE field. The brief includes two cohorts of newly enrolled ECE students in Colorado—those in a bachelor's degree program and those in an associate's degree or comparable certificate program.

Ultimately, strategies to strengthen and grow the CCEE workforce require an understanding of when and how individuals attain credentials and how these credentials impact recruitment, retention, advancement,

and compensation. Across credentials, the existing evidence base on the relationship between professional development for CCEE educators and their professional advancement is limited and suggests complexity. Parents appear to value educational attainment in selecting their children's caregivers.[16] However, at least one resume audit study suggests that when educators' credentials or experience exceed state requirements those characteristics may not increase their likelihood of being interviewed or hired, possibly because employers view more qualified applicants (such as those with bachelor's degrees) as too expensive.[17] There is also evidence that increasing education requirements may reduce diversity in the field by creating barriers to entry. [18] (An outcome that is closely related to barriers to higher education among individuals from historically marginalized backgrounds.) Black and Hispanic applicants already appear to receive fewer interview requests for CCEE jobs than White applicants.[19]

The findings from this analysis of ECE bachelor's degree program participants in Colorado suggests some evidence of a pipeline for bringing new workers into the field. These programs engage young individuals (a majority of them under the age of 20), many of whom do not have prior work experience in CCEE. Three-quarters of ECE bachelor's degree graduates in Colorado go on to work in CCEE one year after graduation. However, less than half of the students in the ECE bachelor's degree program graduate within six years, a rate nearly 20 percentage points below the median six-year bachelor's degree graduation rate in Colorado. Median wages for those who graduate and are working in CCEE one year after graduation are about $32,600. A Colorado Department of Higher Education Dashboard shows median earnings of $37,152 for education majors roughly one year after earning their degrees, suggesting that initial wages for ECE degree earners are somewhat lower than their educator peers.[20]

Additional analyses on outcomes for ECE bachelor's degree graduates in the years after they graduate, especially in comparison to peers of similar ages who enter the CCEE field without the bachelor's degree credential, would further clarify the value of this credential. How do the individuals who enroll in bachelor's programs differ from those who enter the workforce directly? How do the early and mid-career trajectories of these individuals, especially their earnings, advancement, and retention, differ? Furthermore, how do patterns of credential attainment and subsequent career outcomes differ by race and ethnicity? A report on Colorado's CCEE workforce in 2019 found that Hispanic CCEE professionals were less commonly in Lead Teacher or Director roles compared with White professionals (41 percent of Hispanic professionals in CCEE were in these roles compared to 52 percent of White professionals), suggesting potential disparities in advancement by race or ethnicity. [21]

The Colorado ECE associate's degree and certificate cohort analysis discussed in this brief describes a very different population. The majority of the cohort is comprised of nontraditional students over the age of 25, almost half of whom were working in CCEE in the year prior to enrollment. Again, the graduation rate for this cohort (8 percent within three years) is low—only half of the overall graduation rate for associate's degrees (16 percent within three years) in Colorado. The National Association for the Education of Young Children (NAEYC) collects graduation rates from accredited ECE degree programs nationwide. Among

[16]Gordon, Herbst, and Tekin (2021).
[17]Boyd-Swan and Herbst (2018).
[18]Zinsser, Main, Torres and Connor (2019).
[19]Boyd-Swan and Herbst (2019).
[20]Colorado Department of Higher Education (2021). Note that this calculation reflects graduates from 2004 to 2019 and is calculated as the inflation-adjusted median of earnings between the students' third through sixth quarters after graduation for students who met or exceeded the minimum wage threshold.
[21]LeBoeuf, Perrin, and Kennedy (2020).

accredited associate's degree programs (representing about 18 percent of all programs), NAEYC found a median of 15 percent of full-time candidates completed the program within three academic years. However, while these graduation rates only included full-time students, NAEYC reported that about 75 percent of ECE graduates across all degree programs (including bachelor's degrees) had been enrolled part time and could take as long as four to eight years to earn an associate's degree.[22]

These results reaffirm that many individuals who enroll in ECE associate's degree and certificate programs are not students going into postsecondary training directly from high school and completing degrees prior to entering the workforce; they are more likely individuals seeking professional development opportunities. However, the analysis of employment and earnings outcomes for ECE associate's degree and certificate earners in Colorado presented in this brief showed only limited increases in CCEE employment rates and wages for degree recipients. In the year before graduation, 45 percent of graduates were working in CCEE in Colorado with median annualized earnings of $24,328; a year after graduation, 55 percent were working in CCEE in Colorado with median annualized earnings of $28,702. A review of registry data does suggest that these individuals were frequently in Director roles in their first few years after receiving their credentials, but students who enrolled in ECE programs and did not graduate were also reflected in the Director role at high rates. Because Colorado's registry data are only comprehensive since 2019, this analysis cannot address whether individuals who are already in Director roles were more likely to enroll in postsecondary programs or if certain degrees provide pathways to the Director role.

A better understanding of how ECE associate's degrees and certificates factor into CCEE workforce growth and advancement needs to start with the professional development pathways that Colorado's ECE policies and employers expect of the workforce. For example, early education staffing requirements in Colorado do not necessarily culminate in a degree. There are multiple combinations of postsecondary credentials, ECE credits, certifications, and classroom experience that would enable a CCEE worker to meet the professional preparation requirements needed to work in a classroom, as set forth in the Colorado Preschool Program Act and enforced by the Colorado Department of Human Services. Early childhood credentials are also stackable. For example, students in the ECE associate's degree program can earn Early Childhood Assistant Teacher, Early Childhood Teacher, and Early Childhood Director certificates as they progress through their coursework. Earned certificates and educational credits can have labor market value even if the student has not completed the degree. In some cases, students may start with one program and exit with another credential as there are many overlapping course requirements across different ECE programs.[23] A more detailed look at course enrollment, informed by longitudinal information about individuals' contemporaneous or prior employment and their roles, would be better able to describe when credentials are sought and how they impact educators' career trajectories.

In the absence of more detailed information about specific courses and credentials, a next step for analyses in this area would compare employment outcomes across the full cohort, including both graduates and non-graduates. There may be other characteristics, such as age or experience, that

[22]National Association for the Education of Young Children (2021).
[23]For a description of how formal education, other professional development, experience, and demonstrated competencies can jointly contribute to professional credentialing in CCEE in Colorado, see Colorado Shines Professional Development System,"Early Childhood Professional Credential 3.0 Scoresheet" (website: https://decl.my.salesforce.com/sfc/p/#o0000000IHut/a/5c000000V2gF/MH7pZzmyXdGDaA1add_75hbHlGg7pOd20V3D_eBxqVk, 2021). Colorado university websites provide information about how credentials are attained as individuals progress through associate's degrees and similar programs. See for example Front Range Community College (2023).

distinguish these populations and their outcomes. Further research into the specific longitudinal employment and enrollment patterns of the ECE associate's degree and certificate program populations could also help better illuminate how the workforce engages with these credentials. To what extent are individuals working or enrolled continuously, as opposed to churning in and out of either the workforce or the classroom? Are there common patterns? What can be learned about wage growth or career advancement (measured by changes in CCEE role) at the individual level? While median wages and employment rates for this cohort were relatively flat around the time of graduation, there may be subpopulations of students who demonstrate more pronounced advancement trajectories.

Across both cohorts, these analyses demonstrate the potential of linked administrative data to describe how CCEE career pathways and postsecondary credentials connect. These analyses also highlight the complexity of CCEE career pathways and the need for the field to clearly articulate how credentials, in conjunction with experience, are intended to develop the workforce, as well as what incentives exist to further that growth. In addition, analyses on larger populations are needed to better understand how the relationship between credentials and career growth potentially differs by race and ethnicity.

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