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# A Profile of Career and Technical Education Teachers in the 21st Century

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**Abstract**
Though Career and Technical Education (CTE) teachers are pivotal to students' academic and career outcomes, research describing CTE teachers remains scant. In this study, we use nationally-representative data to describe changes in the nation's CTE teacher workforce during a period of significant policy changes. Today's CTE teachers are more frequently credentialed and more racially and ethnically diverse than in the past, though still less diverse than non-CTE teachers and far less diverse than the nation's students. Women now comprise a majority, diversifying a historically male-dominated field. CTE teachers turn over at rates similar to the general teacher workforce, though novice teachers are more likely to turn over. We conclude by recommending future avenues of CTE teacher research and policy development.

**Keywords**: Career and technical education, CTE teachers, teacher turnover, teacher characteristics, high school

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Few factors are more influential in students' educational experiences than the quality of their teachers (Chetty et al., 2014; Jackson, 2018; Kraft, 2019). Yet, despite an extensive research literature on teachers, career and technical education (CTE) teachers, who comprise an increasingly prominent component of the secondary education labor force, have received scant research attention (Anglum et al., 2023; Chen et al., 2023, Theobald et al., 2023). Though a mounting body of evidence underscores factors predicting teacher quality and retention (Ingersoll et al., 2018; Nguyen et al., 2020), the national CTE teacher workforce requires similar scholarship pertaining to trends in its demographic, professional, and turnover characteristics to inform contemporary educational policymaking and practice.

CTE has long served a prominent, yet evolving role in America's high schools. For years, CTE, historically referred to as 'vocational education,' often was saddled with a stigma from its association with tracking, in which certain student groups (especially racially minoritized students, women, and students with disabilities) were placed on a vocational track rather than a college-preparatory track (Anderson, 1982; Clifford, 1982; Oakes, 1983). While some recent evidence suggests that tracking practices have significantly diminished (Giani, 2019), past iterations of vocational education often led to relatively low-paying and low-status jobs, inhibited access to postsecondary education, and closed doors for students in ways that contributed to educational and economic inequality (Bowles & Gintis, 1976; Grubb & Lazerson, 1982). In the 1990s and early 2000s, America's public high schools focused increasingly on college preparation, with many states changing their high school graduation requirements to align with college entry requirements (Mishkind, 2014; Rosenbaum, 2021). With this shift, vocational education also evolved, with the change in name from "vocational education" to "CTE" symbolizing a new chapter that aimed to be high-rigor, high-quality, increasingly STEM-

focused, and oriented to prepare students for both career *and* college (Dougherty & Lombardi, 2016).

Today, CTE has adopted a more accessible, equitable, applied, and preparatory role in America's public high schools, with the U.S. Department of Education estimating that 85% to 90% of secondary students take at least one CTE course over their high school tenure (Hudson, 2014; Levesque et al., 2008). Moreover, these students are disproportionately rural, lower-income, disabled, and lower-academically performing (Ecton, 2023; NCES, 2020). Given that these student populations have lower academic and economic outcomes, on average, a detailed portrait of CTE instruction and instructors is crucial for equitable access to CTE.

Yet, scant research has been devoted to high school CTE teachers, especially from quantitative researchers, with the exception of two recent studies which highlight the importance of a deeper understanding of the CTE teacher workforce. First, in Massachusetts, Chen and colleagues (2023) found that CTE teachers' licensure exam scores were positively linked to student earnings five years after expected high school graduation, providing some of the first large-scale quantitative evidence connecting CTE teacher characteristics to their students' outcomes. Second, in Washington, Theobald and colleagues (2023) found that CTE students performed better (in non-testing outcomes including absences, discipline, course grades, and on-time graduation) when they had CTE teachers who entered the classroom directly from industry experience, compared to otherwise similar students with teachers from formal teacher preparation programs. This research suggests that CTE content area skills, knowledge, and experience may be as – or even more – important than traditional teacher preparation in preparing CTE students for success. We aim to expand this evidence base through our use of

nationally-representative data, which is especially important given that cross-state CTE studies (Goldring et al., 2021; Urban et al., 2022) have found stark differences across state settings.

Understanding who teaches high school CTE courses and their characteristics may help illuminate issues of equity in access to CTE. Growing evidence points to the potential for CTE to increase high school attendance and graduation (Dougherty, 2018; Hemelt et al., 2019; Plasman & Gottfried, 2020), improve early-to-mid-career earnings and employment (Brunner et al., 2021; Kemple & Willner, 2008; Kreisman & Stange, 2020), strengthen two-year college-going (Cellini, 2006; Theobald et al., 2019), and to decrease the likelihood of poverty and disengagement from school and work (Ecton & Dougherty, 2023).

Still, evidence also indicates heterogeneous CTE benefits across student populations (Ecton & Dougherty, 2023; Kelly & Price, 2009). Most notably, studies consistently find stronger returns to CTE for men than women (Brunner et al., 2021; Dougherty & Ecton, 2021; Hall, 2016). Given research that students are especially successful when exposed to teachers who share their characteristics (e.g., race, gender; see Dee, 2005; Gershenson et al., 2022; Lindsay & Hart, 2017; Redding, 2019), it is important to understand the composition of the CTE teacher workforce in order to ensure equitable access, and to identify any areas where the composition of the CTE teacher workforce may limit some students' ability to reap its benefits.

In this paper, we use multiple waves of nationally-representative data to better understand the U.S. high school CTE teacher workforce. We examine how the characteristics and turnover behaviors of high school CTE teachers changed from 2004 to 2018, a period during which CTE underwent a reinvention, became a part of the nation's college and career readiness agenda, and increasingly emphasized applied STEM coursework (Dougherty & Lombardi, 2016; Plasman et al., 2020). We aim to inform policymakers as they work to recruit and retain CTE teachers, and

identify areas where additional research remains necessary. Specifically, we ask the following research questions:

(1) How have the demographic characteristics and qualifications of CTE teachers changed in the 21st century?

(2) To what extent are CTE teachers more likely to turn over (i.e., move schools or leave the profession) than non-CTE teachers? What factors predict the turnover of CTE teachers?

In addressing these questions, we provide the most up-to-date and comprehensive profile of CTE teachers in the 21st century as well as initial evidence on CTE teacher mobility. In the next section, we provide an overview of the literature on CTE teachers. Then we describe our data and empirical approach, and we discuss our findings. As a preview, we find many substantial changes in the CTE teacher workforce in the 21st century, while some characteristics remain fairly steady. While some demographic changes in the CTE teacher workforce reflect broader shifts in the overall teacher workforce, CTE teachers' demographic characteristics remain substantially unrepresentative of the students they teach. Moreover, while we find there were more novice CTE teachers in the workforce by 2018 relative to 2004, we do not find CTE teachers, on average, are more likely to turn over than non-CTE teachers. These findings have important implications for the recruitment and retention of CTE teachers, particularly for the distribution and equitable access to highly qualified CTE teachers.

## Related Literature

In recent decades, secondary CTE policy has evolved to prioritize career and college readiness, academic rigor, and applied STEM. Despite this shift, a large knowledge gap remains concerning both CTE teacher characteristics and their retention in the classroom. Most evidence about CTE teachers comes from subgroup analyses in studies of general or traditional subject

teachers; this complicates defining and measuring success in the CTE teacher labor force, given CTE's aims to prepare students for both college *and* career (Rosen et al., 2018). Consistently, these studies find traditional academic subject teachers themselves test higher and have more teaching experience than CTE teachers (Clotfelter et al., 2006; Kini & Podolsky, 2016; Ladd et al., 2015), signaling, that CTE teachers may be "lower quality," at least according to commonly-used metrics of teacher qualification.

However, there are reasons to exercise caution in generalizing our understanding of what predicts teacher "quality" for CTE teachers, given the unique student population and their many different post-high school goals. For example, CTE teachers are asked to prepare students for a diverse range of "successful" outcomes, including entering bachelor's degree programs after high school, beginning careers immediately after (or even while) in high school with industry-recognized credentials, or returning to school for additional training after a period of work (Hodge et al., 2020; Plasman et al., 2021; Sublet & Plasman, 2018). CTE teachers are also asked to make connections between the classroom and workforce, to stay up-to-date on industry and technology trends, and to help students network for work-based learning experiences as well as jobs. All of this may lead to differences in the nature of quality instruction and preparation for CTE teachers, and may suggest the need for a nimble CTE teacher workforce. CTE teachers may also differ from vocational education teachers of previous eras, given shifts in the nature of CTE program offerings.

Most of the contemporary literature on teacher preparation is based on academic subject teachers. However, while many non-CTE teachers matriculate through educator preparation programs, many CTE teachers also emerge directly from the industry they will teach (Chen et al., 2023; Dalton et al., 2021). For example, nursing CTE instructors may have prior employment

experience in nursing, but may have limited (or in some contexts, no) training in pedagogy, a factor which may relate to their successful recruitment, retention, and student success.

Given their industry expertise, CTE teachers may have increased alternative employment options, some of which offer compensation premiums, particularly relative to the alternative career options of non-CTE teachers. In fact, CTE teachers most frequently cited salary (in comparison to earning potential in non-teaching jobs) when asked why they would *not* recommend a teaching career to their students (Kosloski et al., 2022). Additional barriers to becoming and remaining a CTE teacher include requirements to earn a master's degree within a certain number of years. Policymakers might prioritize learning more about teachers with industry backgrounds, given findings from Washington that such teachers produce stronger non-testing student outcomes (e.g., attendance, discipline; Chen et al., 2023).

While research about CTE teacher characteristics and retention remains limited, we draw upon a robust literature about teachers more generally. Teacher attrition has long posed a challenge to the sustained health of the teacher labor force, especially given evidence of growing teacher burnout following the Great Recession and COVID-19 pandemic (Diliberti & Schwartz, 2022; Ingersoll & Merrill, 2012; Schmitt & deCourcy, 2022; Sutcher et al., 2016). Recent evidence suggests that teachers feel undervalued and dissatisfied with their working conditions (Akiba et al., 2023). While teacher shortages have represented a policy concern throughout the last century (Pawlewicz, 2021), current trends, including declining enrollment in teacher preparation programs (Goldhaber & Holden, 2021; Partelow, 2019) and declining rates of teacher job satisfaction (Master et al., 2018), render these concerns especially salient today. Indeed, as Kraft and Arnold (2022) conclude in their examination of trends in the teaching

profession, “Prestige, interest, preparation, and satisfaction are at or near their very lowest point in over a half century” (pp. 33-34).

Substantial scholarship has investigated causes of teacher turnover, factors to mitigate early attrition, and strategies to increase retention (Nguyen et al., 2020), though not yet specific to CTE teachers despite longstanding CTE teacher shortages (Cardichon, 2017). Desperate to fill teaching vacancies, high-poverty schools often have little choice but to hire new, inexperienced, and often underqualified or uncredentialed teachers (Adamson & Darling-Hammond, 2012; Hanushek et al., 2004) where, alarmingly – though perhaps unsurprisingly – new teachers leave at significantly higher rates (Sutcher et al., 2016). There is some evidence that teachers of in-demand subjects, especially in STEM fields, are more responsive to salary incentives than their colleagues in the humanities and general education (Podolsky et al., 2016). Given their training and experience, it is plausible that CTE teachers may be especially sensitive to competitive marketplace opportunities, though there remains limited empirical evidence to support this claim (Anglum et al., 2023).

Teachers who lack a teaching certificate, hold less experience, and score lower on standardized tests are more likely to leave the profession as well (Borman & Dowling, 2008), findings especially relevant to CTE given that more CTE teachers enter teaching lacking teaching certificates and teaching experience, compared to other subject areas. While some, albeit limited, evidence indicates that CTE teachers have less extensive pedagogical backgrounds, it is unclear whether a typical certification process would best prepare CTE teachers to translate workforce experience into effective teaching (Clark et al., 2014; Kerna, 2012). These characteristics of shortages are similarly correlated with hard-to-staff schools

(Goldhaber et al., 2015; Nguyen et al., 2019), compounding the need to support the retention of CTE teachers who serve historically marginalized students.

## Data

In the following analyses, we use data from the Schools and Staffing Survey (SASS) and its supplement, the Teacher Follow-Up Survey (TFS), as well as SASS's new iteration, the National Teacher and Principal Survey (NTPS). SASS/NTPS, administered by the National Center for Educational Statistics (NCES), consists of nationally-representative samples of districts, schools, principals, and teachers for U.S. public schools. The SASS/NTPS includes more than 30,000 traditional public and charter school teachers in each wave, with the SASS conducted every three to four years and the NTPS every two to three years. The survey is the most comprehensive national data source on the characteristics of public school teachers and the schools in which they teach. For this study, we use the most recent surveys to provide modern descriptive profiles of high school CTE teachers; specifically, we use the 2003-2004, 2007-2008, 2011-2012, 2015-2016, and 2017-2018 SASS/NTPS waves with their respective TFS. We focus on traditional public schools, excluding charter schools. We employ the appropriate sampling weights, rendering the results nationally-representative.

CTE course offerings often begin in high schools; therefore, our analytic focus lies with secondary and combined elementary and secondary teachers rather than teachers exclusively in elementary school settings. Our analytic sample includes 88,540 teachers, 10,100 of whom are CTE teachers or teachers who report their main teaching assignment as one fitting the federal designation of CTE. Turnover data was collected by the SASS only in the 2003-2004, 2007-2008, and 2011-2012 waves; turnover analyses include 62,830 teachers, 7,790 of whom are CTE teachers. Below, we briefly describe how we operationalize CTE teachers, teacher and school

characteristics, and measures of teacher attrition (see Appendix Table 1 for additional information).

**Defining CTE teachers**

CTE teachers are defined as those whose main teaching assignments include classes in one of the federally-defined CTE career clusters, which include subjects as wide-ranging as business management, healthcare occupations, and construction trades. In SASS/NTPS, CTE designation corresponds with subject-matter specific codes 241 to 256. Specifically, this includes agriculture and natural resources, business management, business support, marketing and distribution, healthcare, construction trades, mechanics and repair, manufacturing or precision production, communications and related technologies, personal and public services, family and consumer sciences education, industrial arts, and other career or technical education.

**Measures of teacher and school characteristics**

We include several teacher demographic attributes, including: gender, race/ethnicity, and age. We also include teacher characteristics and qualifications, such as novice status (first two years of teaching), graduate degree(s) attainment, certification status, CTE qualification, salary, and union membership. We categorize a teacher as CTE-qualified if their first or second major is in a CTE field or if they hold a state certification in a CTE subject. We consider several important school characteristics associated with teacher turnover: school urbanicity and enrollment, and the percent of students eligible for free- and reduced-price lunch (FRPL), percent racial/ethnic minority, percent Individualized Education Program (IEP), and percent Limited English Proficiency (LEP). In additional exploratory analyses, we also examine teacher outcomes by schools' majority-FRPL and majority-minority student populations.

**Measures of attrition**

Teacher attrition data come from the principal report of teachers' employment status in the year following the baseline SASS/NTPS survey. Teachers are categorized as staying in the same school (stayers), moving schools (movers), or leaving teaching (leavers).

## Methods

Considering the dearth of prior scholarship specifically focused on CTE teachers, we describe the demographic characteristics of CTE teachers, highlighting changes over the past two decades. We report on changes to teacher experience, education level, certification, qualification in main teaching assignment, salary, and union membership. Critically, we examine CTE turnover rates relative to that of non-CTE teachers.

In regression analysis, we seek to understand the extent to which CTE teachers are predicted to turn over (i.e., move schools or leave teaching) at greater rates than non-CTE teachers and the degree to which CTE teacher turnover relates to teacher and school characteristics. We employ ordinary-least squares (OLS) regression models to estimate the turnover probabilities for moving schools (movers), switching schools (switchers) and leaving the profession (leavers) for each teacher:

$$Y_{ijkt} = \beta_0 + \boldsymbol{T}_i\boldsymbol{\beta}_1 + \boldsymbol{S}_j\boldsymbol{\beta}_2 + \lambda_k + \gamma_t + \varepsilon_{ijkt} \qquad (1)$$

where *Y* represents the three forms of turnover (switching, moving, and leaving) for teacher *i* from school *j* in state *k* in year *t*. *T* is a vector of teacher characteristics and *S* is a vector of school characteristics. $\lambda_k$ represents school fixed effects to account for unobserved heterogeneity across schools, and $\gamma_t$ represents year (survey wave) fixed effects to account for time-specific correlates of teacher turnover, such as the 2008 recession. Lastly, $e_{ijkt}$ is a random error term. We use heteroskedastic-robust standard errors clustered at the state level for all regression

analyses. We use survey weights to account for the stratified cluster sampling and to make our results nationally-representative.

## Results

### CTE Teacher Demographics and Characteristics

In Table 1, we present our descriptive analysis examining CTE teacher demographics, traits, and qualifications across schools, over time. Overall, we see that the CTE teacher workforce is comprised of more rural, female, novice, nonwhite, and credentialed teachers now than in 2004, with fewer teachers claiming union membership. However, in Panel A, we observe that the demographic characteristics of CTE teachers held mostly steady from 2004 to 2018. In contrast with the population of all teachers, just over half of CTE teachers are female. A significant majority of CTE teachers (83% to 86%) are White, and average age remained consistent at approximately 46 years.

In Panels B and C, we examine teacher characteristics and qualifications in addition to the characteristics of their schools. First, we observe slight increases in the proportion of novice CTE teachers (less than three years of experience) and those holding graduate degrees. Interestingly, the percentage of CTE teachers with CTE qualifications surged from 72% in 2004 to 88% in 2008 (with a minor dip since then).[1] Few CTE teachers lack any certification, remaining at about 2%. Salaries remained stable at roughly $55,000 (in constant 2018 dollars). Union membership declined from 72% to 66% from 2004 to 2018. In terms of teachers' school characteristics, we see a greater concentration of CTE teachers in rural schools than urban. We

[1] This could be, at least in part, to provisions of the 2006 Perkins reauthorization that encouraged states and local education agencies to increase CTE certification and invest in CTE teacher professional development.

also observe a rise in CTE teachers across both majority-minority schools as well as in majority FRPL schools from 2004 to 2018.

**CTE Teacher Turnover**

As for teacher retention (Table 2), CTE teachers remained at their current school at rates comparable to non-CTE teachers, with 87.3% of CTE teachers staying year-over-year, compared to 86.3% of non-CTE teachers. This slight difference in mobility is driven mostly by CTE teachers' lower propensity to switch schools (about 4.9% compared to 6.4% among non-CTE teachers). Conversely, CTE teachers are *more* likely, albeit very slightly, to leave the profession (7.9%) compared to non-CTE teachers (7.3%).

Next, we examine the specific factors which predict turnover of CTE teachers (Table 3). For CTE teachers specifically, in column 1 examining all turnover, we observe that Hispanic teachers are less likely to turn over than White teachers (-5.4 percentage points), novice teachers are more likely to turn over than more experienced teachers (7.9 percentage points), and teachers with graduate degrees are also more likely to turn over (3.9 percentage points). We observe no significant turnover findings for holding standard certification or CTE qualification. Teacher salary is significantly related to turnover, but modestly so: a $1,000 increase in salary only is associated with a 0.1 percentage point turnover decline. CTE teachers with union membership are 3.7 percentage points less likely to turn over than those without union membership, holding all else constant. We note that, due to the smaller sample size for turnover, we do not separate the results by urbanicity status, though future analyses should examine heterogeneity by urbanicity including rurality (Rhinesmith et al., 2023). When we disaggregate turnover into switchers and leavers, we find most of the aforementioned relationships are driven by leavers rather than switchers (columns 2 and 3).

Finally, given our findings about the ways that CTE teachers differ in their personal characteristics and rates of turnover, we conduct an initial exploratory analysis to examine CTE teachers' school contexts. In particular, we begin to unpack the likelihood that CTE teachers work in higher-poverty schools and majority minority schools, relative to their non-CTE teacher counterparts and over time (Figure 1). In Panel A, we observe that both CTE and non-CTE teachers have become more likely to teach in higher-poverty schools. There is a small (less than five percentage point), statistically insignificant gap between CTE and non-CTE teachers, with CTE teachers teaching slightly less frequently in majority-FRPL schools.

In terms of working in majority minority schools (Panel B), however, we observe that while CTE and non-CTE teachers teach in these schools at similar rates from 2004 to 2014, CTE teachers became more likely to teach in majority minority schools by 2016. In particular, by 2018, CTE teachers were significantly more likely to teach in a majority minority school than non-CTE teachers (about a 10 percentage point difference). Future scholarship should pursue similar inquiries concerning additional elements of school-based heterogeneity, including urbanicity and subgroups of schools serving different student populations within particular geographic locales.

## Discussion and Conclusion

As the nation continues its 21st century economic and technological advancement, nearly nine in ten students now participate in at least one CTE class during high school (Hudson, 2014; Levesque et al., 2008). Yet, despite the size of this student population and the recent growth in research attention paid to CTE, CTE teachers remain understudied in the extant literature. In this paper, we employ nationally-representative data to provide a unique look into the country's CTE

teacher workforce, examining trends in the demographic makeup and turnover behaviors of CTE teachers, including how they changed over a 14-year period of significant CTE policy change.

Our findings highlight a secondary school CTE teacher workforce that has experienced substantial changes in some areas, but remained relatively steady in others, providing the foundation for future appraisals of CTE teacher characteristics and quality. First, we observe a CTE teacher workforce that differs from the overall teacher workforce in meaningful ways. Notably, fewer CTE teachers are female relative to non-CTE teachers, which one might expect given the longstanding gendered employment skew in some popular CTE fields like construction, manufacturing, agriculture, and IT. However, while the gender balance is quite different than the rest of the teacher workforce, females *do* constitute a majority of CTE teachers, with the proportion of CTE teachers who identify as female growing to 56% by 2018.

While this shift in the gender composition of the CTE teacher workforce echoes previous shifts in the broader teacher workforce (Ingersoll et al., 2021), it remains notable given that male students remain overrepresented in CTE (Ecton, 2023; NCES 2020) and tend to reap more positive returns from CTE (Brunner et al., 2021; Dougherty, 2018; Ecton & Dougherty, 2023; Kemple & Willner, 2008). On the one hand, additional female teachers may represent an opportunity to broaden the population of students who can benefit from CTE through greater female representation, particularly in applied STEM fields that remain male-dominated. Conversely, one possible reason male students benefit more from CTE could be because it often represents one of students' few interactions with male teachers, considering the small and declining share of male teachers in America's schools (Ingersoll et al., 2021). Given that much of the strongest evidence for CTE is in its role as a "safety valve," particularly for male students

who struggle academically and who do not go on to college, CTE's relatively high prevalence of male teachers deserves attention in future inquiry, particularly given this trendline.

We also find that CTE teachers are more White and less racially diverse than the overall teacher workforce, though we do find evidence of increasing racial diversity between 2004 and 2018. Still, 83% of CTE teachers identified as White in 2018, a figure exceeding all public-school teachers (79%) (NCES, 2020), and much higher than the share of White public K-12 students (45.2%) (NCES, 2022). Given the increasing diversity of America's student population, alongside evidence that students benefit from access to same-race teachers (Gershenson et al., 2022; Redding, 2019), this lack of racial diversity should be a major focus for policymakers seeking to best serve a diverse student body.

As the nature of CTE has changed, so too has CTE teacher preparation and training. From 2004 to 2018, CTE teachers became 12 percentage points more likely to be qualified specifically for CTE (to 84% by 2018), and six percentage points more likely to have a graduate degree (47% in 2018). Only about two percent of CTE teachers lack any teaching certification, perhaps contradicting a popular misconception about large proportions of uncertified CTE teachers.

Surprisingly, and perhaps contrary to prevailing thought, we find that CTE teachers actually have slightly higher year-over-year retention in their schools than non-CTE teachers (87.3% versus 86.3%). This belies widespread discussion about the difficulty of retaining CTE teachers (Advance CTE, 2016; Cardichon, 2017; Graves & Hasselquist, 2021), alongside economic theory that suggests teachers with training and experience in other fields may have more diverse career opportunities and more flexibility to leave the teaching profession (Kosloski et al., 2022; Hansen et al., 2019).

While even small amounts of teacher turnover can disrupt a school environment and student learning (Hanushek et al., 2016; Ronfeldt et al., 2013; Sorensen & Ladd, 2020), these findings fail to differentiate CTE teacher turnover as a unique crisis. Rather, these findings suggest that, while differences exist, CTE teacher turnover is relatively similar to teacher turnover in general. Notably, we also find little evidence that CTE teacher retention changed meaningfully over time from 2004 to 2012, suggesting that even during a period of great economic and educational changes in U.S. schools (e.g., the 2008 recession, No Child Left Behind, high-stakes accountability, etc.) and in CTE policy (best signified by the 2006 Perkins Act reauthorization, codifying the shift from "Vocational Education" to "Career and Technical Education"), CTE teacher retention remained steady. In the future, additional scholarship should investigate whether stable retention within the CTE teacher ecosystem benefits the quality of academic and occupational skill training, particularly in light of evolving employment availability and CTE instructional fields. Moreover, future study should consider differences in teacher retention across CTE subject areas as different as construction, healthcare, agriculture, or IT.

We further direct policymaker attention to a worrying increase in inexperienced CTE teachers. We find an increase in the share of novice CTE teachers, from 10% in 2004 to 14% in 2018. Novice teacher status represents an especially reliable characteristic predicting increased teacher turnover (Nguyen et al., 2020). While future research should explore whether and how students might benefit from new CTE teachers (for example, new CTE teachers might have more up-to-date knowledge about their industry or stronger industry connections for purposes of student internship, apprenticeship, and job placement), this should be weighed alongside a cautionary reminder that novice CTE teachers may have more acute needs for professional

development and instructional support, and are also at greater risk of turnover, heightening the importance for policymakers to focus on CTE teacher retention. However, novice CTE teachers are not the only teachers at heightened risk of turnover; CTE teachers with graduate degrees are about 3.9 percentage points more likely to turn over. This may be in part because highly-credentialed CTE teachers, especially in applied-STEM fields, may have especially attractive employment options outside the classroom. For district and school leaders looking to increase teacher retention, this may hold relevance when hiring CTE teacher candidates, especially given evidence of little to no impact of graduate degrees on student learning outcomes (Clotfelter et al., 2007.

For policymakers, we summarize three takeaways. First, it is crucial to recognize that CTE teachers differ in important ways (including their personal characteristics and their training), and to recognize that strategies for recruiting and retaining CTE teachers may differ from their general teacher population. Second, while the CTE teacher workforce has slightly diversified in many aspects, its diversity still lags behind the general teacher workforce and, especially, the student-age population. Given CTE's historic role in race-based tracking, it is imperative that the CTE teacher workforce better reflects the students it aims to serve. Third, given the increase in novice CTE teachers, policymakers should prioritize targeted induction programs and mentorship initiatives for novice CTE teachers, since these programs and initiatives are associated with decreased teacher mobility, and since CTE teachers may have unique professional development and mentorship needs (Ronfeldt & McQueen, 2017). Overall, there remains a wealth to uncover with respect to CTE teachers, particularly in light of quickly-evolving CTE policy and CTE's growing availability across diverse student populations. For policymakers to best support CTE's growth and effectiveness, improved understanding of the

professional characteristics and career trajectories of those closest to student learners, CTE teachers, is imperative.

For researchers, we provide a contemporary portrait of the national CTE teacher workforce and, guided by these findings and previous scholarship, identify key areas for continued research. CTE teacher retention patterns are relatively similar to non-CTE teachers, though with some important caveats. More work is needed to continue unpacking these findings. In particular, we need a deeper understanding of how CTE teachers and their retention differ by field of study, especially as those fields rapidly evolve. More is also needed to understand how CTE teachers differ across contexts, including by school characteristics and urbanicity. While there is some evidence about the effectiveness of CTE teachers (Chen et al., 2023; Theobald et al., 2023), much more is needed in this space, alongside a stronger understanding of how different pathways into the profession relate to student success.

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## Tables

Table 1. Descriptive characteristics of CTE teachers

| Variable | (1) Wave: 2004 | (2) Wave: 2008 | (3) Wave: 2012 | (4) Wave: 2016 | (5) Wave: 2018 |
|---|---|---|---|---|---|
| Panel A: Teacher demographics | | | | | |
| Female | 0.50 | 0.52 | 0.50 | 0.54 | 0.56 |
| Black | 0.08 | 0.09 | 0.06 | 0.09 | 0.09 |
| Asian | 0.01 | 0.01 | 0.01 | 0.03 | 0.01 |
| American Indian | 0.01 | 0.01 | 0.02 | 0.01 | 0.02 |
| Hispanic | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 |
| White | 0.86 | 0.86 | 0.88 | 0.84 | 0.83 |
| Teacher age | 45.6 | 45.5 | 45.5 | 46.1 | 45.9 |
| Panel B: Teacher qualifications and characteristics | | | | | |
| Novice teacher | 0.10 | 0.12 | 0.08 | 0.11 | 0.14 |
| Graduate degree | 0.41 | 0.45 | 0.46 | 0.45 | 0.47 |
| No certification | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| CTE qualification | 0.72 | 0.88 | 0.88 | 0.83 | 0.84 |
| Most selective college | 0.05 | 0.08 | 0.06 | 0.08 | . |
| Very selective college | 0.16 | 0.19 | 0.19 | 0.17 | . |
| Salary per $1,000 | 55.2 | 54.3 | 54.2 | 52.3 | 55.8 |
| Union member | 0.72 | 0.72 | 0.68 | 0.67 | 0.66 |
| Panel C: School characteristics | | | | | |
| Urban school | 0.23 | 0.20 | 0.19 | 0.25 | 0.21 |
| Rural school | 0.29 | 0.30 | 0.38 | 0.26 | 0.32 |
| K-12 enrollment | 1,090.6 | 1,158.5 | 1,182.9 | 1,205.0 | 1,183.4 |
| Secondary school | 0.91 | 0.92 | 0.90 | 0.91 | 0.88 |
| Combined elem+seco | 0.09 | 0.08 | 0.10 | 0.09 | 0.12 |
| Percent FRPL | 0.31 | 0.33 | 0.39 | 0.48 | 0.51 |
| Majority FRPL school | 0.21 | 0.22 | 0.34 | 0.42 | 0.48 |
| Percent minority | 0.31 | 0.33 | 0.36 | 0.41 | 0.43 |
| Majority minority | 0.26 | 0.27 | 0.32 | 0.35 | 0.37 |
| Percent IEP | 0.14 | 0.15 | 0.14 | 0.13 | 0.14 |
| Percent LEP | 0.03 | 0.03 | 0.04 | 0.06 | 0.06 |
| Observations | 3,180 | 2,610 | 2,000 | 1,010 | 1,310 |

*Note*. Nationally-representative weights are employed. Sample sizes are weighted to the nearest 10 in accordance with NCES non-disclosure rules. Novice teachers have less than three years of teaching experience. Salary is in constant 2018 dollar. Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS) and National Teacher and Principal Survey (NTPS).

Table 2. Rates of attrition for CTE teachers

| | (1) 2004 wave | (2) 2008 wave | (3) 2012 wave | (4) Pooled |
|---|---|---|---|---|
| Panel A: Non-CTE teachers | | | | |
| Stayer | 85.26 | 86.29 | 87.37 | 86.33 |
| Switcher | 6.60 | 6.78 | 5.88 | 6.41 |
| Leaver | 8.14 | 6.93 | 6.75 | 7.26 |
| Observations | 20,790 | 18,170 | 16,090 | 55,040 |
| Panel B: CTE teachers | | | | |
| Stayer | 86.95 | 87.79 | 87.11 | 87.29 |
| Switcher | 4.49 | 4.91 | 5.22 | 4.86 |
| Leaver | 8.56 | 7.30 | 7.67 | 7.85 |
| Observations | 3,180 | 2,610 | 2,000 | 7,790 |

*Note*. Nationally-representative weights are employed. Sample sizes are weighted to the nearest 10 in accordance with NCES non-disclosure rules. Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS) and National Teacher and Principal Survey (NTPS).

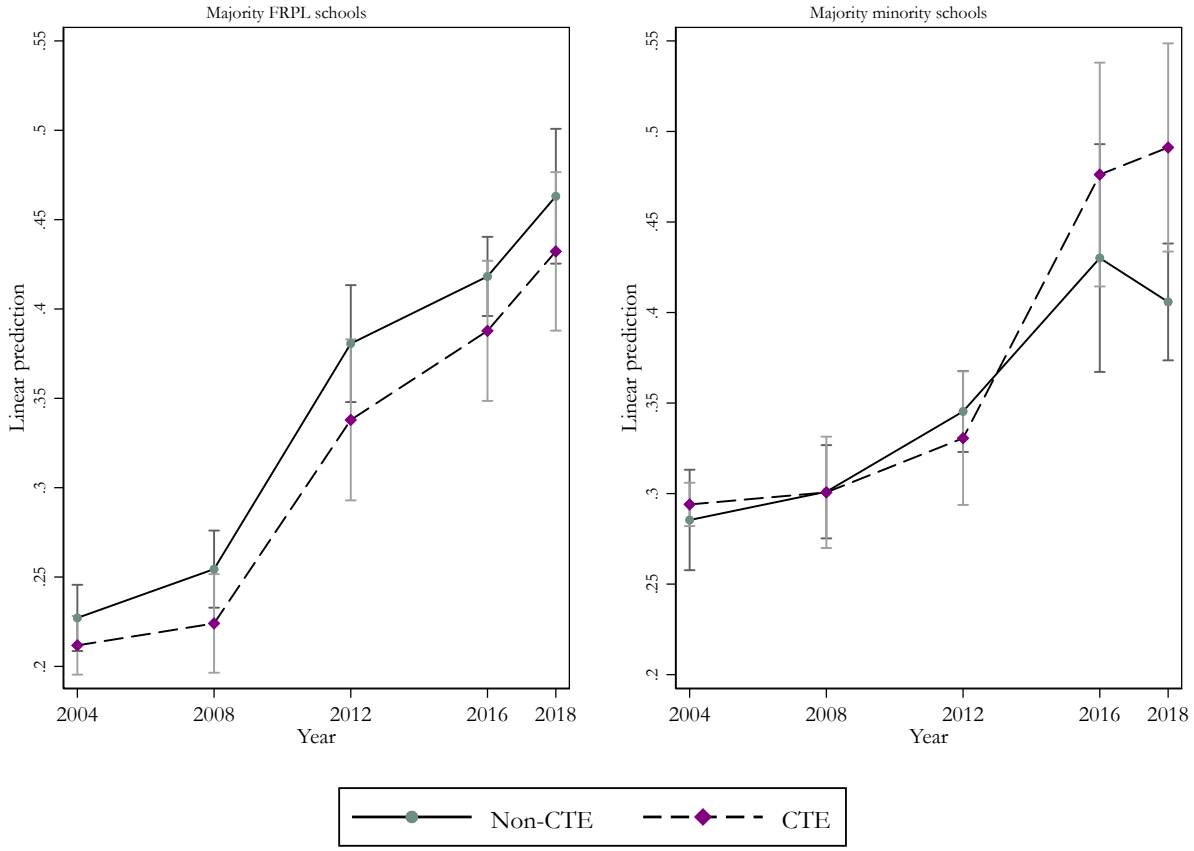
Table 3. Predictors of mobility for CTE teachers only

| | (1) All Turnover | (2) Switcher | (3) Leaver |
|---|---|---|---|
| Female | -0.018* | -0.011 | -0.010 |
| | (0.009) | (0.010) | (0.009) |
| Black | -0.002 | -0.015 | 0.011 |
| | (0.023) | (0.012) | (0.019) |
| Asian | 0.076 | 0.059 | 0.033 |
| | (0.064) | (0.046) | (0.040) |
| Am Ind | -0.004 | -0.042** | 0.033 |
| | (0.037) | (0.010) | (0.044) |
| Hispanic | -0.052** | -0.024 | -0.038* |
| | (0.015) | (0.019) | (0.015) |
| Age | 0.002** | -0.001** | 0.003** |
| | (0.001) | (0.000) | (0.001) |
| Novice | 0.079** | 0.038* | 0.054** |
| | (0.021) | (0.014) | (0.018) |
| Graduate degree | 0.039** | 0.026* | 0.018* |
| | (0.012) | (0.010) | (0.007) |
| No certification | 0.043 | -0.026 | 0.072+ |
| | (0.031) | (0.034) | (0.040) |
| CTE qualification | -0.009 | -0.007 | -0.004 |
| | (0.015) | (0.009) | (0.013) |
| Most selective | 0.021 | 0.005 | 0.015 |
| | (0.020) | (0.014) | (0.020) |
| Very selective | -0.004 | -0.014 | 0.010 |
| | (0.014) | (0.011) | (0.011) |
| Salary ($1,000) | -0.001** | -0.001* | -0.001* |
| | (0.001) | (0.000) | (0.000) |
| Union membership | -0.037** | -0.011 | -0.030** |
| | (0.013) | (0.014) | (0.010) |
| Urban | -0.023 | -0.001 | -0.025 |
| | (0.017) | (0.009) | (0.015) |
| School enrollment | -0.000 | -0.000 | -0.000* |
| | (0.000) | (0.000) | (0.000) |
| Secondary | 0.015 | 0.001 | 0.014 |
| | (0.017) | (0.009) | (0.014) |
| Higher-poverty school | 0.032+ | 0.014 | 0.024+ |
| | (0.019) | (0.011) | (0.014) |
| Majority-minority school | 0.032 | 0.028+ | 0.010 |
| | (0.021) | (0.015) | (0.020) |
| IEP | -0.046 | -0.017 | -0.033 |
| | (0.053) | (0.026) | (0.060) |
| LEP | -0.098 | -0.151** | 0.033 |
| | (0.080) | (0.049) | (0.059) |
| 2008 | -0.010 | 0.004 | -0.015 |
| | (0.014) | (0.008) | (0.012) |
| 2012 | -0.008 | 0.005 | -0.014 |
| | (0.014) | (0.009) | (0.014) |
| _cons | 0.142** | 0.144** | 0.015 |
| | (0.043) | (0.030) | (0.029) |
| *N* | 7,790 | 7,170 | 7,410 |

*Note*. Nationally-representative weights are employed. Heteroskedastic-robust standard errors clustered at the state level are in parentheses. Sample sizes are weighted to the nearest 10 in accordance with NCES non-disclosure rules. Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS) and National Teacher and Principal Survey (NTPS). $^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$

## Figures

Figure 1. Linear prediction of CTE teachers working in majority FRPL and majority minority schools




*Note*. Bars represent 95% confidence intervals for each estimate.

## Appendix Tables

Appendix Table 1. Definition of Measures Used in Descriptive and Regression Analysis

| | |
|---|---|
| **Employment status** | |
| Movers | A dichotomous variable where 1 = teacher moved to a new school and 0 = currently teaching in same school. |
| Switchers | A dichotomous variable where 1 = teacher switched from one school to another and 0 = currently teaching in same school. |
| Leavers | A dichotomous variable where 1 = teacher left the teaching profession and 0 = currently teaching in same school. |
| **Teacher Characteristics** | |
| Female | A dichotomous variable where 1 = female and 0 = male. |
| Black | A dichotomous variable where 1 = Black and 0 = non-Black. |
| Asian | A dichotomous variable where 1 = Asian and 0 = non-Asian. |
| American Indian | A dichotomous variable where 1 = American Indian and 0 = non-American Indian. |
| Hispanic | A dichotomous variable where 1 = Hispanic and 0 = non-Hispanic. |
| White | A dichotomous variable where 1 = White and 0 = non-White. |
| Age | A continuous variable of teacher's age. |
| Graduate degree | A dichotomous variable where 1 = teacher has graduate degree and 0 = no graduate degree. |
| No certification | A dichotomous variable where 1 = teacher has no certification and 0 = teacher has any certification. |
| CTE qualification | A dichotomous variable where 1 = teacher's first or second major field of study is a CTE major, or if teacher has state certification in CTE and 0 = teacher does not have a major or certification in CTE. |
| Salary ($1,000) | A continuous variable of the base teaching salary for the entire school year, scaled in $1,000s, and in constant 2018 dollar. |
| **School Characteristics** | |
| Urban school | A dichotomous variable where 1 = school is classified as urban by U.S. census. |
| K-12 enrollment | A continuous variable of the size of school where the teacher is teaching in the base year. |
| Secondary school | A dichotomous variable where 1 = the school is classified as a secondary school |
| Combined elem-sec | A dichotomous variable where 1 = the school is classified as a combined elementary and secondary (K-8) school |
| Percent FRPL students | Percentage of students eligible for the federal free or reduced-price lunch program. |
| Higher poverty school | A dichotomous variable where 1 = the majority of students at the school is eligible for federal free or reduced-price lunch. |
| Percent minority students | Percentage of non-White students enrolled in a school. |
| Majority minority school | A dichotomous variable where 1 = the majority of students at the school are minority students. |
| Percent IEP | Percentage of students with Individualized Education Plans (IEP). |
| Percent LEP | Percentage of students classified as Limited English Proficient (LEP). |