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Curricular-Credential Decoupling: How Schools Respond to Career and Technical Education Policy

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Abstract

This study examines College and Career Readiness (CCR) policy implementation through the lens of *decoupling*. We investigate how high schools have jointly implemented Career and Technical Education (CTE) and Industry-Based Certifications (IBCs), and whether there is evidence of *curricular-credential decoupling* via misalignment between the subject-areas of students' CTE course and IBC completion. Descriptive analyses of Texas's statewide longitudinal dataset (n=2,119,750) demonstrate the rapid rise in certification rates with a concomitant decline in the rate of alignment to CTE, suggesting schools may be using IBCs as a superficial way to meet CCR policy requirements. Regression analyses show student characteristics minimally relate to IBC receipt and (mis)alignment, but schools explain substantial variation. We then develop a typology to categorize schools based on these school-level rates, which may be a useful tool for understanding CTE & IBC implementation across different state policy contexts. Finally, by comparing school characteristics across typology categories, we highlight factors that may contribute to misalignment and inform future policy.

Keywords: Career and Technical Education (CTE), Industry-Based Certifications (IBCs), Industry-Recognized Certifications (IRCs), Policy Implementation, Accountability, Decoupling

1. Introduction

In recent years, there has been a surge in research and policy reform related to "college and career readiness" (CCR) for high school students (Darling-Hammond et al., 2014), in part due to high school graduates facing challenges successfully navigating the labor market (Carnevale, Rose, & Cheah, 2013), critiques of the "college for all" paradigm (Rosenbaum et al., 2015; Rosenbaum, 2001), and growing public skepticism of the value of higher education in the face of skyrocketing costs (Pew Research Center, 2024). For over a half-century, career and technical education (CTE), historically referred to as vocational education, has been one of the most prominent strategies for preparing students for the labor market (Dougherty & Lombardi, 2016). In the past decade, CTE has been linked to a new strategy rising to prominence: the receipt of industry-based certifications[1] (IBCs) in high school.

IBCs are credentials conferred by businesses, industry groups, or state certifying entities to individuals demonstrating competencies in a particular domain. IBCs are typically embedded in career and technical education (CTE) programs of study at both the K-12 and postsecondary level but are distinct from the completion of CTE coursework or the receipt of postsecondary credentials (Carnevale, Rose, & Hanson, 2013). The logic of IBCs is that coursework alone may be a weak signal to employers that prospective employees possess the knowledge and skills needed to perform particular job functions. Additionally, licenses in fields such as education, health care, and human services may be required before one may be employed as a childcare provider, certified nurse assistant, or cosmetologist. IBCs may therefore serve as loose signaling or formal screening mechanisms, depending on the characteristics of the IBC and the occupation.

[1] IBCs are also referred to as industry-recognized certifications (IRCs) or just industry certifications.

IBCs have become increasingly common in high schools through federal and state policy reforms (Advance CTE & The College in High School Alliance, 2022; National Center for Education Statistics at IES, 2020). The Every Student Succeeds Act (ESSA, 2015) placed new requirements on states to incorporate components of college and career readiness, like CTE and IBCs, into state accountability plans (Hackmann et al., 2019). By 2023, at least 16 states had begun using IBC receipt as an indicator of CCR in their ESSA plans (Education Commission of the States, 2023). Perkins legislation (Perkins V, 2018) made the attainment of recognized post-secondary credentials, including IBCs, one of the core accountability indicators of student performance in secondary CTE. At least 22 states chose this indicator. In addition, some states have implemented additional incentives that financially reward schools for their students' receipt of IBCs.

A critical assumption of these policies is that the IBCs earned by students are directly aligned with their CTE coursework (i.e., in the same subject area) and are designed to supplement, rather than supplant, students' college and career preparatory curricular experiences. However, whether students earn IBCs aligned to their CTE coursework depends upon both the design of state and federal policies and how schools respond to the salient policy environment. Research on policy adoption and implementation shows that schools are often resistant to or constrained from making substantive change and may opt for superficial ways to meet policy requirements, a phenomenon described as *decoupling* (Coburn, 2004; Coburn et al., 2016; Diamond, 2012; Diamond & Spillane, 2004). Although most research on decoupling in schools has examined the linkages between standards-based reforms and test-based accountability with teaching and learning, we use this framework to examine an understudied phenomenon we describe as *curricular-credential decoupling,* indicated by CTE-IBC misalignment. We argue

that *curricular-credential decoupling* may be a manifestation of schools "gaming the system" (Diamond, 2012, p. 173; Diamond & Spillane, 2004; Heilig & Darling-Hammond, 2008; Jacob & Levitt, 2003), evidence of inefficient public spending, a symptom of the growing corporate influence on education, and a risk for students to be harmed by the opportunity costs associated with curricular trade-offs in high school (Ecton, 2023). In doing so, we investigate:

1. What is the degree of CTE-IBC (mis)alignment, and how does this vary across CTE/IBC subjects and years?
2. How do student and school characteristics relate to IBC receipt and CTE-IBC (mis)alignment?
3. How can school approaches to jointly offering CTE & IBCs be categorized, and how have these approaches changed over time?

This paper is outlined as follows. In Section 2, we review the literature on CTE, IBCs, and their (mis)alignment. In Section 3, we provide greater detail on federal, state, and school and district policies relating to CTE and IBCs. In Section 4, we describe our methods using detailed administrative records on six cohorts of high school graduates in Texas (n=2,119,750) to measure and predict CTE-IBC (mis)alignment, categorize schools (k=1,982) into a typology based on their CTE-IBC approach, examine how school characteristics vary across these categorizations, and investigate longitudinal trends. Our results are presented in Section 5, followed by our discussion and recommendations for research and policy in Section 6.

2. Literature Review

2.1. Career and Technical Education

CTE is one of the most prominent approaches for CCR nationally, comprised of courses designed to "focus on the skills and knowledge required for specific jobs or fields of work" (National Center for Education Statistics at IES, 2024). CTE courses are a core element of the U.S. high school curriculum, with more than 82% of schools offering CTE courses and 88% of students earning at least one CTE credit (National Center for Education Statistics at IES, 2020). While students are able to take individual CTE courses, CTE courses are offered in programs of study aligned to career fields (e.g., Business, Health Care, Transportation) that allow students to either concentrate in or complete a CTE program[2].

CTE courses are "designed to provide both a bridge to well-paying jobs for non-college bound students, and a head start on more advanced career training for those who seek a college degree" (Carruthers et al., 2024, p. 2). And indeed, research shows that CTE participation has been linked to positive education and workforce outcomes, including an increased likelihood of high school attendance (Plasman et al., 2024), high school graduation (Brunner et al., 2023; Dougherty, 2018; Ferreira & Martins, 2023; Gottfried & Plasman, 2018; Lindsay et al., 2024), college enrollment (Brunner et al., 2023), short-term employment (Lindsay et al., 2024), and short-term wage returns (Brunner et al., 2023; Hendricks et al., 2021; Kreisman & Stange, 2020). Further, students report receiving affective benefits from participation in CTE, such as increased measures of self-efficacy (Turley, 2023).

These benefits are often amplified for CTE completers, compared to students who take only one CTE course (Kreisman & Stange, 2020). This is by design, as the CTE completers are

[2] Historically, CTE concentrators were defined as students who completed three or more credits in the same CTE subject. However, variation in definitions across states recently led legislators to include a standardized definition of concentrators in Perkins V as students who completed two or more CTE courses. Students who completed three or more courses are now generally described as CTE completers. In this study, we examine CTE completion and refer to historical mentions of concentrators as completers.

"on identified career pathways that should support their transition" after high school (Broderson et al., 2021, p. 2). Compared to non-completers, completers are more likely to graduate from high school on time (Broderson et al., 2021), enroll in post-secondary education (Broderson et al., 2021), major in that field of study in college (Xu & Backes, 2023), complete a post-secondary credential (Broderson et al., 2021), and earn higher wages (Kreisman & Stange, 2020). This is important given concerns that CTE completion or concentration could come with the opportunity cost of forgoing other core and advanced academic courses in high school (Ecton, 2023).

However, examining the benefits of CTE participation in the aggregate does mask variation. Given an extensive literature base documenting how CTE programs historically "tracked" students by race, class, and disability status (Dougherty & Lombardi, 2016), many researchers have investigated variation in CTE participation across student characteristics and CTE subject areas (Gottfried & Sublett, 2018; Jacob & Ricks, 2023; Leu & Arbeit, 2020; Sublett, 2019; Sublett & Gottfried, 2017). When disaggregating by CTE field of study, scholars have identified that "students enroll in CTE fields in ways that foreshadow pay inequalities in the labor market" (Carruthers et al., 2024, p. 15). There is wide variation in selected field of study by gender, where women are more likely to enroll in Health Care and Human Services programs (Brunner et al., 2023; Jacob & Ricks, 2023; Keily et al., 2024; Leu & Arbeit, 2020). White and Asian students are more likely to enroll in STEM programs and Black and Latinx students are more likely to enroll in "trade programs" (Keily et al., 2024, p. 6; Leu & Arbeit, 2020). These heterogenous participation patterns are then echoed in college attendance and earning outcomes which vary across student characteristics and CTE subject area (Ecton & Dougherty, 2023).

While research generally suggests CTE improves students' postsecondary outcomes, concerns about CTE's impacts on employment outcomes lend support for the growing emphasis on IBCs. Despite CTE's central role of preparing students for the labor market, there remains a lack of rigorous evidence suggesting that CTE participation improves earnings (Lindsay et al., 2024). The few causal studies examining the relationship between CTE and earnings have examined career academies or other CTE-focused schools, particularly those that are oversubscribed and employ a lottery selection process that allows researchers to estimate causal effects of admission offers. It is unclear whether these findings generalize to the ~90% of public high school students in the United States who participate in CTE through traditional, comprehensive high schools. Finally, initial labor market benefits may fade over time, particularly if CTE students are unable to enter careers with opportunities for advancement or to "upskill" over time (Hanushek et al., 2017). Thus, ensuring CTE programs provide students with verifiable skills or certifications sought by employers remains a key priority and IBCs are positioned as one potential solution to these concerns.

2.2. Industry-Based Certifications (IBCs)

IBCs are another increasingly common form of college and career preparation offered in high schools, and while they are most often earned through CTE programs of study (Giani, 2022), IBCs and CTE are distinct entities. Like participating in CTE coursework, earning an IBC in high school is associated with several positive education and workforce outcomes, including an increased likelihood of high school graduation (Glennie et al., 2017; Walsh et al., 2019), college enrollment (Glennie et al., 2023; Glennie et al., 2020; Walsh et al., 2019), college graduation (Glennie et al., 2023; Glennie et al., 2020), short-term employment (Baird et al., 2022; Giani, 2022; Turley, 2023; Xu et al., 2024), short-term wage returns (Baird et al., 2022;

Giani, 2022; Hendricks et al., 2021; Walsh et al., 2019; Xu et al., 2024), and boosts in affective measures of self-efficacy (Spillers & Lovett, 2022).

Research again suggests that the likelihood of earning an IBC in high school varies across student characteristics, including academic performance (Eagan & Koedel, 2021; Giani, 2022), gender (Eagan & Koedel, 2021; Hicks et al., 2024), race/ethnicity (Eagan & Koedel, 2021; Giani, 2022; Walsh et al., 2019), special education status (Giani, 2022), socioeconomic status (Eagan & Koedel, 2021; Giani, 2022), and whether a student completed a CTE program (Giani, 2022). Further, the benefits of IBC receipt to post-secondary and workforce outcomes vary across subject area (Giani, 2022; Xu et al., 2024), where "only a handful of IBCs are related to overall success beyond high school" (Giani, 2022, p. 12).

This study also found that the majority of IBC earners were neither enrolled in a major nor employed in an industry matching their credential after high school, and that schools, not student characteristics, are the strongest predictors of IBC receipt (Giani, 2022); this suggests that IBC receipt may be being influenced by elements other than students' educational or career interests. Similarly, other research has found little relationship between certification receipt and labor-market needs, implying that factors such as policy incentives and school accountability criteria may be "pushing" students into obtaining IBCs (Dalton et al., 2021, p. 6). So, while IBCs can provide value to students, this value may be mediated by external mechanisms like state policies, accountability incentives, and school-level decisions which influence which IBCs are offered and when.

2.3. High School Models of CCMR Delivery

Finally, we discuss how CTE and IBCs are implemented at the school-level, as we know that high schools play a role in disparities in both CTE and IBC access and participation (Ansel

et al., 2022; Cashdollar, 2023; Giani, 2022; Jacob & Ricks, 2023). "CTE and work-based learning programs are often governed by a complex web of state and federal policies and by various agencies in state and local government" (Keily et al., 2024, p. 10), and nationally, "school models of CTE delivery (1) vary from state to state, and (2) states and school districts may have more than one model of CTE delivery" (Aliaga, 2023, p. 23). There are well-documented barriers to offering CTE programs of study in high schools, including "the costly nature of equipment-intensive programs and the need for dedicated CTE facilities" (Cashdollar, 2023, p. 1722). Additionally, opportunities and constraints to offering CTE programs vary by geographic region, where "in rural areas, challenges frequently center around a limited number of employers in the region to offer a wide range of opportunities" and the lack of a sufficient "tax base to generate local funds to help sustain the programs" (Keily et al., 2024, pp. 6, 4).

However, research on models of CTE delivery categorize schools rather reductively, as either "comprehensive high schools" or "whole-school models of CTE," often called career academies, technical centers, or CTE-dedicated high schools (Hodge et al., 2020). While this distinction is important, we argue that this simplistic classification system does not allow for a thorough understanding of students' access to and participation in CTE or IBCs. As other scholars have pointed out (Ansel et al., 2022; Cashdollar, 2023; Hodge et al., 2020), the bulk of studies on CTE participation and its benefits exclusively sample students at CTE-dedicated high schools (Ansel et al., 2022; Brunner et al., 2023; Dougherty, 2018; Kemple et al., 2023; Plasman et al., 2024). These sampling restrictions not only vastly limit our general understandings of CTE delivery, student enrollment, and benefits of participation, but also confound any relationship to extant IBCs research, which is not restricted to these types of high schools. We propose that a more nuanced approach to understanding CTE and IBC offerings in high schools is necessary to

address calls to understand the ways participation in CTE and IBCs may dismantle and/or reproduce stratification (Ansel et al., 2022; Cashdollar, 2023; Hodge et al., 2020).

3. Policy Context

To contextualize this work, we discuss policy related to college and career readiness for high school students nationally and in Texas specifically. Then, we provide an overview of our conceptual framework and its applicability to CCR policy indicators like CTE & IBCs.

3.1. College and Career Readiness Policy Context

Multiple factors have contributed to the surge in policy interest and research related to CCR in recent years. Research has shown that high school graduates face challenges successfully navigating the labor market (Carnevale, Rose, & Cheah, 2013). For example, nationally representative data from the High School Longitudinal Study of 2009 (HSLS:09) shows that nearly 40% of 2009 ninth-graders who were working and not attending college in 2016 (roughly three years after on-time high school graduation) earned less than $10,000/year, despite the sample working a median of 40 hours/week (Radford et al., 2018 - see Table 4). While many researchers and reformers have responded to these findings by underscoring the importance of postsecondary education, others have critiqued the "college for all" paradigm and recommended the development of more purposeful pathways for preparing high school graduates for the labor market (Rosenbaum et al., 2015; Rosenbaum, 2001).

Additionally, federal policy in the last decade has strengthened the emphasis on college and career readiness generally (Darling-Hammond et al., 2014) and IBCs specifically. The Every Student Succeeds Act (ESSA) placed new requirements on states to incorporate components of college and career readiness into state accountability plans (Hackmann et al., 2019). The

Strengthening Career and Technical Education for the 21st Century Act – the latest reauthorization of the federal Carl D. Perkins legislation (Perkins V) signed into law in 2018 – made the attainment of recognized postsecondary credentials (including IBCs) one of the core indicators of performance in secondary CTE for the first time, resulting in at least twenty states using IBC attainment as a key indicator of CTE student performance (Perkins Collaborative Resource Network, n.d.). Both policies have also led to the development of new systems for collecting data on high school students' receipt of IBCs, overcoming the historical limitations of state data systems that did not collect this information which limited research on IBCs (Castellano et al., 2005).

The growing emphasis on IBCs in state policy can also be understood as a response to increasing skepticism of traditional college degrees as signifiers of workforce skills and a movement towards new forms of credentialism in education and work. Credential Engine, an initiative supported by the Lumina Foundation and JP Morgan Chase, has documented over one million distinct credentials available in the US economy (Credential Engine, , n.d.). Large corporations such as Amazon, Google, and Microsoft have announced removing degree requirements for many of their jobs, often replacing them with certifications they have developed (Díaz et al., 2022). More broadly, there is a movement toward "skills-based hiring," with skills often signified through non-traditional credentials such as IBCs (Fuller et al., 2022). In theory, combining CTE coursework with IBCs may provide an additional signal that workers possess the skills sought by employers.

Nevertheless, the explosion of non-traditional credentials has also raised questions about which credentials have value and should be prioritized in state and federal education policy. Limited research has examined how states have produced, revised, and evaluated the lists of

approved IBCs eligible to be counted in state accountability systems or to unlock financial incentives. Given that many IBCs cost money to earn, and corporations and industry groups that offer these IBCs may generate substantial revenue if their IBCs are included in lists authorized by state policy, schools may offer, and students may complete IBCs for reasons other than their labor market value.

3.1.1. Texas State Policy Context

A primary driver of Texas's growing emphasis on career readiness vis-à-vis college preparation began when the Texas Legislature passed House Bill 5 (HB 5) in 2013. HB 5 created the Foundation High School Program (FHSP) which structures students' curricular pathways. Prior to HB 5, Texas had adopted what was referred to as the 4X4 curriculum, requiring high school students to complete four courses in each of the four core subjects of English, Math, Science, and Social Studies as the default recommended diploma. HB 5 created new endorsement pathways that allowed students to concentrate their studies in one of five areas: 1) Arts & Humanities; 2) Business & Industry; 3) Public Service; 4) STEM, and; 5) Multidisciplinary Studies. The Multidisciplinary Studies endorsement most closely resembled the curricular requirements of the recommended plan under the 4X4 policy. Of note, the Business & Industry and Public Service endorsements added requirements for CTE coursework in lieu of core course requirements. The 2018 class was the first cohort that graduated under the FHSP and, as we later show, there was an uptick in CTE completion between the 2017 and 2018 cohorts that coincided with the implementation of HB 5.

The Texas school accountability system relies on measures referred to as College, Career, and Military Readiness (CCMR) indicators. CCMR indicators include being college-ready (e.g., earning an Associate's degree or completing a dual-credit course), being career-ready (e.g.,

earning an IBC or completing a CTE course sequence), or being miliary-ready (e.g., enlisting in the United States Armed Forces). IBCs were added to this list via House Bill 22 (2017), when the Texas Legislature directed the Texas Education Agency (TEA) to factor students' receipt of approved IBCs into the state's public school accountability system and to publish a list of approved IBCs that qualify as industry-recognized and valued by employers (Texas Education Agency, 2024).

Since 2019, Texas schools also receive monetary "CCMR outcomes bonuses" for students meeting specific CCMR indicators, with $240,222,000 distributed to school districts in 2019-20. Students who earn IBCs qualify for CCMR bonus funds under the career ready criteria. However, students must enroll in a postsecondary institution for schools to receive funding under the college ready criteria. By design, this accountability system prioritizes quantity over quality, which in practice may (over)incentivize IBC receipt as an easy mode of meeting accountability pressures (i.e., "gaming the system"), while simultaneously causing a lack of alignment between IBC receipt and CTE course-taking (Diamond, 2012, p. 173; Diamond & Spillane, 2004).

4. Conceptual Framework: Curricular-Credential Decoupling in CTE-IBC Alignment

We conceptualize this disconnect as an example of the phenomenon known as *decoupling*, in which schools respond to their external environment (e.g., accountability policies) by making symbolic or structural reforms in ways that do not actually impact classroom instruction (Deal & Celotti, 1980; Driscoll, 1995; Firestone, 1985; Malen et al., 1990; Meyer & Rowan, 1977; Meyer et al., 1978). *Decoupling* has been used to explain an enduring paradox in education; on one hand, schools appear to be undergoing near-constant reform, adopting the latest programs, technologies, and innovations. On the other, pedagogy, student achievement,

and racial/ethnic and socioeconomic inequalities in student outcomes remain stubbornly persistent (Cohen, 1988; Cuban, 1993; Elmore, 1996; Sarason, 1990). *Decoupling* posits that this continues in part because classrooms and instruction are buffered from the substantial changes of policy directives.

While organizational theorists and scholars investigating *decoupling* initially conceptualized the phenomenon as a full disconnect between policies and classrooms, more recent scholarship has argued the relationship between the external environment and instructional practice is more nuanced (Coburn, 2004; Coburn et al., 2016; Diamond, 2007, 2012; Diamond & Spillane, 2004; Kenney et al., 2024). For example, drawing on *sensemaking* theory (Berger & Luckmann, 1966; Dutton & Dukerich, 1991; Porac et al., 1989; Weick, 1995) as well as Oliver (1991)'s typology of organizational responses to institutional pressures, Coburn (2004) investigated how teachers became familiar with, interpreted, and adjusted instructional practice based on external pressures, and identified four additional categories of response besides *decoupling: rejection, parallel structures, assimilation,* and *accommodation*.

Similarly, other scholars have interpreted responses to more recent accountability policies as a *partial recoupling*, mediated by teachers, where policy has a stronger influence on content than on pedagogy (especially in the context of high-stakes testing), and there are vastly different responses to policies between schools and across states (Coburn et al., 2016; Diamond, 2007, 2012; Kenney et al., 2024). For instance, "schools that have struggled to meet accountability requirements may be more likely to 'game the system' than to transform instruction" (Coburn et al., 2016; Diamond, 2012, p. 173; Diamond & Spillane, 2004). In practice, scholars report testing linked to accountability simply leads to an increase in classroom time devoted to "teaching test-taking skills as distinct from the content being tested" and unequal resource division amongst

students who are more or less likely to pass the test (Coburn et al., 2016, p. 3; Diamond, 2012; Diamond & Spillane, 2004).

Coburn et al. (2016) further delineates four conditions of policy implementation (see Table 1) on the axes of *alignment* and *accountability*, which they define as "the degree to which standards, assessments, instructional materials, the focus of evaluation schemes, and professional development are coordinated with one another," and "the authority and power of the instructional guidance system," respectively (Coburn et al., 2016, p. 4). For each quadrant, the authors hypothesized how policies will be implemented in schools, ranging from "little" or "superficial change" to "substantive implementation" (Coburn et al., 2016, p. 4).

Table 1: Hypothesized Policy Implementation Responses (Coburn et al., 2016, p. 5)

	Weak Accountability	**Strong Accountability**
Low Alignment	"Little change in instructional practice," "hybrid practice (where new approaches are layered on top of existing ones) or superficial enactment."	"Change may be superficial," "high levels of resistance, gaming, symbolic, and/or partial and superficial implementation. Learning opportunities are more likely to be fragmented and weak."
High Alignment	"Less resistance but more uneven implementation," teachers have "opportunities and support to deepen their enactment, but there are fewer incentives for those not already inclined to shift their practice to do so"	"Substantive implementation," "teachers would have the opportunity to develop a more comprehensive understanding of new instructional approaches [and be] supported in their enactment by multiple levers"

4.1. Applying Decoupling to CCMR in Texas

Given the recent surge in policy and research related to college, career, and military readiness for high school students, here, we use the lens of *decoupling* to understand whether and how schools have implemented CCMR strategies such as CTE and IBCs. In doing so, we conceptualize the policy landscape in Texas as one potential *Strong Accountability/Low*

Alignment environment, where the rapid approval of CCMR policies may not actually be influencing classroom instruction or may only exist as superficial changes (Coburn et al., 2016). We draw upon extant *decoupling* literature to examine what we call *curricular-credential decoupling*, where districts, schools, or teachers are offering credentialling opportunities that are not aligned with the curricular topics students are learning (i.e., *CTE-IBC misalignment*). *CTE-IBC misalignment* is important to examine because it could limit the benefits of CTE and IBCs and potentially result in students being harmed by the opportunity costs associated with curricular trade-offs in high school (Ecton, 2023).

In addressing our first research question, what is the degree of CTE-IBC (mis)alignment, we hypothesize that holding schools accountable to metrics like IBC receipt could, in practice, create perverse incentives for schools to overuse certification receipt as an easy way to meet CCMR requirements and obtain additional funding. National Perkins legislation (Perkins V, 2018) includes funding for IBCs, but with no requirement for alignment between CTE and IBCs; in Texas specifically, schools also receive "bonus funds" for students completing CCMR indicators like IBCs. Simultaneously, our understandings of which credentials have value, for who, and by what metrics are in flux and vary across different policy contexts (Baird et al., 2022; Berger et al., 2024; Wagner, 2023; Xu et al., 2024), leading to confusion about which and how many certifications may best serve students. In all, we expect these factors to lead to over-credentialing and a subsequent lack of alignment between CTE and IBC subject areas, as schools attempt to maximize funding received. We also anticipate that the prevalence of *curricular-credential decoupling* will vary at the school- rather than student-level, given prior policy implementation research showing vastly different responses to policies between schools and across states (Coburn et al., 2016; Diamond, 2007, 2012; Kenney et al., 2024), as well as IBC

research showing that schools are the most important predictor of a students' IBC receipt (Giani, 2022).

Next, we explore how these school characteristics may influence approaches to offering CTE and IBCs. As previously stated, we expect schools' overall achievement levels to play a key role, where low-achieving schools or schools that have struggled to meet accountability requirements may be more likely to 'game the system' by pushing students towards certifications (Coburn et al., 2016; Diamond, 2012, p. 173; Diamond & Spillane, 2004). We also expect the frequency of CTE-IBC misalignment to vary based on how many CTE courses, how many IBCs, and how many other types of course options (e.g., AP, IB, or dual-credit courses) are offered at each school. For instance, less traditional school types like Early College High Schools (ECHS), which heavily promote dual-credit course-taking on their campuses, are likely to offer fewer CTE courses and IBC exams, and this lack of availability may lead to less misalignment.

However, the number and types of CCMR offerings available at each school are also likely dependent on school location, size, resources, and state or district funding mechanisms. Research suggests that schools in rural areas face challenges in establishing CTE programs due to a limited number of available employer partners in their region, and even if offered, programs may not align to students' career interests (Keily et al., 2024). Schools may also face financial barriers, including the "costly nature of equipment-intensive programs and the need for dedicated CTE facilities," which may prevent them from offering CTE programs (Cashdollar, 2023, p. 1722). We expect that resource-constrained schools will be more likely to respond to CCMR policy in a manner indicative of *decoupling*. For one, resource-constrained schools may not be able to offer a breadth of CTE courses and IBC exams, and so may have to piece together CCMR opportunities rather than offering cohesive pathways. Additionally, similar to our hypotheses for

low-achieving schools, we expect resource-constrained schools may have more motivation to offer piecemeal certifications in order to maximize funding received. However, whether schools cover the costs of students sitting for IBC exams may also strongly influence students' likelihood of attempting them, which may decrease decoupling at resource-constrained schools.

At a student-level, we hypothesize inequities in terms of greater *decoupling* experienced by historically marginalized communities, given an extensive literature base documenting how CTE programs historically "tracked" students by race, class, and disability status (Dougherty & Lombardi, 2016). Although more recent studies have found far less evidence of racial and socioeconomic stratification between CTE and non-CTE students (Giani, 2017), recent research has theorized that tracking *into* CTE may have simply transitioned to tracking *within* CTE, where there may be "a bifurcation of CTE in which high-performing students benefit from the growth in rigorous, high-quality programs, leaving lower-performing students in relatively unchanged, traditional vocational programs" (Ansel et al., 2022, p. 22; Malkus, 2019). Ample research suggests that both CTE and IBC participation patterns vary by academic performance, disability status, gender identity, racial/ethnic identity, and socioeconomic status, especially when participation data is disaggregated by subject area (Eagan & Koedel, 2021; Giani, 2022; Gottfried & Sublett, 2018; Hicks et al., 2024; Jacob & Ricks, 2023; Leu & Arbeit, 2020; Sublett, 2019; Sublett & Gottfried, 2017; Walsh et al., 2019). In the context of CTE-IBC misalignment, we expect historically marginalized communities may be disproportionally earning more misaligned credentials overall, and that these rates may vary by CTE subject area.

Finally, we speculate on how school approaches may have changed over time, relative to our third research question. On the one hand, in response to a brand-new policy, schools may have initially adopted IBCs somewhat randomly, creating a high initial misalignment to CTE

programming; we hypothesize that this misalignment could decrease over time as schools become more familiar with IBCs and CCMR policies, invest in their CTE programs of study, and prioritize program components that are aligned. Conversely, schools may have initially adopted only IBCs that were nested within their existing CTE programs of study, creating a low initial misalignment. Over time, schools may have learned that IBCs are an easy way to meet CCMR, leading to an increase in misalignment as schools push students towards credential exams to maximize funding received. This may be especially true after the implementation of Texas's CCMR "bonus funds" in 2019, which do not require CTE-IBC alignment.

5. Methods

5.1. Research Questions

The research questions guiding this study are:

1. What is the degree of CTE-IBC (mis)alignment, and how does this vary across CTE/IBC subjects and years?
2. How do student and school characteristics relate to IBC receipt and CTE-IBC (mis)alignment?
3. How can school approaches to jointly offering CTE & IBCs be categorized, and how have these approaches changed over time?

5.2. Data Sources

We addressed these questions using descriptive statistics and multilevel regression models (Guo & Zhao, 2000). The quantitative data we analyzed is from the Texas Education Research Center's (ERC) statewide longitudinal data system, which includes individual-level data on every K-12 public school student from the Texas Education Agency (TEA), public and

private college enrollee data from the Texas Higher Education Coordinating Board (THECB), and employment data from the Texas Workforce Commission (TWC). The ERC contains TEA records of students' high school course-taking, IBCs earned, student characteristics, school information, and district information. Each course record contains information about the course's credit value, whether students passed or failed, the subject area, and whether the course is classified as a CTE course.

5.3. Sample

Our analyses drew upon a quantitative sample of more than two million students (n=2,119,750) who graduated from high schools (k=1,982) in Texas between 2017-2022. In statistical models predicting IBC receipt, we excluded the 2022 cohort because the majority of these students were missing standardized exam data due to the COVID-19 pandemic.

5.4. Analytical Approach

To answer our first research question, we used descriptive statistics to identify rates of *CTE Completion* and *IBC Receipt,* as well as the most common CTE and IBC subject areas. Then, we developed a measure of *CTE-IBC misalignment* by pairing the subject of the IBCs students earn with whether they complete a CTE program in the same subject. We descriptively analyzed CTE-IBC misalignment rates across CTE subjects and years.

To answer question two, we used multilevel logit models (Guo & Zhao, 2000) with students nested in high school-by-year clusters. Initially, we fitted empty models to estimate the unconditional intraclass correlation (ICC), or the amount of pseudo-variation in the likelihood of the outcome explained by school-by-year clustering versus within-school variation. We then restricted the sample to students graduating from schools where one or more students earned an

IBC in that year to estimate the influence of student-level variables on the outcomes. The statistical model may be specified as:

$$\log\left(\frac{p_{ijt}}{1-p_{ijt}}\right) = \beta_{0jt} + \beta_1 Demog_{ij} + \beta_2 Courses_{ij} + \beta_3 Test_{ij} + \delta_t + \varepsilon_{ijt}$$

$$\beta_{0jt} = \beta_0 + u_{0jt}$$

The outcome variable was the log-odds of the student *i* in school *j* and year *t* experiencing a dichotomous outcome, such as completing any IBC or earning a misaligned IBC. The model controlled for vectors of student demographic and coursework variables as well as a measure of student achievement (described below). The δ_t term controlled for cohort fixed effects to account for temporal variation in the likelihood of earning IBCs. School-by-year intercepts (β_{0jt}) are a product of the grand mean intercept β_0 and each school's yearly deviation from that grand mean u_{0jt}.

Finally, to answer our third research question, we used yearly school-level rates of *IBC Receipt* and *CTE-IBC Alignment* to classify schools into a 6-category typology. We summarized school-level characteristics within each typology category in 2022 and examine trends within and across typology categories over time.

5.5. Analytical Variables

Our variables of focus are *CTE Completion, IBC Receipt,* and *CTE-IBC Alignment*. From the ERC course-taking data, we created student-level variables to indicate whether students earned course credit, in what type of course, and, if appropriate, in what CTE subject area. The CTE courses are classified into 14 categories of study (Texas Education Agency, 2024): *Agriculture, Food & Natural Resources; Architecture & Construction; Arts, Audio Visual Technology & Communications; Business, Marketing & Finance; Education & Training; Energy; Health Science; Hospitality & Tourism; Human Services; Information Technology; Law*

& Public Service; Manufacturing; STEM; and *Transportation, Distribution & Logistics.* Then, for each of the 14 CTE subject areas, we created a dichotomous variable indicating whether students completed a CTE program, defined as receiving credit for 3 or more courses in one subject area.

We repeated this process to create student-level variables to indicate whether students earned an IBC, how many they earned, and in which IBC subject area. Each certification exam is categorized into one of 12 subject areas (Texas Education Agency, 2024): *Agriculture; Architecture & Construction; Arts & AV; Business; Education; Health Sciences; Hospitality; Human Services; Information Technology; Manufacturing; Public Service;* and *Transportation*. We note that the CTE areas of *Energy* and *STEM* do not have state-approved IBCs associated with them. We created dichotomous *IBC Receipt* variables for each of the 12 IBC subjects, which we then used to create a *CTE-IBC Alignment* variable, indicating whether students earned an IBC in the same CTE subject area that they completed during high school. For this variable, students who completed either *Energy* or *STEM* programs were unable to receive an aligned certification, as there is no correlating IBC subject area. However, all IBC subjects have an aligned CTE subject area, allowing us to determine CTE-IBC alignment for all IBCs. Finally, we also created several additional school-level variables, defined in Table 2, in order to capture school characteristics.

Table 2: Definitions of School-Level Variables

Variable Name	**Definition**	**Range**
CTE Subject Availability	Number of CTE subject areas that offer courses at each campus	0-14
CTE Participation	Percentage of students at each campus that take at least one CTE course during high school	0-1
CTE Completion	Percentage of students at each campus that complete a CTE program during high school	0-1
IBC Availability	Number of unique IBCs offered at each campus	0-336

IBC Subject Availability	Number of IBC subject areas that offer IBCs at each campus	0-12
IBC Participation	Percentage of students at each campus that earn at least one IBC during high school	0-1
Advanced Course Participation	Percentage of students at each campus that take at least one AP or IB course during high school	0-1
Dual Credit Participation	Percentage of students at each campus that take at least one Dual Credit course during high school	0-1

5.6. Control Variables

The ERC includes a range of demographic and academic variables. Demographics include gender, race/ethnicity, free-or-reduced-price lunch eligibility (a measure of economic disadvantage), limited English proficiency (LEP) status, special education status, and gifted status. Academic variables include students' test scores on the State of Texas Assessments of Academic Readiness (STAAR) "end-of-course" (EOC) exams in Algebra I, Biology, English II, and US History, and the courses students completed in high school. At the school-level, the ERC also contains information about each high school campus in the state, including school size, yearly accountability scores, and regional information.

5.7. CTE-IBC Alignment Typology Creation

Given the results of our regression analyses, we then turned to school-level rates of *IBC Receipt,* and *CTE-IBC Alignment* from the most recent cohort of data available (2022) to develop a typology to categorize high schools. We first categorized each school as having *High-, Low-,* or *No-Certification* rates based on the percentage of students at that school who earned a certification before graduating, using a 50% threshold (i.e., at *High-Certification* schools more than half of students earned certifications). Then, we categorized each school as having *High-, Low- or No-Alignment* between the subject of CTE courses students took and the subject of certifications students earned. Alignment means that a student completed a CTE program and a

certification in the same category of study. Schools were categorized as *High-, Low- or No-Alignment* based on the percentage of students at that school who earned aligned certifications, again using a 50% threshold amongst certification-earners (i.e., at *Low-Alignment* schools, less than 50% of students earning IBCs earned aligned certifications). Schools were coded as *No-Alignment* if there were no students at that school who earned a certification that was aligned with their CTE coursework. Combined, this results in a 6-category typology (see Figure 4).

To answer our final research question, we reclassified each school into a typology category for each of the six years of data (2017-2022) and examined category membership over time. We examined the movement of schools across categories by creating a *New Entrant* variable indicating whether a schools' typology categorization changed from the prior year; for example, a school categorized as *No Certifications* in 2019 and *Low Certifications-Low Alignment* in 2020 would be classified as a *New Entrant* to *Low Certifications-Low Alignment* in 2020.

6. Results

6.1. CTE-IBC Misalignment Across CTE Subjects and Years

Table 3 provides an overview of *CTE Completion, IBC Receipt,* and *CTE-IBC Alignment* by graduation cohort and for the entire sample. From 2017-2022, 35.7% of students (n=757,332) completed a CTE program of study in high school; the rate of completion showed a sharp increase between 2017 and 2018, coinciding with the adoption of the FHSP as described in the Texas state policy section, but then remained roughly constant. In comparison, the rate of students earning any IBC increased dramatically over the six-year period from 2.7% to 27.4% of students, while the rate of aligned IBCs decreased from 43.1% of certification earners to only

27.2% of earners. On average, 12.8% percent of all students (n=270,196) earned at least one IBC before graduation from high school, and 32.4% of certification earners (n=86,472) earned an aligned certification.

Table 3: CTE Completion, IBC Receipt, and CTE-IBC Alignment, by Cohort

Cohort Year	***n*=**	**CTE Completers**		**Certification Earners**		**Misaligned Earners**	
2017	333,470	89,261	26.8%	8,980	2.7%	5,107	56.9%
2018	346,724	123,833	35.7%	16,539	4.8%	8,330	50.4%
2019	354,558	132,404	37.3%	36,186	10.2%	22,097	61.1%
2020	359,011	135,725	37.8%	45,915	12.8%	30,697	66.9%
2021	358,217	136,846	38.2%	61,711	17.2%	42,994	69.7%
2022	367,770	139,263	37.9%	100,865	27.4%	73,405	72.8%
Total	*2,119,750*	*757,332*	*35.7%*	*270,196*	*12.8%*	*182,630*	*67.6%*

Tables 4 and 5 display how CTE completion and IBC receipt changed during our study timeframe, 2017-2022, disaggregated by CTE/IBC subject. The denominators used to calculate the percentages are the total number of students who completed a CTE program (Table 4) and the total number of students who earned an IBC (Table 5). The final column in both tables represents the percent change in the rates during the study timeframe.

Amongst the 35.7% of students who completed a CTE program of study (n=757,332), Health Sciences, Agriculture, and Arts were the most popular subject areas, with 23%, 18%, and 13% of all CTE completers, respectively. Education, Manufacturing, and Transportation were the least common areas of CTE completion, comprising 0.8%, 1.8%, and 2.3% of all CTE completers across years, respectively. The final column in Table 4 displays the growth/decline of CTE completion by subject. We note that STEM had the highest rate of growth at 44.6% and IT had the largest relative decline of 50.0%.

Table 4: CTE Completion, by Cohort and Subject Area

CTE Subject Area[1]	Cohort						*Total*	*Percent Change*
	2017	**2018**	**2019**	**2020**	**2021**	**2022**		
Agriculture	21.4%	17.9%	17.1%	16.8%	16.8%	17.5%	17.7%	-18.2%
Arts	14.4%	11.9%	12.2%	12.7%	12.2%	12.5%	12.6%	-13.2%
Business	7.7%	8.7%	8.8%	8.3%	9.0%	8.7%	8.6%	13.0%
Construction	2.8%	3.1%	3.2%	3.1%	2.9%	2.9%	3.0%	3.6%
Education	0.8%	0.9%	0.8%	0.8%	0.7%	0.8%	0.8%	0.0%
Health Science	21.7%	23.0%	23.1%	23.3%	24.0%	24.1%	23.3%	11.1%
Hospitality	2.4%	2.4%	2.6%	2.8%	3.1%	3.3%	2.8%	37.5%
Human Services	6.9%	6.7%	6.2%	5.9%	5.5%	5.1%	6.0%	-26.1%
IT	2.8%	2.7%	2.5%	2.5%	2.0%	1.4%	2.3%	-50.0%
Manufacturing	1.7%	1.7%	1.8%	1.8%	1.7%	1.8%	1.8%	5.9%
Public Service	7.5%	9.3%	9.4%	9.2%	9.2%	9.3%	9.1%	24.0%
STEM	7.4%	9.3%	10.0%	10.5%	10.7%	10.7%	9.9%	44.6%
Transportation	2.5%	2.4%	2.4%	2.3%	2.1%	2.1%	2.3%	-16.0%

[1]Subject area names are shortened, see Methods for full names. The *Energy* CTE subject area was created in 2023 and students could not concentrate in *Energy* before that year.

Table 5: IBC Receipt, by Cohort and Subject Area

IBC Subject Area[1]	Cohort						*Total*	*Percent Change*[2]
	2017	**2018**	**2019**	**2020**	**2021**	**2022**		
Agriculture	2.6%	2.4%	4.3%	7.9%	12.8%	14.3%	10.5%	450.0%
Arts	0.0%	0.0%	8.8%	9.1%	7.2%	6.8%	7.0%	-22.7%
Business	12.9%	11.8%	25.0%	30.4%	32.9%	35.8%	30.8%	177.5%
Construction	9.4%	10.5%	8.0%	8.3%	7.3%	4.7%	6.8%	-50.0%
Education	0.0%	0.1%	0.1%	0.5%	0.5%	0.8%	0.5%	700.0%
Health Science	30.9%	35.2%	20.0%	12.6%	11.2%	11.1%	14.3%	-64.1%
Hospitality	0.0%	0.0%	2.2%	3.4%	2.7%	2.7%	2.6%	22.7%
Human Services	10.2%	7.0%	3.0%	1.1%	0.8%	1.2%	1.9%	-88.2%
IT	2.2%	1.8%	1.5%	1.3%	1.6%	1.1%	1.4%	-50.0%
Manufacturing	14.9%	15.8%	12.4%	11.4%	11.3%	9.8%	11.2%	-34.2%
Public Service	2.7%	1.5%	5.2%	6.1%	5.3%	6.2%	5.5%	129.6%
Transportation	14.1%	13.9%	9.6%	7.8%	6.6%	5.4%	7.4%	-61.7%

[1]Subject area names are shortened, see Methods for full names.
[2]Percent change is calculated from 2017-2022, unless the IBC rate was 0% initially. For those IBC subjects (Arts, Education, and Hospitality), the base year from which percent change is calculated is the first year where IBCs were reported.

Amongst the 12.8% percent of all students earned at least one IBC before graduation from high school (n=270,196), *Business* and *Health Sciences* were the most popular subject

areas, with 30.8% and 14.3% of all certification earners, respectively, while Education, Human Services, and IT all exhibited IBC rates around 1.0% by 2022. In this instance, we see far greater change in the IBC rates over time. Excluding *Education* which had an extremely low IBC rate in the base year, the IBC rates for *Agriculture, Business,* and *Public Service* increased by 450.0%, 177.5%, and 129.6%, respectively. In contrast, the IBC rates in *Construction, Health Science, Human Services, IT,* and *Transportation* all decreased by at least 50% from 2017-2022.

To illuminate how trends in CTE completion coincided with trends in IBC receipt, Figure 1 presents a scatterplot of the 2017-2022 changes in both outcomes by subject, excluding Education due to its small size. The figure highlights several instances of CTE-IBC misalignment. *Construction, Health Science,* and *Manufacturing* are found in the bottom-right quadrant because they exhibited increases in CTE completion with declines in IBC receipt. *Business* and *Public Service* exhibited modest increases in CTE completion of 13.0% and 24.0%, respectively, but increases in IBC receipt of 177.5% and 129.6%. Most notably, the 450.0% increase in *Agriculture* IBC certifications coincided with an 18.2% decline in the share of *Agriculture* CTE completers. Overall, there is essentially no relationship between changes in CTE concentration and IBC receipt over time ($R^2 = 0.01$).

Figure 1: The Relationship Between the Percent Changes in CTE Completion and IBC Receipt from 2017-22, by CTE/IBC Subject

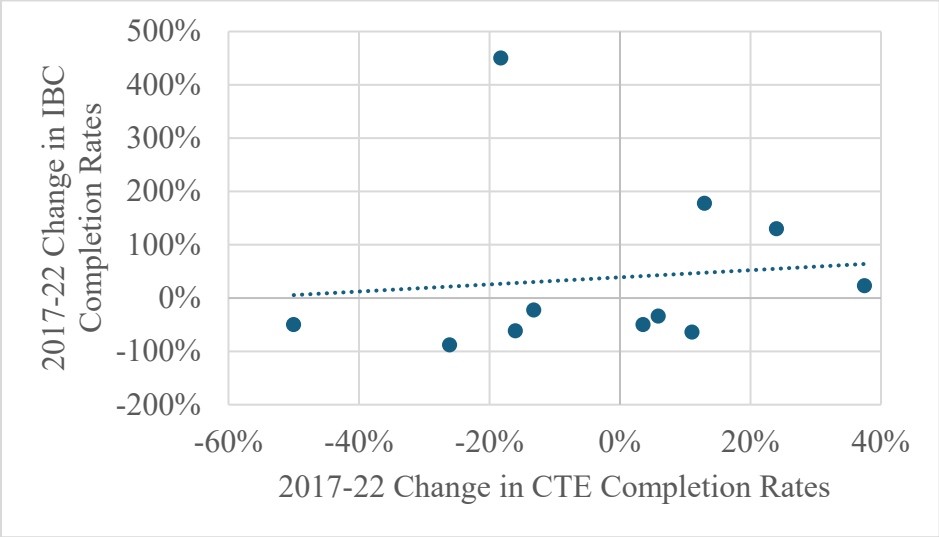
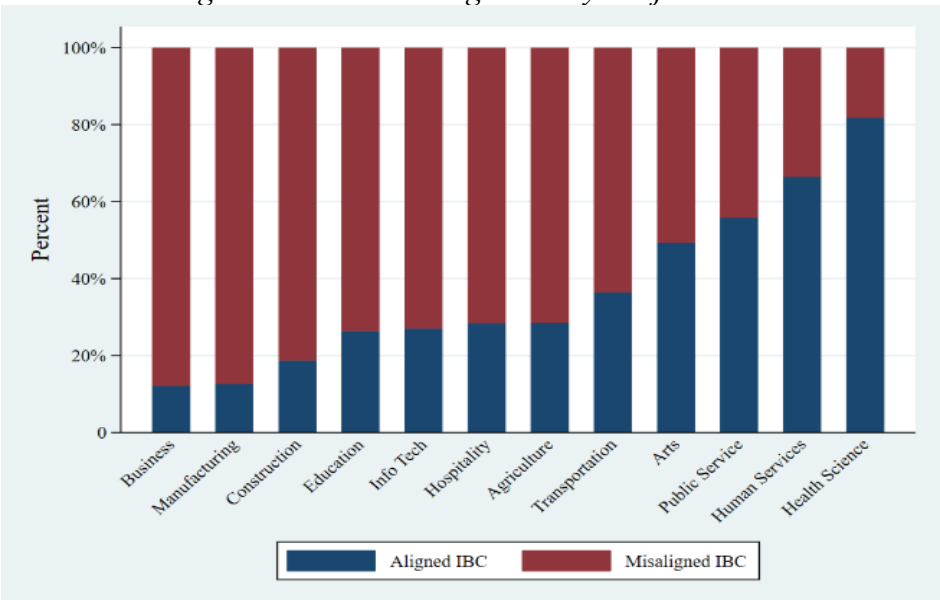


Figure 2 shows the rates of aligned and misaligned certifications within each subject area in the aggregate, sorted from least aligned to most aligned. Interestingly, the two most popular certification areas, *Business* and *Health Sciences*, which also experienced inverse changes in popularity over time, are the least and most aligned subject areas, respectively; less than 20% of *Business* certification earners completed a *Business* CTE program, whereas more than 80% of *Health Sciences* certification earners also completed a *Health Sciences* CTE program.

Figure 2: CTE-IBC Alignment by Subject Area



6.2. Predicting IBC Receipt and CTE-IBC Misalignment

We address our second research question by beginning with the estimates of the ICCs from multilevel logit models predicting different IBC outcomes, the results of which are presented in Table 6. As shown in the table, the proportion of pseudo-variation in students' likelihood of experiencing IBC outcomes is largely explained by school-by-year clustering. This clustering explains 64% of the variation in earning any IBC and 63% of the variation in earning a misaligned IBC. Across IBC subjects, schools explain between 64%-83% of the variation in IBC receipt. We note that, in national studies, schools explain roughly 15-25% of the variation in student achievement measured by standardized exam scores, depending on the grade level and subject examined (Hedges & Hedberg, 2007). Thus, the results suggest that between-school factors outweigh the influence of within-school factors in predicting IBC outcomes.

Table 6: Pseudo-ICCs of Multilevel Logit Models Predicting IBC Outcomes

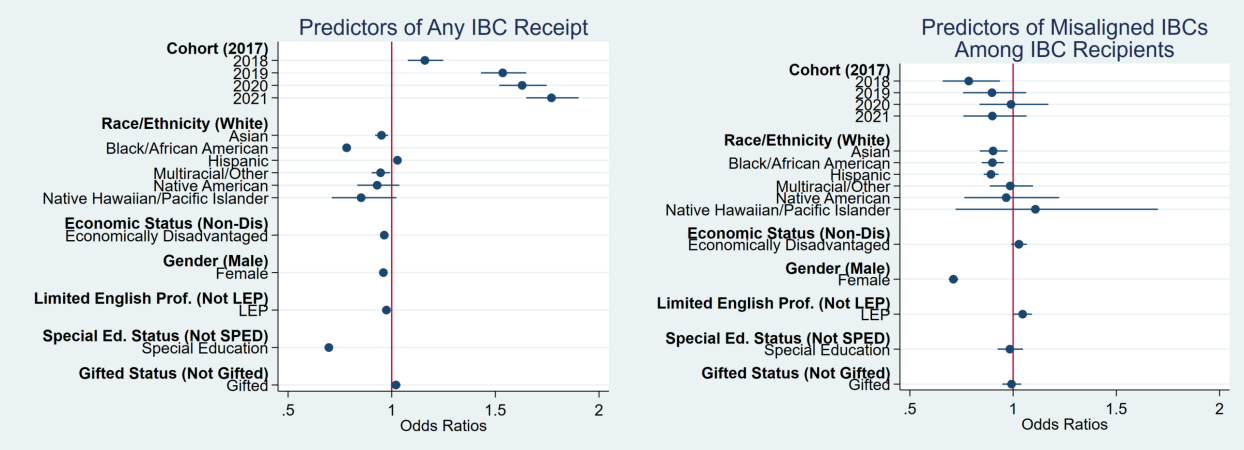
	ICC	n	k
Any IBC	0.643	2,119,750	11,681
Misaligned IBC	0.634	2,119,750	11,681
Agriculture	0.839	2,119,750	11,681
Arts	0.765	2,119,750	11,681
Business	0.786	2,119,750	11,681
Construction	0.830	2,119,750	11,681
Education	0.769	2,119,750	11,681
Health	0.647	2,119,750	11,681
Hospitality	0.750	2,119,750	11,681
Human Services	0.662	2,119,750	11,681
IT	0.689	2,119,750	11,681
Manufacturing	0.743	2,119,750	11,681
Public Service	0.815	2,119,750	11,681
Transportation	0.643	2,119,750	11,681

Figure 3 presents the results from the full multilevel logit models, restricting the sample to only students enrolled in schools that offered IBCs in a given year and adding all student-level

covariates. In the left-hand panel of Figure 3, the estimates show that the odds of IBC receipt are substantively and significantly higher for more recent cohorts compared to the reference 2017 cohort. However, odds ratios for demographic variables are either statistically indistinguishable from one or, if statistically significant, very close to one. The two exceptions are that Black students are estimated to have 0.80 ($p < 0.001$) times the odds of any IBC receipt compared to White students, and students receiving special education services have 0.74 ($p < 0.001$) times the odds compared to non-SPED students.

For the estimates of misaligned IBC receipt among IBC recipients shown in the right-hand side of Figure 3, we do not find an increase in the likelihood of misaligned IBC receipt for later cohorts, in contrast with the prior analysis. However, the key findings from this analysis are roughly similar to the estimates for any IBC receipt. The majority of estimates are either indistinguishable from an odds ratio of one or, if statistically significant, have OR between 0.9-1.1. The only exception is for gender, with female students estimated to have 0.71 ($p < 0.001$) times the odds of earning a misaligned IBC compared to male students. Overall, the results suggest minimal influence of student demographic characteristics on the likelihood of earning any IBC or a misaligned IBC specifically.

Figure 3: Coefficients from Multilevel Logit Models Predicting Any and Misaligned IBC Receipt



Notes: The coefficients presented in the figure are produced by multilevel logit models with students nested in school-by-year clusters. The models also control for the number of total course credits students earned, the number

of credits they earned in each CTE and non-CTE subject, the number of advanced and dual-credit course credits they earned, and standardized scores on the Algebra I EOC exam. The sample is restricted to students who graduated from 2017-2021, excluding the 2022 cohort which was missing extensive test score data due to COVID-19, and students enrolled in schools where one or more students earned an IBC in the year the student graduated (n = 1,284,404).

6.3. Typology of High Schools

Finally, we turn to school-level rates of IBC Receipt and CTE-IBC Alignment to develop a typology to categorize high schools and address our third research question. We categorized each school as having *High- (>50%), Low- (1-49%),* or *No-Certification* rates and *High- (>50%), Low- (1-49%), or No-Alignment*. For the full sample, 18.6% of schools in Texas were categorized as *High Certification*, 61.1% were categorized as *Low Certification*, and 20.8% were categorized as *No Certifications*; 14.3% of schools in Texas were categorized as *High Alignment*, 44.7% were categorized as *Low Alignment*, and 20.1% were categorized as *No Alignment.* Combining these IBC Receipt and CTE-IBC Alignment categorizations results in a 6-category typology, visualized in Figure 4.

Figure 4: Conceptual Typology of High Schools

Table 7 shows the distribution of Texas high schools across our typology categories for the 2022 school year, as well as the average characteristics of schools in each category. Of the

approximately 2,000 schools in Texas, only 27 were categorized as having both high rates of certification earning and high rates of alignment; most schools (n=643) were categorized as *Low Certification-Low Alignment*.

In terms of school characteristics, *No Certification* and *No Alignment* schools tend to be smaller than schools in other categories and had a lower frequency of schools meeting state accountability standards. Unsurprisingly, schools with high certification rates tend to offer more certifications and in more subject areas at their campus than schools in other categories, although *Low Certification-Low Alignment* schools also offer more than the other 3 categories. There are no substantial differences in the number of CTE subject areas offered or the rate of participation in CTE courses across categories, but schools with more students completing CTE programs have higher alignment rates. Inversely, schools offering more IBCs tend to have lower alignment rates. While student demographics were included due to our hypotheses, we see no significant variation by gender or racial/ethnic groups. However, there is some variation across categories by the percentage of students who have been economically disadvantaged, where *No Alignment* and *High Certification-Low Alignment* schools tend to have more economically disadvantaged students than other categories.

Table 7: Average Campus Characteristics of each Typology Category (2022)

	No Certs	No Align	Low Certs-Low Align	Low Certs-High Align	High Certs-Low Align	High Certs-High Align
Number of Schools	415	394	643	249	254	27
Average Campus Size	194	353	1850	1582	1134	582
Met Accountability Standards	73%	88%	95%	96%	96%	96%
City	38%	31%	29%	32%	19%	37%
Suburban	13%	12%	22%	20%	19%	7%
Town	7%	11%	16%	12%	17%	4%
Rural	39%	45%	33%	36%	45%	52%
Academic Offerings						
CTE Subject Availability	4.4	5.2	6.2	6.0	6.3	5.3
CTE Participation	92%	96%	97%	97%	99%	100%
CTE Completion	26%	36%	40%	49%	51%	83%
IBC Availability	0	13.6	104.4	54.2	176.2	85.1
IBC Subject Availability	0	1.8	5.4	4.2	5.2	3.6
IBC Completion	0%	27%	26%	17%	70%	68%
Advanced Course Completion	66%	56%	64%	65%	63%	64%
Dual Credit Completion	33%	33%	30%	31%	36%	48%
Student Demographics						
Female	49%	50%	50%	50%	50%	53%
Asian	3%	2%	4%	4%	1%	3%
Black	10%	9%	11%	12%	9%	3%
Hispanic	52%	47%	48%	48%	53%	53%
Native American	2%	2%	2%	2%	2%	1%
Native Hawaiian or Pacific Islander	<1%	<1%	<1%	<1%	<1%	<1%
Multiracial	<1%	<1%	<1%	<1%	<1%	<1%
White	32%	39%	34%	34%	34%	40%
Economically Disadvantaged	59%	61%	55%	53%	62%	50%

6.4. CTE-IBC Alignment Trends over Time

Finally, we investigate trends in CTE-IBC Alignment and other school-level characteristics over time for each typology category. Figure 5 shows the number of schools in each typology category from 2017-2022. In 2017, shortly after IBCs were introduced in Texas, most schools fell into the *No Certifications* category (*n=1,149*), with some early adopting schools being categorized as either *No Alignment* (*n=148*), *Low Certifications-Low Alignment* (n=193), or *Low Certifications-High Alignment* (*n=257*). Over time, there was a steady decline in the number of schools categorized as having *No Certifications*, decreasing to only 415 schools in 2022; similarly, while there was an initial jump in the number of *Low Certifications-High Alignment* schools from 257 in 2017 to 390 in 2018, this category also experienced steady decline over time, decreasing to 249 in 2022. All other categories grew over time, with most schools (n=643) being categorized as *Low Certifications-Low Alignment* in 2022.

Figure 5: Schools in each Typology Category, 2017-2022

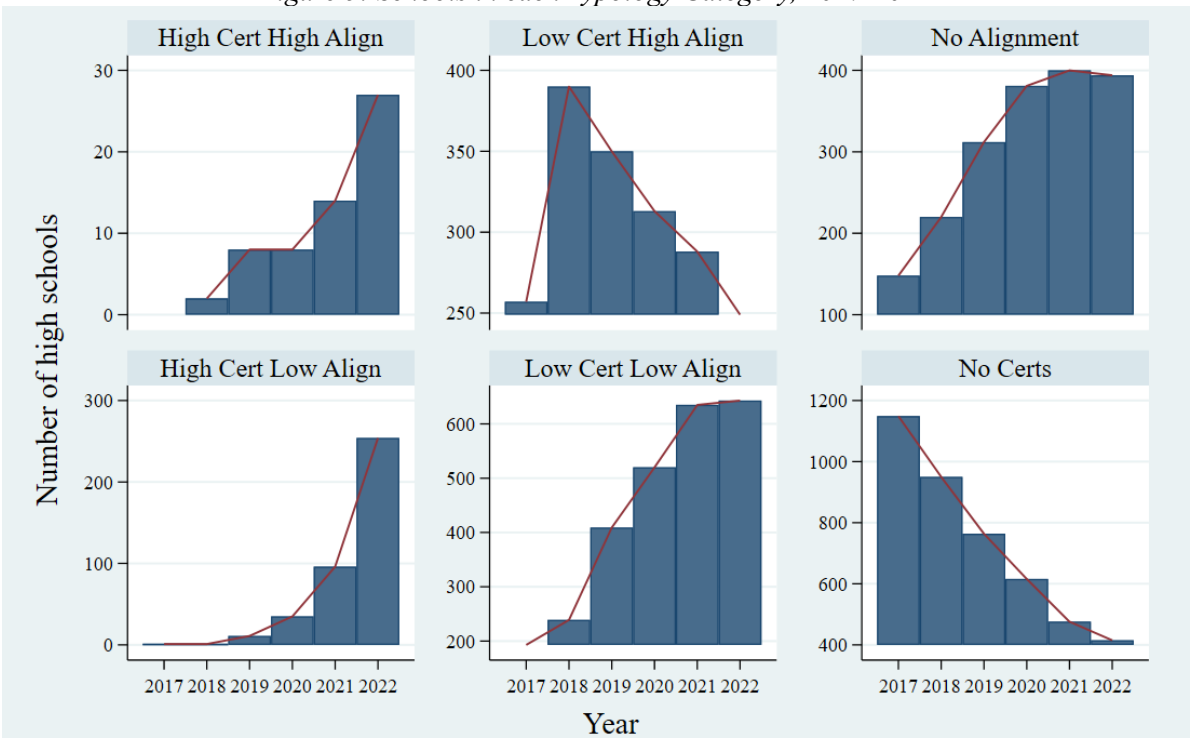


Figure 6 shows the percentage of new entrant high schools into each typology category per year; this graph begins in 2018, as it reflects a change in typology categorization from the prior year. As there were no schools categorized as *High Certifications-Low Alignment* or *High Certifications-High Alignment* in 2017, 100% of schools in these categories in 2018 were new entrants. The rate of new entrants remains high for *the High Certifications-High Alignment* category for all 5 years, likely due to the small size of this category, which peaks at 27 schools.

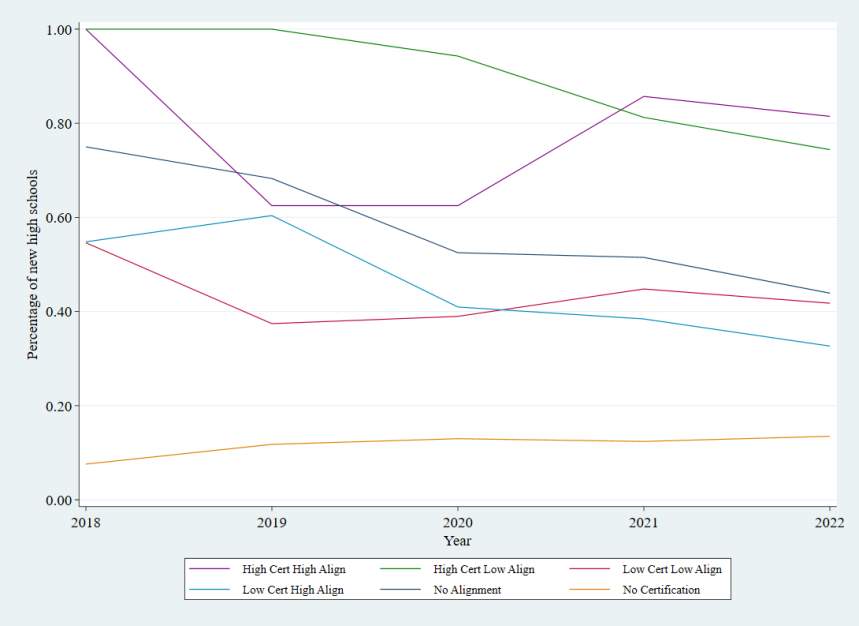


Figure 6: Percentage of New Entrant High Schools within each Typology Category, 2018-2022

7. Discussion & Conclusions

Federal and state policy are increasingly promoting high school students' receipt of IBCs through program quality indicators, accountability measures, and financial incentives (Advance CTE & The College in High School Alliance, 2022; Hackmann et al., 2019; National Center for Education Statistics at IES, 2020). The logic of IBCs is that they may serve as a more reliable labor market signal of the knowledge and skills students possess compared to the completion of

CTE coursework alone (Education Commission of the States, 2023; Fuller et al., 2022). However, whether IBCs confer educational and economic value to students may depend on whether schools are responding to IBC policy with fidelity or, conversely, are employing strategies to confer students IBCs that may be misaligned with their educational or economic aspirations. Drawing upon the theoretical framework of *decoupling* (Coburn, 2004; Coburn et al., 2016; Diamond, 2012; Diamond & Spillane, 2004), in which organizational responses to the policy environment may entail surface-level compliance to policies without substantive pedagogical or curricular changes, we developed the concept of *curricular-credential decoupling* and examined its prevalence and correlates. We begin by revisiting our hypotheses in Table 8 and then discuss our key findings and recommendations.

Table 8: Results of our Hypotheses

#	Hypothesis	Confirmed?	Supporting Evidence
1	Texas is *Strong Accountability/Low Alignment* environment	Yes	>70% of IBCs are misaligned (Table 3)
2	We will find evidence of *curricular-credential decoupling*	Yes	>70% of IBCs are misaligned (Table 3)
3	IBC accountability metrics could, in practice, create perverse incentives for schools to overuse IBCs as an easy way to meet CCMR requirements and obtain additional funding	Some evidence	>70% of IBCs are misaligned; this rate increased from 57% to 73% misalignment from 2017 to 2022 (Table 3, Figure 5)
4	Schools will have high initial misalignment after policy implementation that will decrease over time	No	Misalignment increased from 57% to 73% from 2017-2022; schools moved into *No* and *Low Alignment* categories (Table 3, Figure 5)
5	Schools will have low initial misalignment after policy implementation that will increase over time	Yes	Misalignment increased from 57% to 73% from 2017-2022; schools moved into *No* and *Low Alignment* categories (Table 3, Figure 5)
6	The prevalence of *curricular-credential decoupling* will vary at the school- rather than student-level	Yes	Schools explain 64-83% of variation in IBC receipt (Table 6)
7	We hypothesize inequities in terms of greater *decoupling* experienced by historically marginalized communities	No	Demographics do not substantially vary across typology categories (Table 7)

8	The frequency of CTE-IBC misalignment will vary based on how many CTE courses, how many IBCs, and how many other types of courses are available at schools	Some evidence	Schools with more students completing CTE programs have higher alignment rates; schools offering more IBCs have lower alignment rates; little variation across AP/IB/DC (Table 7)
9	Resource-constrained schools will be more likely to respond to CCMR policy in a manner indicative of decoupling	Some evidence	*No Certification* and *No Alignment* schools were smaller than others (Table 7); however, our dataset does not include school funding data
10	Historically low-achieving schools will have more misalignment	Some evidence	*No Certification* and *No Alignment* schools had a lower frequency of schools meeting state accountability standards (Table 7)

7.1. CTE-IBC Misalignment is Common & Growing

Our findings show a rapid rise in certification rates with a concomitant decline in the rate of aligned IBCs. We also find little relationship between changes in CTE course taking and IBC rates over time, suggesting schools may be using IBCs as a superficial way to meet CCR requirements, and providing strong evidence of *curricular-credential decoupling*. Moreover, this practice is becoming more frequent over time; some of this growth may be specific to Texas's state policy context, where since 2019 schools also receive "bonus funds" for students' receipt of IBCs. While both CTE and IBC experiences have been linked to various positive education and workforce outcomes (e.g., Giani, 2022; Klein et al., 2023; Lindsay et al., 2024), *CTE-IBC misalignment* may limit the benefits of CTE and IBCs for students and potentially result in students being harmed by the opportunity costs associated with curricular trade-offs in high school (Ecton, 2023). Misalignment could also be a concerning indication of bifurcation within CTE and IBCs. CTE scholars have voiced concerns about tracking or opportunity hoarding within CTE, where "high-performing students benefit from the growth in rigorous, high-quality programs, leaving lower-performing students in relatively unchanged, traditional vocational

programs" (Ansel et al., 2022, p. 22; Cashdollar, 2023; Hodge et al., 2020; Malkus, 2019). Future research might investigate whether misalignment is more or less prominent in certain CTE/IBC subject areas.

7.2. Variation across School, Rather than Student, Characteristics

Like prior research (e.g.,Giani, 2022), our analyses indicated that between-school factors outweigh the influence of within-school factors in predicting IBC outcomes. This once again provides supporting evidence for the prevalence of *curricular-credential decoupling*, where "schools as organizations, through the work of principals, counselors, teachers, and others, construct interpretive frameworks about CTE's meaning and purpose in ways that can be consistent or inconsistent with broader policy goals" (Cashdollar, 2023, p. 1707). The importance of school-level responses to IBC policy is further supported by evidence showing that student demographic characteristics frequently found to relate to CTE course taking and other educational outcomes are minimally related to misaligned IBC receipt, whereas school-level variation in overall IBC receipt and misaligned IBC receipt is extensive. In short, CTE-IBC misalignment is not simply a matter of students making "misguided" choices about IBCs; IBC opportunities and CTE-IBC misalignment are largely structured by school-level factors.

To conceptualize school approaches to IBC policy through the lens of *curricular-credential decoupling,* we then developed a typology to categorize schools based on overall IBC and CTE-IBC alignment rates, which may be a useful tool for understanding CTE & IBC implementation across different state policy contexts. We found that the share of schools in the high certification categories, and particularly the *High Certification-Low Alignment* group, has grown considerably over time. Thus, while one may have hypothesized that CTE-IBC misalignment would decrease over time as schools developed the CTE pathways aligned with the

IBCs they were promoting, our results suggest *curricular-credential decoupling* is a growing phenomenon.

Although our results documented the phenomenon of CTE-IBC misalignment and categorized schools based on the ways in which they jointly offered CTE and IBCs, only some of our hypotheses about the relationship between school characteristics and CTE-IBC misalignment were supported. Specifically, our results suggest that smaller schools, which tend to be more resource constrained, are more likely to fall into the *High Certification-Low Alignment* category. We theorize that these schools may be particularly likely to find ways to award students IBCs, even if they are unable to offer the CTE pathways aligned with the certifications, thereby gaming the system (Coburn et al., 2016; Diamond, 2012, p. 173; Diamond & Spillane, 2004). However, while we hypothesized that schools which served larger shares of historically marginalized populations would be more likely to exhibit CTE-IBC misalignment, due to an extensive literature base documenting how CTE programs historically "tracked" students by race, class, and disability status (Dougherty & Lombardi, 2016), we found little relationship between the demographic characteristics of schools and where schools fell in our typology. Similarly, we found little relationship between school accountability ratings and the typology categories, although we note that schools that award more certifications may have higher accountability ratings regardless of CTE-IBC alignment given the design of state and federal policy.

7.3. Implications and Future Work

Our results have important implications for educational policy as well as future research. We theorize that states that incentivize IBCs without requiring that students earn IBCs in subjects aligned to their educational pathways will exhibit greater CTE-IBC misalignment. Although some IBCs may provide value to students pursuing different pathways, states must

consider ways to ensure that IBCs are relevant to students' educational and employment goals. For example, providing stronger incentives for aligned over misaligned IBCs may be warranted. Additionally, some states have implemented policies that provide more "points" for IBCs that require more education and training than others. For example, earning a license as a licensed vocational nurse requires far more coursework than completing a CPR certification. Although both would count as health science IBCs, it is reasonable to offer stronger incentives for schools to support students' completion of higher-level IBCs. Indeed, this may explain why fields such as Health Science exhibit far lower rates of CTE-IBC misalignment than other fields, where the IBCs may require less preparation.

Although our results suggest that CTE-IBC misalignment is an important phenomenon, future research must examine how and why schools respond to IBC policy in the ways that they do. Districts likely vary in the extent to which they prioritize and financially incentivize students' completion of IBCs, and educators in different schools likely face different pressures to award students' IBCs, aligned or not. Districts may also evaluate the performance of CTE teachers based on their students' completion of IBCs. For example, the Texas Incentive Allotment (TIA) allows districts to choose measures to evaluate teachers, and some districts have chosen IBC scores as a student outcome for this purpose. Future research is also needed to unpack the educational mechanisms that result in CTE-IBC misalignment. For example, research must examine how teachers encourage or require students to earn IBCs, in what courses, and for what stated purposes (e.g., economic value or as a required assessment that comprises the course grade).

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