Equity Framework for Career and Technical Education Research

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Equity in CTE Workgroup of the Career and Technical Education Research Network

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The Career and Technical Education (CTE) Research Network is a learning community of researchers who have grants from the Institute of Education Sciences to conduct causal research studies on CTE. The Equity in CTE Workgroup is a CTE Research Network subgroup dedicated to considering equity-related issues in CTE research. Members of the workgroup and contributors to this report include the following:

- Crystal Byndloss, MDRC
- Julie A. Edmunds, SERVE at the University of North Carolina at Greensboro; *Workgroup Co-Lead*
- Clare Buckley Flack, Research Alliance for New York City Schools, New York University
- Ivonne Garcia, MDRC; *Workgroup Co-Lead*
- Catherine Imperatore, Association for Career and Technical Education
- Lois Joy, JFF; *Workgroup Co-Lead*
- Samuel Kamin, University of Connecticut
- Emily Passias, Linked Learning Alliance
- Luke Rhine, Deputy Assistant Secretary, Office of Career, Technical, and Adult Education, U.S. Department of Education (formerly Delaware Department of Education)
- Dawn Rowe, East Tennessee State University
- John Sludden, Research Alliance for New York City Schools, New York University
- Lisa Soricone, JFF
- David Stern, University of California–Berkeley
- Aimée Vargas, JFF; *Workgroup Operations Coordinator*

Project Officer: Corinne Alfeld, Institute of Education Sciences

CTE Research Network Principal Investigator: Katherine Hughes, American Institutes for Research

CTE Research Network Co-Principal Investigator: Shaun Dougherty, Vanderbilt University

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Abstract

Systems for learning and producing knowledge, such as career and technical education (CTE), often reproduce inequities unless an equity-focused lens is used when designing, implementing, and evaluating programs. This framework presents guidance for conducting CTE research with an intentional focus on equity. Developed by the CTE Research Network's Equity in CTE Workgroup, the framework illustrates how researchers can infuse an equity approach into research from start to finish and provides real and hypothetical examples from CTE research.

The framework addresses equity at six stages of the research life cycle:

Stage 1: Project Management

Stage 2: Research Design

Stage 3: Measurement and Data Collection

Stage 4: Data Analysis

Stage 5: Cost and Resource Equity

Stage 6: Reporting and Dissemination

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Introduction

The Need for an Equity Framework for CTE Research

Educators, researchers, and policymakers now realize that systems for learning and producing knowledge often reproduce inequities unless a deliberate equity-focused lens is used when developing, implementing, and evaluating education programs. This realization spurred the creation of multiple tools to address equity in education programs and research, including frameworks from Child Trends, MDRC, the Urban Institute, and We All Count. However, none of these frameworks is specific to research in career and technical education (CTE), a field of education that has played a significant part in the history of inequity in U.S. education.

This framework presents guidance for implementing CTE research with an equity-focused lens. The Equity in CTE Workgroup explains how CTE's role in high school tracking continues to present equity challenges that researchers need to understand. The workgroup then lays out some definitions to ensure a common language and present the values driving this work. The bulk of the framework includes information about how to infuse equity throughout each stage of the CTE research process.

This framework illustrates how researchers can build an equity approach into research from start to finish, with real and hypothetical examples from CTE research. For instance, researchers investigating CTE can reveal the processes, structures, policies, and outcomes that impact equity by providing relevant evidence about whether race/ethnicity, gender identity, family income, language, disability, immigration status, geographic location, parents' education level, and other factors play a role in determining which students enroll in and complete various education and career pathways. Researchers can document how administrators decide whether and where to offer certain pathways and to whom. Researchers also can measure inequity in the distribution of valuable CTE resources. Data protocols and analyses informed by an awareness of equity challenges for vocational education in the past and CTE in the present will offer a better understanding of and guidance toward a more equitable CTE future.

Development of the Equity Framework for CTE Research

This framework is a collaborative effort of the Equity in CTE Workgroup (henceforth, workgroup) within the CTE Research Network. The Network is an initiative of the Institute of Education Sciences (IES) to expand the evidence base on CTE, with an emphasis on causal studies.[1] The workgroup comprises a subset of Network researchers who are interested in better understanding CTE equity issues and producing guidance for CTE researchers on how to better incorporate equity into all aspects of their work. In addition to this framework, the workgroup has produced two blog posts: *Equity: Alignment of Mission and Methods* and *Our Network's Ongoing Commitment to Equity-Centered Research in Career and Technical Education*.

To develop this framework, members of the workgroup reviewed equity frameworks for researchers (see the resources section) and sought to synthesize these frameworks and connect them to CTE. The team found the stages of research used in the MDRC framework (Cerna & Condliffe, 2021) to be an effective organizing structure and adapted it for this document. Drafts of this document were presented for comment at the January 2022 IES Principal Investigators Meeting, at Network advisory board meetings, and at various other Network meetings. Other researchers and policymakers concerned with this issue also reviewed this framework. The workgroup will

[1] The American Institutes for Research® and its partners—the Association for Career and Technical Education, JFF, and Vanderbilt University—serve as the Network Lead to coordinate research, training, and dissemination to increase the number and quality of CTE impact evaluations and strengthen the field's research capacity. The Network's member projects include six IES-funded CTE-focused impact studies.

update this living document as needed to reflect new techniques in CTE research and new insights about the impact of historical and current inequities in CTE programs on education and career success for students.

Statement of Underlying Values

To be transparent and explicit about the values that informed the development of this framework, the workgroup agreed on four statements about CTE and CTE research:

About CTE

- Every student should have the opportunity to engage in high-quality CTE experiences that align with and expand their interests and aspirations and prepare them for labor market opportunities.
- Participation in CTE programs, experiences of CTE, and outcomes of CTE should not be determined by group characteristics (e.g., race/ethnicity, family structure, income, disability status, language, sexual orientation, gender identity).

About CTE Research

- Data should be collected, obtained, analyzed, and used to identify and address structural and institutional barriers that inhibit equitable participation and outcomes for CTE participants.
- Different research questions require different methods, and multiple methods are needed to understand the issues of equity more fully.

The workgroup recommends that researchers and other users of this framework be similarly explicit about the equity-related values that drive their work. For example, CTE research teams may want to consider identifying a core set of values and then include these as a part of reports or design documents. This process can help increase transparency and provide a way for teams to hold themselves accountable for conducting research that aligns with the core values.

Reading This Document

The next section provides important contextual information about equity issues within CTE about which researchers should be aware. Definitions of terms used in this framework then follow.

The remaining sections are organized according to the key stages of research:

- Stage 1: Project management
- Stage 2: Research design
- Stage 3: Measurement and data collection
- Stage 4: Data analysis
- Stage 5: Cost and resource equity
- Stage 6: Reporting and dissemination

Each section contains the following:

- An overview of the stage and what it would look like to implement the stage with an equity-focused lens.
- A list of guiding questions for researchers to consider in their own work.

- Barriers that researchers might face as they integrate an equity-focused lens into their work, along with potential strategies for addressing those barriers.
- Examples of how to apply an equity-focused lens to the research stage in real settings.

A final note about this document: This document is not intended to serve as a methodological primer or replicate existing research guidance. Instead, the document's primary purpose is to encourage CTE researchers to think about their work differently, through an equity-focused lens. The workgroup believes that infusing equity throughout research is critical to ensure that research will make a difference in promoting equitable learning experiences and outcomes for all students who participate in CTE.

Equity in CTE: Past, Present, and Future

The Legacy of Tracking in CTE

Equity issues are particularly complicated when thinking about the past and present of CTE. Vocational education, CTE's historical predecessor, arose in the United States in the late 19th and early 20th centuries as a curriculum uniquely defined by the social class of its intended students. Vocational education aimed to provide what policymakers considered a more relevant school experience for working-class and immigrant children in secondary schools, trade schools, and technical institutes. The goal of vocational education programs was to prepare students for the agricultural or industrial workforce (Advance CTE, 2018; Gordon, 2014; Hodge et al., 2020; Imperatore & Hyslop, 2017; Kim et al., 2021; Oakes, 1985).

The practice of tracking students from low-income backgrounds and marginalized groups reduced access to higher education and higher lifetime earnings and also restricted opportunities for many students, including those from more privileged families, by denying access to practical skill building and experience in the world of work as part of their secondary education. This tracking was based on the long-standing misconception that mind and thinking are separate from—and superior to—material being and doing. This belief historically upheld the authority of managers and white-collar professionals over pink- and blue-collar professionals who manipulate physical objects or provide personal services, such as food and caregiving.

Tracking, and the mistaken beliefs it perpetuated, steered the evolution of American high schools in the early and mid-20th century. This separation between academic and vocational education began to close in the later 20th century with efforts to de-track and create integrated curricula that combine academic and technical content and include supervised experiences in the world of adult professional work. Career academies, an integrated approach that took off in the 1990s, were found to promote educational and economic attainment among high school students of color living in nonaffluent neighborhoods (Kemple, 2008).

CTE Today

Currently, CTE includes a variety of programs at the secondary and postsecondary levels—from manufacturing and the skilled trades to business, health care, and IT (information technology) fields—as well as an emphasis on integrating academic and technical curricula and student attainment of postsecondary credentials, such as associate degrees, postsecondary certificates, licenses, and industry certifications. CTE also moved toward developing programs of study—vertically aligned sequences of technical and academic content—that begin with a broader, more exploratory curriculum and experiences and become increasingly job specific, as defined in the latest iteration of federal CTE legislation (Hyslop, 2018).

Although the implementation of CTE programs of study varies greatly from place to place and field to field, scaffolding from broader to more specific content gives students options to develop individualized education and career pathways that meet their specific needs and goals. Many learner trajectories could be considered successes, as long as each student is well informed about their options and makes a choice that aligns with and expands their goals (see sidebar). This shift no longer defines a CTE program as preparation for a horizontal segment of the occupational structure (that is, occupations requiring a high school diploma but not a bachelor's or advanced degree, which were the restricted target of 20th-century vocational education) and instead provides access to a vertical segment defined by industry (e.g., health care, IT, business and marketing, culinary and hospitality) in which employment is possible at different levels of education and compensation.

Equity Challenges in CTE Today

Despite CTE's evolution, differences remain among student groups as to which students take CTE courses in high school, enroll and persist in postsecondary education, and complete postsecondary programs. Differences also remain among groups as to which programs students enroll in—CTE or others—that lead to opportunities for further education, to credentials with value in the workplace, or both (Advance CTE, 2019; National Center for Education Statistics, n.d.). These are critical equity issues for CTE researchers to consider.

The current equity challenges in CTE grow out of the legacy of tracking and also reflect broader disparities in access to high-quality K–12 education and different postsecondary options. These interrelated challenges can be roughly categorized in three ways: equity in access to CTE programs, equity in credential attainment, and equity in workforce outcomes.

Equity in Access to CTE Programs

Disparities in the chance to participate in CTE—particularly programs with high-quality equipment, experienced teachers, work-based learning (WBL), and co-curricular activities—are just one equity challenge in today's CTE environment.

Examples of CTE Student Trajectories

- *Student A* takes an introductory CTE course in health care, another introductory CTE course in engineering, and a third introductory CTE course in marketing. Upon graduation, this student enrolls in a bachelor's program to major in English with a minor in marketing and communications.
- *Student B* takes several courses in health care, increasing in specificity, and graduates from high school as a certified nursing assistant. This student works and attends community college part time, pursuing an associate degree in radiology.
- *Student C* takes several courses in IT, increasing in intensity, earning valuable certifications and dual enrollment credits in the IT area and Advanced Placement credits through academic courses. This student enters a bachelor's degree program in IT as a second-year student.

Many of these disparities may arise from differences in school-level access to CTE (Carruthers et al., 2021). School, district, and college budgets limit the availability of CTE programs, which are frequently structured to direct more resources to already well-resourced communities. State and national CTE leaders report that CTE programs with the best equipment and most experienced teachers are concentrated in communities with more wealth (Advance CTE, 2019), and some specialized CTE programs and schools have more demand than seats available (Hodge et al., 2020). Meanwhile, CTE programs in less resourced areas and rural communities struggle to provide all students with CTE programs that offer industry-standard equipment, qualified teachers, and WBL opportunities.

Equity of access also is a factor within schools and districts. The likelihood of CTE participation across various program areas differs by gender identity and race/ethnicity (Leu & Arbeit, 2020), as does the likelihood of becoming a CTE concentrator—that is, a student who takes two or more courses in the same CTE program area—with concentrators more likely to be male and White (Hodge et al., 2020). Counselor biases, particularly

regarding race/ethnicity and gender, affect student enrollment in advanced coursework (Francis et al., 2019) and likely affect CTE course taking as well. In addition, scheduling policies and access to transportation can hinder students' ability to take CTE courses and achieve CTE concentrator status in high school. An inability to achieve concentrator status could negatively affect some students. Data show correlations between CTE concentration and increased student engagement, as well as better outcomes in employment and earnings (Dougherty, 2016; Hodge et al., 2020). The data about postsecondary outcomes are more ambiguous and mediated by program area, as further explored in the next subsection (Hodge et al., 2020).

Equity in Credential Attainment

Another equity consideration is the tracking of students between CTE program areas that are more likely to lead to immediate labor market transitions, associate degrees, or postsecondary certificates and those that are more likely to lead to bachelor's degrees or higher.

The evidence about CTE's impact on postsecondary outcomes varies by CTE program area. Students (mostly male) concentrating in manufacturing, construction, and transportation are more likely to attend a 2-year college or enter the workforce after high school graduation, whereas students concentrating in "new era" CTE programs (e.g., engineering, health care, hospitality programs) are about as likely as nonconcentrators to attend 4-year colleges (Malkus, 2019). These different groups of students generally follow the same trajectories as their parents, with students in new era CTE programs more likely to have parents with bachelor's degrees, whereas the parents of students in traditional CTE programs are less likely to have bachelor's degrees (Malkus, 2019). CTE programs and students have been pivoting toward these new era fields, with high school graduates earning an increasing number of credits in health care and IT and fewer credits in manufacturing, construction, and transportation, potentially leading to worker shortages in these traditional vocations (Malkus, 2019).

It makes a difference for students' short- and long-term earnings, however, whether they earn a postsecondary degree. It is an equity concern if CTE students are directed away, by purposeful or implicit mechanisms, from bachelor's degree programs. On average, higher degrees lead to higher annual earnings during a person's lifetime. Raw data show that associate degrees boost median earnings each year by roughly $3,000 to $6,000 for every racial/ethnic group compared with a high school diploma (National Center for Education Statistics, 2019). A bachelor's degree (without further degrees), on average, leads to additional increases of $10,000 to $15,000 per year over an associate degree. However, big differences exist among majors and fields of specialization—associate degree holders in CTE occupations such as health practice and protective service have close to the same median lifetime earnings as average bachelor's degree holders (Georgetown University Center on Education and the Workforce, n.d.).

Despite these program area differences, a bachelor's degree typically is a ticket to substantially higher lifetime earnings compared with an associate degree. Although it costs more to get a bachelor's degree, the returns on that investment justify the cost. An analysis by the Federal Reserve Bank of New York found that an associate degree typically gives about a 15% annual rate of return on the time and money a student invests, and the additional investment in a bachelor's degree also offers about a 15% rate of return (Abel & Deitz, 2014). However, many students do not pursue the investment in a bachelor's degree, likely in part because they cannot afford the initial investment. There is a very strong correlation between parental income and the likelihood that a student who graduates from high school will enroll in college. Persistent racialized gaps in income and wealth in the United States, which are the legacy of centuries of structural racism past and present (Darity et al., 2018), mean that financial barriers to the pursuit of a bachelor's degree contribute to reproducing racial gaps. Equity-minded researchers should be attentive to the role that CTE programs play in these patterns.

Equity in Workforce Outcomes

Siloed data systems make it difficult to follow CTE students through their education and into the workforce, but an analysis of national data shows positive correlations between high school CTE concentration and employment and earnings 8 years after graduation (Kreisman & Stange, 2019; U.S. Department of Education, 2019). An analysis of Arkansas data found similar positive associations between more exposure to CTE, higher rates of employment, and increased earnings by 1 year after presumed high school graduation (Dougherty, 2016). Certain CTE fields of study also are associated with degree attainment and higher lifetime earnings. However, CTE-associated potential wage premiums in the first few years after high school likely fade across time, as students who earned postsecondary degrees enter the workforce.

Moreover, as a person progresses further in their career, it is difficult to draw a line between their CTE participation or concentration at the secondary and postsecondary levels and their workforce outcomes. Many factors mediate employment outcomes for both CTE and non-CTE students. According to the Georgetown University Center on Education and the Workforce, "while much of the variation in lifetime earnings is connected to education level, field of study, and occupation, there are also differences in earnings by gender and race and ethnicity" (Carnevale et al., 2021, p. 16). These differences include the underrepresentation of women and people of color in occupations that pay the most plus wage gaps within particular occupations that arise from structural discrimination embedded into internal career pathways and promotion opportunities, especially for women of color (Advance CTE, 2018; Carnevale et al., 2021). In addition, the unemployment rate for people with disabilities in 2017 was more than twice that for people with no documented disabilities across education levels (Advance CTE, 2018).

Equity-minded researchers should be alert to the many complex factors that impact workforce outcomes and how access and equity issues within CTE raised throughout this introduction fit within the broader societal patterns of inequities to affect employment and earnings.

Defining Equity and Creating a Common Language

Creating a common understanding of terminology is a critical component of equitable research and helps ensure that all involved have the same understanding of what they are trying to accomplish. This framework first defines equity and then provides context about other key terms.

Equity

In prior publications, the CTE Research Network used the following definition of equity: "Every student has access to the educational resources and rigor they need at the right moment in their education across race, gender, ethnicity, language, disability, sexual orientation, family background, and/or family income" (Wisconsin Department of Public instruction, n.d.). This definition encompasses two important dimensions of equity relating to educational inputs: educational adequacy and equalizing treatment.

In CTE, educational adequacy means that all students receive an education that empowers them to fulfill their capabilities and prepares them for "labor market positions that enable them to lead dignified lives" (Kim et al., 2021, p. 364). Inputs for providing such an education include access to childcare, safe facilities, sufficient school funding, student support, quality teachers, rigorous and culturally responsive and sustaining instruction, and a positive school climate. Equalizing treatment requires an additional investment of inputs according to need with the goal of producing "equal effects" (Meuret, 2001, p. 93). The distribution of resources is likely uneven (Stone, 2011). To make up for differences that accrue across time, an equitable system should focus the distribution of

resources to favor historically marginalized populations (e.g., students from low-income backgrounds, students of color) and populations with particular needs (e.g., students with disabilities, multilingual students; Verstegen, 2016).

Equity also requires equality of educational opportunity. This situation is achieved when, across time, no observed differences exist between student subgroups in outcomes such as educational attainment, income, wealth, life expectancy, incarceration, and job satisfaction. Equity requires that these reductions in disparities across groups be evident and sustained (Rebell, 2009), although the members of the workgroup recognize that attaining equitable outcomes across our society will require changes that reach beyond the education system.

Disparities

Disparities are differences in inputs or outcomes based on specific characteristics, such as gender, racial identification, and disability status (Andrews et al., 2019).

Implicit Bias

Subconscious impressions or associations inform one's opinions, decisions, and actions. Implicit biases operate despite stated intentions. For example, research suggests that the average teacher expresses less racially biased beliefs than the average nonteacher (Quinn, 2017), but school professionals are not immune to the racist attitudes circulating in society. Decades of evidence find racist attitudes and actions consistently operating in public schools, and school personnel hold more negative views of Black and Latinx students than of White students (Quinn, 2017; Redding, 2019; Staats, 2016).

Intersectionality

Intersectionality is a theory of identity that understands that individuals are socially positioned based on overlapping and "mutually reinforcing" (Nash, 2008, p. 1) criteria—such as race/ethnicity, class, gender, sexuality, disability status, and country of origin—that carry with them different and structurally determined privileges or disadvantages. Intersectionality rejects a binary notion of identity and replaces it with a multidimensional view that recognizes that identities and the privileges they carry are context specific (Crenshaw, 1989, 1990; Nash, 2008; Villavicencio et al., 2020).

Structural Racism and Structural Inequality

The related concepts of structural racism and structural inequality recognize that discrimination and racism exist beyond individual agency or interactions. Inequalities and racism exist in broader social structures, including systems (e.g., criminal justice), policies (e.g., school funding), institutions (e.g., schools), and networks, reflecting a systematic distribution of resources, power, and opportunity that disproportionately benefit particular groups (Carbado & Roithmayr, 2014; Feagin, 2006; Viano & Baker, 2020; Villavicencio et al., 2020).

Intellectual and Developmental Disabilities

Intellectual and developmental disabilities can influence physical, mental, or emotional development. Intellectual disabilities often are present at birth and typically affect intellectual functioning or adaptive behaviors. Developmental disabilities may be intellectual, physical, or a combination of the two.[2]

[2] See About Intellectual and Developmental Disabilities, National Institutes of Health, for more information on intellectual and developmental disabilities.

Stage 1: Project Management

Project management is the process of organizing tasks, activities, responsibilities, and people to successfully initiate, execute, monitor, and end a project, as well as disseminate the findings. This section provides recommendations for applying an equity-focused lens to project management activities in CTE research studies.

Implementing This Stage With an Equity-Focused Lens

Applying an equity-focused lens to project management involves building sufficient time and resources into project planning to embed culturally responsive evaluation practices throughout the life cycle of a project. Culturally responsive research recognizes "culture as central to the research process" and uses "the cultural standpoints of both the researcher and the researched as a framework for research design, data collection and data interpretation" (Oregon Museum of Science and Industry, n.d., p. 2). Culturally responsive evaluation requires the integration of equity in all phases of research, including the creation and professional development of research teams. It gives particular attention to groups that have been historically marginalized, seeking to bring balance and equity into the research process. A culturally responsive evaluation approach includes the following practices.

Creating Diverse and Representative Research Teams

Diversity in research teams can be defined in terms of academic training, work experience, and political beliefs, as well as race, gender, socioeconomic status, disability, geographical region (e.g., rural versus nonrural), and other attributes. CTE research teams may want to pay particular attention to including representatives from the populations that are participating in the research, particularly when those populations have been historically underserved in CTE. It also is important to consider including people with experience in delivering CTE or with perspectives from the workforce. CTE research teams should consider paying these representatives to formalize and value their participation. A research team that includes individuals from representative backgrounds and viewpoints is better equipped to connect with the communities participating in a study. A diverse team brings together a set of people who see the same thing in different ways because of their different lived experiences. In addition, exposure to different perspectives can create opportunities for team members to become more aware of their own biases.

Improving the Cultural Competence of Research Team Members

Simply put, cultural competence is the ability to understand and engage with people from different communities. Cultural competence is not a static skill; rather, it is the process of learning and unlearning that leads to an increased understanding of one's own cultural identity, biases, prejudices, and experiences of both privilege and marginalization. Culturally competent evaluators should recognize individual variation within communities. They also should refrain from assuming that they fully understand the perspectives of stakeholders, especially those with backgrounds different from their own, or assuming that they have knowledge of another's background because not all characteristics of diversity are visible.

To ensure recognition, accurate interpretation, and respect for the communities in a study, initiatives that support cultural competence development among members of the research team are necessary. Such initiatives may include workshops, trainings, guest speakers, and resources that promote and amplify the visibility, value, and voices of said communities.

Creating a Team Culture of Inclusion

Inclusion and diversity are related but different concepts. Diversity refers to the composition of a team that considers gender, ethnicity, age, socioeconomic status, and disability, among other characteristics. Inclusion is an aspect of team culture related to the value of everyone's contributions. Inclusion requires that all individuals on a research team have a voice to share ideas and different perspectives. It is especially important for team members who hold privileged identities to both explicitly value all team members' contributions and make space for all members, particularly those from marginalized groups, to exercise their voice. Inclusion enables diversity to thrive.

Teams should co-create and codify norms and practices to ensure that everyone on the research team feels heard, valued, and respected. For example, setting the tone in meetings to engage participants with different communication styles—cultural, linguistic, or introverts/extroverts—allows everyone to contribute. Other examples include explicitly documenting roles and responsibilities to ensure that people feel comfortable speaking up when appropriate and necessary. Teams also can commit to revisiting and setting goals regularly about improving inclusion and team culture.

Providing Leadership and Development Opportunities to All Members of the Research Team

Another way to enable diversity to thrive within a team is to regularly evaluate whether all members, especially those from historically marginalized groups, have access to professional development and leadership opportunities. These opportunities can include attending trainings and research conferences, which allow individuals to learn new information or skills. They can include opportunities for facilitating or leading meetings, which can help individuals develop key leadership skills. It also is important to recognize that team members may come into the project with different levels of understanding and perspectives about CTE. Part of the team-building process should include space and time for team members to build common understandings of these different competencies and perspectives regarding CTE.

Allocating Time and Resources in Work Plans and Budgets to Engage Stakeholders at Every Stage of the Research Process

Building diverse, representative, and inclusive teams with cultural competencies is the foundation for embedding a culturally responsive and equity-based perspective throughout the research process, but more needs to be done. Project managers must allocate time and resources for the research team to engage with the communities participating in the study as partners in research. Some example strategies for community engagement are described later.

Guiding Questions

Consider the following questions to implement this stage with an equity-focused lens.

- To what extent does the project team reflect multiple backgrounds and cultures?
- Do team members share identities with the communities participating in the research?
- Have or will all team members receive appropriate training to prepare them to recognize their own biases and how those biases may shape their work on the project?
- Will team members receive training on how to conduct an evaluation using a culturally responsive and equity-based perspective?
- Who will lead ongoing conversations about how biases shape the work?

Potential Barriers

Creating diverse and representative research teams can be challenging in a relatively homogeneous organization. In such organizations, hiring diverse staff can be a transformative process that requires using a diversity lens to carefully reassess recruitment strategies, job descriptions, applicant screening, interviews, job placements, onboarding, and training processes. This organizational shift may take a significant amount of time, which may not align with the more immediate staffing needs of a research study. When hiring new staff is not a possibility, one means for building team diversity is to include interns and consultants.

Another potential barrier to implementing the previously described practices is a lean budget. Research teams may not have the financial resources—through grants or an organization—to cover cultural competency trainings or community engagement activities. Ways to mitigate this barrier could be to include such expenses in future grant applications or to request that funders support these expenditures.

Stage 2: Research Design

Arguably the most critical stage of the research process, research design is the phase in which a team conceptualizes its CTE research project. Research design involves developing an understanding of the problems under study, creating research questions, identifying the data to collect and the methodology for data collection, and contextualizing this work in existing literature. As with any research project, the research questions should drive the selection of the methodology and all downstream activities (e.g., instrument development, data collection, analysis strategies).

Implementing This Stage With an Equity-Focused Lens

Using an equity-focused lens to design a CTE research project requires that researchers (a) develop an understanding of the context and the community to be studied, (b) be transparent about the motivation and assumptions that underlie the project, and (c) consider equity-related topics throughout the design process.

Developing an Understanding of the Context and the Community

All CTE research takes place within a specific context and community, so understanding that community's perspective and needs is crucial. A good first step is to involve members of the community affected by the research in the design process, whether by collecting data through a needs assessment or establishing an advisory panel. Use care when reaching out to members of a community who might have been historically underserved in CTE. Whenever possible, it is desirable to compensate people for their time spent in interviews or advisory panel activities.

For example, when studying a program such as CTE-focused dual enrollment, researchers may want to get input in the design stage from students who might take dual enrollment courses and high school and college staff who are implementing the program. In addition, it may be useful to ask for input from people representing the different industry pathways within the program. It is important to include the perspectives of people the project focuses on, such as students from families with low incomes or students who are members of racial and ethnic groups underrepresented in college. If resources or time are not available for on-the-ground data collection, researchers might consider exploring these issues through literature searches.

Specific questions that CTE researchers may want to ask about the community are as follows:

- What is the history of "voc tech" and CTE in this community? How do families perceive it—as an opportunity or as a stigmatized noncollege track? On average, do White families and families of color have different perceptions about CTE? How do perceptions vary within groups?
- If CTE programs are locally perceived as good opportunities, are there any concerns about equitable representation of different groups of students (e.g., those with higher socioeconomic status) enrolling in CTE at higher rates? Does equitable representation differ across specific sectors/programs in the region?
- What is the local labor market context in terms of growth occupations, wages, and the demographics of the workforce in major sectors? How does this context affect student and family interest in particular career pathways as well as access to WBL opportunities?

Being Transparent About Motivation and Assumptions

Inherent in any research design is a series of choices about the area of focus, the research questions, the data to be collected, and how to analyze those data. These choices are present even in the most theoretically objective methods and data sources. Transparency about all aspects of the research design is a key aspect of equity because it helps ensure that researchers and stakeholders have similar understandings of the research. For example, if a funder requires certain research questions or a certain methodology, it is important to be transparent about that.

We All Count, a project focused on equity in data science, recommends creating a "motivation touchstone" that provides a clear and unambiguous statement about the project's motivation or goal. Researchers should establish a goal statement and clearly define the words in that statement. Keeping with the example of a CTE-focused dual enrollment program, the research goal could be as follows: "Examine the impact of the CTE dual enrollment program on students." Team members should agree on what they mean by terms such as *impact, CTE dual enrollment program,* and *students.* For this activity, it is important to consider community input as well. We All Count recommends that research teams explicitly lay out any restrictions that affect the research (e.g., time, money, capacity, rules) and the potential rewards that affect the research (e.g., personal benefits that researchers receive, benefits that the organization might gain from doing the work). Restrictions and rewards are always present, and transparency about them can help frame the research project. These three pieces—a clearly defined goal, restrictions, and rewards—create a motivation touchstone that can drive the team's planning. Sharing this touchstone with external audiences also can help build trust with the community.

Embedding Equity-Related Emphases Throughout the Design

Incorporating an equity-focused lens means ensuring that there are specific emphases on equity in the different parts of the research design. Ideally, the team should include research questions that explicitly ask participants and stakeholders about issues of equity. These questions might focus on understanding the impact on specific groups of people, whether the CTE intervention is expanding or reducing existing gaps, or what might be causing the gaps. For example, girls and young women participate in certain aspects of CTE programming at much lower levels than boys and young men do. Thus, the research questions could include a focus on issues of gender and factors that might encourage or discourage girls and women from participating.

When developing project goals or research questions, it is important to be careful about where the onus for change resides. Researchers should consider whether the research questions or the research design is expecting the target population to change or whether the emphasis is on systems that prevent the target population from attaining specific goals. For example, a program to build awareness of different CTE courses might say that the goal is to "increase the level of participation in CTE courses of students who are economically disadvantaged to

the same level as their peers who are not economically disadvantaged." The phrasing of this programmatic goal suggests that those who are economically disadvantaged need to change in some way. An alternative way of thinking about this goal may be to "reduce systemic barriers to allow students with low incomes to participate in CTE programming more easily." This shift in phrasing represents a perspective more focused on the system rather than the people.

The research methods and sample need to align with the project's goals and research questions. Most complex research projects require the use of multiple or mixed methods, with quantitative and qualitative components that can be integrated to present a more complete picture (Creswell & Plano Clark, 2017). More fully exploring issues of equity within a research design will require qualitative data to develop a more complete understanding of individuals' lived experiences, the structural factors shaping those experiences, and the frequency of those experiences. Quantitative data can be useful in documenting a problem/need; determining the impact of a program; or understanding more about specific populations, particularly those with unique experiences. In addition, researchers should carefully consider the study's sample and the extent to which it will be able to provide useful information about certain populations or whether statistical adjustments may be needed to ensure adequate representation.

When considering impact studies, it is important to note that randomized controlled trials, in which some individuals receive an intervention and others do not, may be viewed with suspicion in communities that have been taken advantage of by researchers in the past. In thinking about designs, researchers should be open to hearing a community's concerns and considering alternative designs—such as staggered entry or quasi-experimental designs—that maintain rigor but allow all study participants to participate in the tested program.

Guiding Questions

Consider the following questions to implement this stage with an equity-focused lens.

Developing Research Questions

- Do the research questions reflect the experiences, input, and perspectives of the impacted community? To what extent can the research team involve members of the impacted community in developing the research questions?
- What opportunities (in the context being studied) are available to highlight barriers faced by populations that have been historically underserved or marginalized in CTE?
- Do the research questions place the burden of change primarily on the system, versus the individuals or groups facing the challenges? Do the research questions and design recognize the value of individual agency? Research designs ideally should account for multiple levels (e.g., student, school, district).
- How can the research questions move beyond the impact on subgroups to look at the conditions that might be causing those impacts? Can the research questions explore system- or institution-level factors that might result in disparities in impact?
- Are the terms in the project goals and research questions clearly defined? Has the team explicitly stated all the assumptions present in the goal and research questions?

Identifying Methods

- What are the most appropriate methods for answering equity-focused research questions? What opportunities are available for using both quantitative and qualitative methods in the study?

- For impact studies, how can researchers ensure that they are not only looking at the project's average impact but also exploring how it works and for whom?
- How will the research team ensure that the community participating in the study understands the aims of the project and is aware of the research design, what is being asked of them, and what will be done with their data? Are there ways in which the community can be involved in co-creating the research design?

Potential Barriers

All research teams will face barriers in carrying out their optimal design plans. These barriers are usually the restrictions noted earlier. For example, a funder may require that researchers ask specific questions, look at specific outcomes, work with specific groups, or use a specific methodology. Being transparent about those requirements from the beginning can help a research team decide whether (a) the project is consistent with their values of equity and they actually want to do it and (b) there is leeway to expand the focus on equity or get the funder to expand their interests to include equity. Even in situations that require a specific study design (as with some impact studies), there may be opportunities to use different strategies or look at different questions in addition to the primary question.

Stage 3: Measurement and Data Collection

Description

Once a project is designed, the next step is to identify the measures required to answer the research questions. These measures may be quantitative or qualitative and should align directly to the methodology established in the research design phase. After identifying the measures, new instruments may need to be developed to capture the data required. During data collection, the research team gathers and measures information on variables of interest—qualitative, quantitative, or a mix of both. In many ways, these are the first "implementation" stages in the research process. As researchers transition from designing to implementing the research project, they will need to consider several important things, including accuracy, privacy, cost, efficacy, feasibility, and other details of implementation.

Selecting measures and conducting data collection may look very different depending on the nature of the research project. For example, a quantitative project may include administrative data. In this situation, data collection may mean connecting with local education offices and developing legal documents (e.g., a formal data-sharing agreement) to facilitate the use of their administrative data. For a qualitative project, individual experiences, actions, or reactions may be the primary measurement. As such, data collection may be in the form of interviews, surveys, focus groups, or direct observation. Again, decisions on what types of data will be used should be made during the research design phase, but the choice of measures and the implementation of data collection itself carries its own set of challenges.

Selecting and collecting measures in CTE is no different, although researchers should keep in mind a few key ideas specific to CTE (see Dougherty et al., 2020, for a thorough review). First, it is important to remember that CTE potentially involves a relatively wide variety of stakeholders, including students, parents and caregivers, administrators, local businesses, and K–12 and postsecondary partners. This variety means that selected measures may need to cast a relatively wide net to capture the breadth of data required to complete the rich picture of CTE experiences. In the same way, CTE is a complex and multivaried education experience. Whether using administrative data or original data collection, researchers must pay attention to and capture these rich experiences during data collection to ensure an accurate and full view of the CTE landscape.

Implementing This Stage With an Equity-Focused Lens

Maintaining an equity-focused lens when selecting measures and carrying out data collection is crucial to effectively implementing research that respects and maintains the dignity of the population being studied. Actionable Intelligence for Social Policy at the University of Pennsylvania (Hawn Nelson et al., 2020) developed a toolkit for implementing racially equitable research practices. The Urban Institute (Gaddy & Scott, 2020) also has developed suggestions for equitable data practices. These suggestions (and others) inform the following crucial concepts that researchers should keep in mind throughout this stage.

Develop a Deep Understanding of Local Context When Selecting Measurements

When selecting measures for a research project, equity-focused researchers should attend carefully to the local context (Hawn Nelson et al., 2020). CTE is not a one-size-fits-all set of programs, and implementation varies across different contexts. For example, settings for CTE programs include local high schools, CTE-dedicated high schools, regional centers, and community colleges. To ensure that the research captures the breadth of experience and the subtle details of these implementations, a deep understanding of local context is necessary.

Integrate Community Feedback Throughout the Design and Data Collection Process

Regardless of the measurements used, effective equity-focused researchers will work with the community being studied to integrate their feedback throughout the process. In practice, this process may mean a variety of things (e.g., collecting and integrating feedback on survey forms to ensure that potential responses give respondents the opportunity to accurately describe themselves and their experience). Similarly, researchers should collaborate with community leaders to ensure that the sample selected actually represents the population being studied. In the example of a CTE-focused dual enrollment research project, researchers may partner with state policymakers and create an advisory panel of local practitioners and students to get input, such as feedback on the data collection tools.

Examine Administrative Data With a Critical Lens Before Implementation

Often, administrative data (i.e., nonoriginal data) are used in projects to gain a broad look at a population across years. However, these data are inherently limited because they were originally gathered for alternative purposes. An effective equity-focused researcher will keep this in mind and explicitly refer to the limitations of the data source throughout the data collection and analysis process. Many CTE studies use state-level administrative data at the secondary and postsecondary levels. Researchers should carefully consider how these data elements are defined and collected and transparently describe these elements in all reports.

Directly and Explicitly Examine Selected Measures for Implicit or Explicit Bias

Students experience CTE in a variety of ways; thus, researchers have a variety of ways in which to measure that experience. With this variety also comes different scenarios in which bias may impact the measurement of student experiences of CTE (e.g., nonresponse bias in a previously distributed survey). An equity-focused researcher will examine the measures selected, including any tools or surveys, for implicit or explicit bias before reporting generalized results.

Create a "Data Biography" That Carefully Tracks Metadata

Measures and data may come from a variety of sources to capture the rich experience that is CTE. An equity-focused researcher will pay close attention to documentation of "metadata," or "data about the data," throughout the process (We All Count, 2021). Metadata may include who collected the data; how the data are defined; how

the data were collected, including uniformity of collection; why the data were collected; and any effort to minimize bias in collection, even if the original data collection is not part of the project. This "data biography" (Krause, 2019) creates a helpful trail for reproducibility, and the process of creating the biography itself can uncover issues of equity.

Minimize the Collection of Personally Identifiable Data

When selecting measures and implementing data collection, it is generally important to limit the collection of personally identifiable information. This practice is extremely important from an equity perspective because historically disadvantaged populations may be particularly vulnerable to violated privacy (Gaddy & Scott, 2020). Data security should be at the forefront of researchers' mind when using any potentially identifiable information. From an equity standpoint, this mindset is critical because the data collected may be particularly sensitive for some populations, especially those in low-*n* subgroups for whom the risk of identifiability may be higher. Keeping data de-identified also is important for data sharing, which some funders may require.[3]

Limit the Scope of Inquiry to Only What Is Necessary

In general, researchers should identify measures and collect data only to the extent necessary for the project. This issue becomes especially important when considering questions of equity and the burdens that data collection may place on the participants. Additional data collection may elevate the risk of causing harm to participants or place an undue burden on them in the form of additional stress required to respond (Gaddy & Scott, 2020).

Consider Integrating Qualitative Data to Contextualize It

Although quantitative data provide the opportunity for causal and (potentially) generalizable research, too often the context of the data is lost, and the data may "speak for themselves." As discussed more fully in the data analysis section, numbers are not neutral. Providing context can prevent deficit-focused interpretations of the findings. An effective equity-oriented researcher using quantitative data will provide ample context and discussion, potentially by integrating qualitative data as well (Hawn Nelson et al., 2020). For example, a study of CTE and dual enrollment might use administrative data for key outcomes, but descriptive data from surveys and qualitative data from interviews may provide more detailed context and understanding of the aspects of implementation not captured by administrative data.

Guiding Questions

Consider the following questions to implement this stage with an equity-focused lens.

- Are the selected measurements aligned with the methodology and research design? Do the selected measures and tools require any modification to address issues of equity?
- Has the research team effectively integrated community feedback into the measurement design and data collection processes? Have the measurement tools been sufficiently piloted after integrating feedback?
- Is the scope of the data collection limited to what is absolutely necessary?
- Has the research team examined the potential reasons that participants may opt out of data collection and why these reasons may be a potential source of bias?
- Has the research team critically examined the administrative data for inherent biases and addressed these biases in the analysis to the extent possible?

[3] IES Exploration and Efficacy grants require projects to make their data publicly available.

- Has the research team carefully tracked the metadata for the planned measures?
- Did all participants have the opportunity to effectively describe themselves from a demographic standpoint (if required)? If this is not possible (i.e., because of the use of administrative data), has the research team accurately and fully delineated that limitation?
- Is there flexibility in the data collection plan to account for unforeseen issues of equity that may arise?
- Is a data security plan in place that minimizes participants' risk of exposure?

Potential Barriers

A variety of potential barriers may affect the effective selection of measures and the implementation of data collection from an equity-oriented standpoint. First, the use of administrative data limits researchers' ability to be flexible and attend to community needs. These data, not collected for research purposes, may be subject to a variety of biases, including selection or confirmation bias, in which individuals collect data to confirm preexisting beliefs (Hawn Nelson et al., 2020). Although researchers may experience limitations in accessing existing data, this barrier should be acknowledged and addressed throughout the research process.

Potential barriers also arise when using original measures and implementing original data collection. One potential barrier is developing trust within the community being studied. Researchers may not be in close contact with the study participants prior to data collection; this is inherently a barrier to community-integrative practices. Other barriers may be time or cost related. For example, consider the cost of developing original data collection tools that effectively reflect the population to be studied. An equity-focused researcher may need to spend more time engaging with the community to develop such tools in a way that attends to equity rather than using a prewritten product, which can have cost implications.

Stage 4: Data Analysis

In the data analysis phase of a project, researchers make crucial decisions about how to use the data collected to answer their research questions. At its root, data analysis consists of categorizing inputs and outputs into relevant groupings and drawing connections between them. Qualitative analysis includes activities such as developing codes for qualitative analysis and applying these codes to interviews. Quantitative analysis includes activities such as data coding, cleaning, and the application of statistical tests.

Implementing This Stage With an Equity-Focused Lens

Applying an equity-focused lens in CTE data analysis and the interpretation of findings asks that researchers be aware of structural barriers to quality CTE that certain groups face (e.g., women, students of color, students with disabilities) and disparate outcomes, including participation in postsecondary education and high-wage employment. This section details specific equity-related issues associated with qualitative and quantitative data.

Qualitative Data Analysis

Qualitative data, such as interviews or observations, are collected to gather information about how CTE programs have been implemented, the quality of CTE programs, and student experiences in programs. Qualitative data also may provide insight about why students participated in CTE and how this participation influenced their postprogram education and employment outcomes. Qualitative information can be used to glean insights into factors external to the CTE program, such as school climate, community context, and family socioeconomic status, that impact student participation and outcomes. Qualitative data are typically analyzed by applying codes

that capture and categorize information about different aspects of the CTE program, including opportunities and challenges in implementation, participation, and completion, as well as countervailing or supportive external factors. Codes and connections between them are then analyzed to answer the research questions.

When coding interview data, the Child Trends Equity Framework (Andrews et al., 2019) encourages researchers to disaggregate the analysis of responses by relevant groups, when possible, and note if some codes or categories apply more readily to some groups than others and why this may be the case. For example, does the CTE program have aspects that some groups do not have access to? Was student participation encouraged or supported differently by different groups? Disaggregating the analysis of codes will enable researchers to uncover structural barriers to quality CTE and equitable outcomes and highlight group differences in CTE experiences.

Another recommendation in the Child Trends Equity Framework is to include coders from different groups and backgrounds to bring different perspectives to the development, application, and interpretation of the coding. Ongoing discussion about how coders interpret and apply codes can help researchers identify their underlying assumptions and biases about the CTE program and group participation and outcomes. When these biases remain uncovered, they can inadvertently influence the interpretation of a study's findings. For example, researchers who assume that girls and young women are not interested in advanced manufacturing programs may not pick up in interviews the implicit bias that high school girls can face when entering programs dominated by boys and young men. Finally, the Child Trends Equity Framework encourages researchers to highlight voices from all relevant groups in the presentation of findings to demonstrate that wide-ranging experiences and outcomes were considered to inform the conclusions.

Quantitative Data Analyses

Emerging scholarship in critical approaches to quantitative methods (e.g., quantitative critical theory) has brought our attention to how quantitative analysis is not without embedded biases (Gillborn et al., 2018). Biases creep into all aspects of data analysis, from coding and cleaning data to estimating and interpreting the findings. A key insight of quantitative critical theory and related scholarship is that categories of gender, race/ethnicity, and other socially constructed demographic groupings capture the role of structural systems of oppression, which are hard to observe and tease out of limited datasets. In other words, gender, race/ethnicity, and other demographic categories are not only categorical variables but also outcome variables that capture the impact of sexism, racism, and other "isms" that emerge from social, educational, and economic processes and power dynamics. Making the invisible structures of oppression visible is the challenge for quantitative researchers. When this is not possible, researchers must be transparent about the limitations of the analysis to do so. This approach to making structural barriers more visible in the analysis also will help address what has historically been a bias toward "deficit approaches" in education research. In deficit approaches, learners are blamed for educational and outcome gaps, and structural barriers contributing to gaps remain unexamined (Davis & Museus, 2019). To more accurately capture the lived experiences of individuals impacted by gender, race/ethnicity, and other demographic barriers, researchers should use strategies to minimize biases and clearly articulate the limitations of quantitative analysis. Specific strategies for minimizing biases are as follows.

Creating the Dataset. After data collection, data analysis starts by creating the variables for statistical analysis. The main equity consideration for this activity is the coding of gender and race/ethnicity variables that allow for subgroup analyses. To explore differences by groups, we must define the groups in ways that make them visible. The delineation of groups will be constrained by how the data were collected. With federal and state education data systems, for example, researchers are limited by how questions about gender, race/ethnicity, disability, family income, and other characteristics are designed in data gathering tools. For example, data systems might employ a binary male or female category for gender, which forces people into a gender with which they may not identify. Race and ethnicity may be constrained similarly depending on which choices are available to

respondents and whether respondents can check "all that apply." When reviewing and presenting their methodology, researchers should note constraints in group selection because of data collection.

When respondents can select multiple categories for gender, race/ethnicity, and other demographic categories, researchers next need to decide how to categorize the respondents for analysis. For example, should someone who chooses Black and Hispanic/Latinx be placed into the same group as someone who chooses White and Hispanic/Latinx? It would be preferable to create two different groups to capture the "intersectional" reality of people's race/ethnicity and other identities. As noted by Strunk and Hoover (2019), the practice of "collapsing" small race categories can be overly simplistic and render intersectionality within groups invisible. More fine-grained categories enable researchers to discern with more specificity how these "social locations" of gender, race/ethnicity, and other demographic categories impact CTE program structures, participation, and outcomes. However, small sample sizes might pose a challenge to not only analysis but also the protection of confidentiality. When fine-grained groupings are not possible, it may be useful to run estimations using different kinds of race/ethnicity groupings to test the robustness of findings on these variations. Another strategy would be to oversample people in groups of interest to build up sufficient sample sizes for robust analysis.

An additional consideration in creating subgroups for the dataset is how to code respondents who do not self-identify their gender, race/ethnicity, or ability. One strategy would be to include a "nonresponse" category in the data analysis and compare outcomes with other groups. In addition, observations in the tails of the distribution often are dropped from the analysis as outliers. Because gender, race/ethnicity, ability, and other demographic categories often are clustered in these tails, researchers should explore how leaving them out of the analysis impacts findings on the between- and within-group differences in CTE participation and outcomes.

Structuring the Analysis. Many issues associated with structuring the analysis must be considered, such as the formation of a comparison group, selecting a sample, selecting the counterfactual, and estimating the results.

Comparison Group. In examining gender, racial/ethnic, and other demographic differences in program participation, persistence, or outcomes, researchers must decide what the relevant comparison group will be. Which gender or racial/ethnic group will be "centered" as the key comparison group against which to compare all other groups? Strunk and Hoover (2019) raised the concern that if marginalized groups are compared with only those who face few barriers, then their outcomes will be seen as deficient. One way to address this concern is to run estimations with different centering groups to test the impact on the findings. In addition, to make more visible how the intersection of gender, race/ethnicity, and other processes work, researchers can conduct within- and between-group comparisons of key participation and outcome variables. In the example CTE-focused dual enrollment study, researchers could examine the results for subgroups and use techniques such as cluster analysis to explore intersecting identities.

Counterfactuals. In Ross et al. (2020), the authors ask us to consider the following: "Do the opportunities and environment of control group students reflect the environment that program participants would have experienced if they had not been in the program?" (p. 3). The same question should be asked for gender, race/ethnicity, and other demographic categories. More specifically, researchers need to document whether and how the counterfactual conditions might vary by group (e.g., gender, race/ethnicity). Because of gendered and racialized differences in schools and programs (and their resources), the experiences of women and students of color in the nontreatment group may vary compared with White men; they cannot be presumed to be the same. These authors further noted that "careful documentation of differences in resources, peers, CTE classes, and other CTE activities (e.g., WBL) is important for understanding the impacts of CTE" (Ross et al., 2020, p. 27). To understand the counterfactual, researchers must consider how gender, race/ethnicity, and other social locations may shape these differences.

Sample Selection. In CTE research, investigators often are analyzing the outcomes of a CTE program that is not randomly offered to all students, in which there is student choice to enter the program and/or school selection of students based on eligibility criteria and assessments. These underlying selection criteria will introduce selection bias into the estimation results, such that factors responsible for selection into the program will be picked up in estimation coefficients and attributed to the program (not selection into the program) if the bias is not adequately accounted for. As noted by Dougherty et al. (2020):

> The fact that students sort into CTE based on interest or other personal considerations means that in nearly all instances, the individuals who choose to concentrate their studies in CTE differ from those who did not in important ways. Those differences, almost by definition, cannot be observed, meaning that most attempts to quantify the impacts of CTE leave large concerns about omitted variables bias. (p. 2)

To reduce selection bias, researchers can draw on many techniques to account for how students opt into CTE programs, schools, and interventions. In research designs, these techniques can include randomized controlled trials, discontinuity designs, quasi-experimental designs, propensity score matching, instrumental variable approaches, and two-stage estimations. These procedures aim to control much of the observed and unobserved factors contributing to program selection, although they are not without limitation. Regression discontinuity designs, for example, do not support inferences about students located far from the cut-off score, whereas propensity score matching may exclude some types of students who cannot be matched because they are not included in common areas of support.

From an equity-focused lens, complications include the possibility that not only individual factors but also group factors may impact selection. For example, because of occupational segregation, women and men may face a very different feasible choice set in the selection of fields of study: Women are less likely to enter advanced manufacturing, and men are less likely to enter nursing for reasons that relate to their perception of a feasible social role for their gender. In skill assessments for placement, students who perceive their race/ethnicity as a stigma to entering a field in which they are underrepresented may be underselected by the assessment tool for entrance into the program because of instrument bias and/or stereotype threat (Spencer et al., 2016). For internal validity, researchers need to understand how participation in a CTE program, school, or intervention is shaped by gendered, classed, and racialized social processes, including sexism, classism, and racism. Investigators could explore possibilities for using selection bias tools to control for these kinds of processes.

Strategies to address selection bias in analysis could include estimating a group selection effect and an individual effect or participation. For example, if researchers use a discontinuity design to analyze the impact of an intervention, they could explore how variation around the cutoff varies by groups. Additional information about participation could be ascertained from qualitative data on program implementation, with specific data on the experiences of different gender, race/ethnicity, and other demographic groups. For example, suppose that WBL is part of a CTE intervention, and the data show that Latinx men are far less likely than White men to participate in the intervention. Without knowing more about the source of this difference in participation, a regression that examines ethnic differences in the impact of internship on employment outcomes would be difficult to interpret or could be misinterpreted in a way that perpetuates deficit narratives about Latinx men. Would the coefficient for Latinx men be different if more men participated? Documenting gender and racial/ethnic differences in opportunity structures that shape selection into programs (and their translation into outcomes) can help researchers grasp how unobservable factors drive participation and their correlation to outcomes. With qualitative data, researchers can come to a fuller understanding of how program implementation impacts participation in ways that can reproduce gender and racial/ethnic (and other demographic group) differences in outcomes.

Qualitative data collection is an important investigative tool for shedding light on possibilities of group selection bias. Even if these biases cannot be controlled for in the data analysis, the qualitative information can help investigators incorporate equity and bias insights when interpreting the quantitative findings.

Estimation (or Multivariate Analysis). Many researchers incorporate demographic characteristics as covariates in regression analyses. The problem with this process is that it does not consider the possibility that the relationships between variables may differ by group. One way to handle this potential problem is to run a subgroup analysis. In multivariate analysis, accounting for group membership (e.g., gender, race/ethnicity) with a binary variable forces the coefficients for the other independent variables to be the same across groups, which is an unlikely assumption. Running regression separately by group allows for the possibility that the independent variables are expressed differently across groups (Joy, 2003). This method also addresses the centralizing issue when White males are the comparison group. For example, research previously established that skill ratings depend on the gender and race/ethnicity of those being rated (Collins & Bilge, 2016). Because of labor market discrimination, interests, skills, and competencies do not translate into opportunities in the same ways across groups in ways that will be captured in estimated coefficients, significance, error, and bias. Running analyses separately by group (unpooled) frees up the estimated coefficients to capture these group differences. Oaxaca-type decompositions can measure how much of the variation in the independent variable is accounted for by group differences in the "independent" variables versus group differences in the translation of these variables into the outcome (coefficients). Researchers also can use this technique to measure group differences in observed versus unobserved factors impacting outcomes, allowing researchers to capture how well models explain variation across different groups and what remains unexplained, pointing to structural differences in treatment (Jann, 2008). Researchers can incorporate interactions between group variables and other covariates into their regressions, although these can be harder to interpret. Seemingly unrelated regression analysis, which considers the interrelationships between unobservable underlying different outcomes, is one way to see whether subgroup treatment heterogeneity might change baseline disparities (Moon & Perron, 2006).

An additional concern for estimation is that the individual error terms may not be heteroskedastic but vary systematically by gender and race groups. For example, Heilmann (2021) showed that the relationship between numeracy and literacy skills and income and labor market position is not linear for women as it is for men. Adding a group error term in the regression model would help make this explicit. Attrition bias also might vary by groups if the reasons for leaving the sample vary systematically by group-level factors. Including a group-level estimate for the probability of staying in the sample (for repeated measures of outcomes across time) could help reduce this kind of bias. In general, missing data analysis should consider whether certain groups are systematically absent from the data, and, if so, why this might be the case. Imputations to correct for missing data must consider these systemic group absences.

Interpreting the Findings. A key consideration for the interpretation of findings is what the gender, race/ethnicity, or other demographic variables are measuring. In most cases, it will be a combination of macro/social, meso/organizational, and micro (individual and interpersonal) factors that drive group differences in participation and outcomes. The magnitude of and variance in unobservables will vary by group. This idea, as developed in critical race, intersectionality, and feminist economic theory, is that the group is not only an individual identity but also a social process, a social location, and a dependent variable (Solórzano & Orelas, 2002). As discussed by Zuberi and Bonilla-Silva (2008), presenting race as a cause in statistical analysis can hide the underlying factors correlated with race that contribute to differences in group outcomes. Zuberi (2001) further noted, "It is not a question of how race causes disadvantage and discrimination. The real issue is the way society responds to an individual's race" (p. 101). To the extent possible, researchers should consider how group-level gaps in CTE participation and outcomes is shaped by the systemic and institutional practices and policies that re-create marginality. Qualitative inquiry can help shed light on the interpretation of findings, especially when studying how

the implementation of CTE programs might differentially impact outcomes by groups. For example, if the coefficient on WBL participation on wages is lower for Latinx women, qualitative data may help researchers identify the root cause of this difference in the quality of and access to WBL experiences originating at the school or programmatic levels.

Guiding Questions

Consider the following questions to implement this stage with an equity-focused lens.

Qualitative

- Are codes applied differently to different groups in ways that bias the analysis?
- Have researchers explored ways in which implicit bias has potentially impacted the development, application, and interpretation of the codes?

Quantitative

- In variable creation, have groups been defined and compared in ways that make them visible and nonmarginalized?
- Have controls for sample selection considered group differences in access to CTE programs?
- Have group differences in the counterfactual been identified?
- Have group differences in the returns to factors and unobservables been accounted for in the estimations?
- When interpreting the findings, are any structural barriers impacting group participation and outcomes included along with individual factors?
- Have qualitative and quantitative findings been integrated in ways to complement and expand understanding of student experiences and program implementation?

Potential Barriers

Researchers face numerous barriers in trying to plan and conduct analyses equitably. Many of these barriers center on the ability to appropriately and accurately identify subgroups, account for differences in group access to programs in outcomes analysis, and tease out structural barriers to participation and outcomes. Researchers can work to ameliorate bias by (a) allowing survey participants to self-identify their gender, race/ethnicity, and other demographic categories; (b) leveraging statistical measures to tease out individual and institutional impacts on student participation, persistence, and outcomes; and (c) using qualitative findings to interpret statistical analysis. When this is not possible, researchers should ideally discuss the limitations of their methods in their findings.

Stage 5: Cost and Resource Equity

Analysis of Cost and Resource Allocations in Equity-Focused Research

Economic evaluation, or the analysis of cost and resource allocation, often is overlooked in educational research (Levin, 2001). However, as recognition of its importance grows, researchers are using it with increasing frequency (Sparks, 2019). Analysis of cost and resource allocation is fundamental to equity-focused research. In addition to building understanding of what resources are required to implement an education intervention with fidelity and

helping policymakers consider the cost-effectiveness of various programs, cost analysis enables researchers to understand whether resource distributions are equitable (Hollands et al., 2021).

At an institutional or programmatic level, fiscal inequity occurs through differential access to scarce resources. Do some students and communities get more—and others less—of the educational experiences that open options for a more fulfilling future, including a lifetime income that supports human flourishing? Too often, the answer is yes. Further, fiscal inequities often reflect and perpetuate systems of oppression grounded in racism, sexism, classism, and ableism that limit the opportunities of people who hold marginalized identities. In contrast, fiscal equity may involve unequal allocations that invest additional resources in particular groups of students who have been historically underserved (Jordan, 2010; Kornhaber et al., 2014). Analyses of cost and resource allocation shed light on whether fiscal inequities exist and how those inequities are structured.

Description of Cost Analysis

The starter kit for cost analysis (IES, 2020) shows how to measure the costs (p. 6 and Table 10) of education programs in general. Costs are resources used as "ingredients" in a program. These ingredients include actual staff time, actual materials and equipment, and other things counted in physical units, not dollars. Budget allocations almost never provide accurate information on these "real" ingredients. For instance, a teacher may be budgeted to spend 20% of their time on a particular course, but, in reality, the teacher may spend a good deal more, or less, than 20% of their time on that course. The budget can tell you that the teacher's salary comes from a particular source, but it cannot tell you how much time—the real "ingredient"—is actually going into the course. Cost analysis usually must go beyond budgets to collect information more directly through interviews, surveys, time records, and other documents. This is especially true in CTE programs because much of the student experience takes place in settings other than standard classrooms. Once the amounts of time and other physical ingredients are measured, the IES guide explains how to convert them back to dollars by using comparable prices and salaries.

Implementing This Stage With an Equity-Focused Lens

From an equity standpoint, one issue is the disproportionate participation of different groups in different parts of a CTE experience. Another issue is the disproportionate enrollment of different groups in high- and low-cost programs. Whether within a program or in comparing different programs, if students from affluent circumstances are getting more resources, a more equal allocation of resources per student (or an unequal allocation that favored students who are less affluent) would create more opportunities for students from low-income families.

Cost analysis is central to assessing equity in CTE because of the nature of the programs, which usually include not only coursework but also other distinctive elements not part of ordinary classroom instruction, and which may require substantial resources (e.g., WBL or the use of expensive equipment). Researchers should account for the costs of such resources even when they are borne by school partners rather than schools themselves. To measure equity in the distribution of resources across programs requires program-level data, but measuring the distribution of resources among subgroups within a program requires individual-level student data not ordinarily available from student information systems. Constraints on real resources necessitate various forms of rationing between programs, giving rise to questions about access to different programs and access to different components within programs, resulting in some students missing out on some elements. In programs of study that include internships, for example, it often is not possible for every student to be placed because of a shortage of placements or a lack of school staff to find, schedule, and manage placements. Researchers analyzing intraprogram equity therefore would have to use their own student surveys, observations, and other procedures to determine which students actually participated in the various experiences offered by the program.

School and college budgets often limit the ability of CTE programs to offer components such as WBL, up-to-date equipment, an integrated curriculum, and co-curricular activities. Even when bigger budgets are available, CTE programs in some locations may not find enough qualified instructors or committed partners from industry or postsecondary education. For example, geographic location matters in determining the kinds of employment and instructional experiences that are available and relevant. Budgetary or resource constraints mean it is often not possible for schools and colleges to offer every student a high-quality WBL experience or a curriculum that integrates technical and academic content so that program completers have a full range of future options for postsecondary employment and further education. High school master schedules, advising, and restrictive admissions policies in some CTE programs are among the mechanisms for limiting access to high-quality CTE programs. For example, a capstone CTE course for high school seniors may be scheduled at the same time as an Advanced Placement course, forcing students to choose. These rationing mechanisms result in differential access to resources both across and within programs.

For example, in the evaluation of the CTE-focused dual enrollment program, researchers might conduct a cost analysis that incorporates the costs of components such as WBL, career and college planning, integrated curriculum, specialized equipment, or other costly features not found in every program. The program evaluation could go beyond this to examine whether access to and resources provided for these specific program components are correlated with race/ethnicity, socioeconomic status, or gender—between or within programs.

To summarize, CTE researchers investigating equity with data on multiple programs can and should—and to some extent already—do the following:

- Use the ingredients method at the program level to measure cost in a consistent and economically meaningful way (not relying on only program budgets), as described in the IES starter kit (IES, 2020).
- Compare the enrollment of different sociodemographic and geographic groups in high- and low-cost programs.
- Compare longitudinal progress and outcomes of different groups within and between programs to allow for the examination of cost effectiveness.

In addition, CTE researchers investigating equity in resource allocation within a particular program can do the following:

- Collect information from individual learners to compare participation in different resource-using activities as part of the CTE experience (internships, field trips, use of special equipment or software, integrated curriculum, cohort scheduling, career exploration and planning, trips to CTE student conventions, perhaps others).
- Compare within-program participation rates of different sociodemographic groups in each resource-using component of the CTE experience.
- Provide cost information to compare longitudinal outcomes by subgroup and cost.

In addition, qualitative information from interviews and public documents would illuminate the processes that influence which students participate in which programs and experiences and how administrators explain any group disparities in enrollment, experience, or outcomes. These kinds of data could shed light on the causes of inequities in resource allocation.

Guiding Questions

Consider the following questions to implement this stage with an equity-focused lens.

- Are researchers fully conceptualizing the different resource-using components of a CTE program?
- Does the research capture the extent to which those costly components are differentially provided for students from different groups?
- Are researchers comparing participation by different groups in high-cost and low-cost programs?
- Does the research capture within-program differences in exposure to costly activities that are provided to some but not all learners in a particular program of study?

Potential Barriers

Individual student participation in various parts of a CTE experience may not be recorded in the student information system, although some may be, particularly WBL. Teachers, program directors, administrators, and policymakers all could use more complete information, but it is costly to collect. For example, collecting more complete information would involve recording in the student information system details such as whether a student travels to a weekend convention of the state or national student organization, with which some CTE course objectives are intentionally aligned. CTE researchers will have to fill in the information missing from administrative data by using their own instruments. Offering to help CTE programs incorporate parts of these instruments into their own information system would be a contribution to the field. Here is an opportunity to improve both research and practice in CTE.

Stage 6: Reporting and Dissemination

The final stage of the research process is reporting and disseminating the research findings. Researchers synthesize the results, place them in context, and create a narrative. After creating this narrative, it is disseminated to relevant audiences who are expected to use the results. Equity challenges can be present at any stage of this process.

Traditional reporting and dissemination approaches often involve the creation of a final report or a research article for a peer-reviewed journal, which is predominantly read by other researchers and will not easily reach the people who could benefit from it. However, to reach broader audiences—including CTE practitioners, administrators, business or industry partners, and students—researchers are now recognizing the importance of disseminating findings using a wider variety of approaches, such as websites, policy briefs, webinars, and social media platforms. In addition, a broader effort is ongoing to increase transparency in educational research by making datasets publicly available.

Implementing This Stage With an Equity-Focused Lens

Using an equity-focused lens on reporting and dissemination requires paying attention to the interpretation and narrative and designing dissemination strategies that can reach different audiences.

Reporting

According to We All Count, the reporting phase has two distinct steps: (a) interpreting the results (which come from the data analysis phase described earlier) and (b) creating a narrative that places the interpretation in context and often includes recommendations.

Interpretation. Interpretation is critical in equitable research. We All Count (2021) has four ways in which the interpretation must match the analyses. First, the definitions and language used in the interpretation should match the definitions and language used throughout the rest of the research. This statement might sound self-evident, but it can be easy for report writers to slightly change the language, resulting in using a different definition from what the group originally agreed on. The interpretation also should be relevant and match the context and perspectives on which the research was centered. Researchers should make sure that the interpretation is consistent with the techniques used so that they are not overstating the implications of the findings. Finally, researchers should be clear about the level of certainty in their findings. For example, in reporting findings from any CTE study, researchers should clearly describe any uncertainty related to the impact findings.

Creating a Narrative. The narrative takes the interpretation of the results and places it in context, suggesting what should happen next. In creating this narrative, CTE researchers should be thoughtful and intentional about the choices they make when deciding how and what to present. The interpretation and accompanying narrative can differ depending on how researchers think about the answers to questions such as the following:

- Were the results good, bad, or uncertain and for whom?
- What do those results look like in context (by whose standards and what counterfactuals are you judging the results)?
- What should change as a result of your findings?
- How should CTE stakeholders modify behavior as a result of your work?
- What information was missing?

The Child Trends framework thinks of this narrative as “messaging” and recommends that researchers share their findings with representatives from the populations who contributed data so that they can make recommendations about the types of language to use in reports and presentations. For example, researchers should share the findings with both policymakers and a panel that includes various CTE stakeholders, such as business partners, CTE practitioners, and students participating in CTE.

Researchers also should be careful about the language in their narrative to avoid blaming the individuals or groups who might be experiencing challenges and move the responsibility from individuals to the system. For example, instead of emphasizing only the outcomes of a project (e.g., Black students were less likely to take CTE-focused dual enrollment courses), the messaging can focus on broader systemic issues that appear to be driving the outcomes (e.g., schools with higher percentages of minority students had lower participation in CTE-focused dual enrollment) followed by explanations of possible systemic issues (e.g., lower resources in those schools, lower expectations for students) coming from qualitative or descriptive data.

Dissemination

As CTE researchers disseminate their findings, they should begin by considering the audience that they are trying to reach. For each type of audience, researchers should consider the content, the medium, and the extent to which people have access to the information. It also is important to think about the timing of dissemination activities.

Audience. In addition to the standard audiences of funder(s), policymakers, practitioners, and other researchers, CTE research projects have a range of audiences, such as employer partners, local industry associations, community organizations that train or host interns, parents, students, CTE and academic instructors, community college instructors, and program staff. Multiple existing equity frameworks show that a key audience should be the individuals from whom the researchers collected data, many of whom “share intimate details of their lives and are often abandoned after the research project ends—left without knowing or understanding the findings of the research to which they contributed” (Andrews et al., 2019, p. 24). Different audiences will then require different content, media, and ways of accessing information.

A key audience for CTE research can be national or local CTE organizations, such as Advance CTE or the National Council for Workforce Education. These organizations will need guidance on how to interpret and disseminate the findings. For example, if the CTE research does not use a strong causal design, advocacy organizations will need to understand any relevant caveats and how their language about the findings might need to be appropriately tempered.

Content. In developing the appropriate content for specific audiences, researchers need to make choices about the content included in the narrative (e.g., the findings, the amount of detail about the methodology), the type of language used, and the tone and perspective. Likely, there will be a need for some cultural translation or a review to ensure that the language and symbols are appropriate for the audience. Researchers also may want to consider, as appropriate, including content that emphasizes potential solutions for equity problems.

Medium. Today, researchers can use many kinds of media, and the selection of media should take into account the needs of the audience. To reach community members or business partners, researchers may want to consider the following: doing presentations at community events, distributing briefs or infographics through community channels, and doing interviews with local newspapers or television stations. Members of the community also can provide input on how to best reach this audience.

Access. Although access is related to the medium, paying specific attention to issues of access allows the researcher to identify potential challenges to the dissemination strategies. It is important to think about the requirements that are in place to read and understand the research results. Some things to consider are whether (a) a specific technology is needed to access the materials, (b) the findings are behind a paywall, and (c) people need a certain level of training to understand it. Access is definitely an issue for individuals who need accommodations because of visual or auditory challenges. Researchers also should think about ways in which people can provide feedback about the content.

Timing. For research to have the maximum impact, researchers also should consider the extent to which their research and dissemination timeline aligns with the timelines for planning of the organizations who would implement the recommendations. For example, if a researcher intends to influence CTE legislation, it would be appropriate to disseminate findings when the legislature is in session and before they are making decisions. On a smaller scale, if a researcher wants to influence CTE program implementation in school, it would be best to disseminate research in the winter or spring when planning for the following year is underway.

Data Sharing

More and more people are interested in making the underlying data from the research available to both researchers and the individuals who provided the data, presuming that issues of privacy and confidentiality can be adequately protected. Child Trends recommends holding a “data party” (i.e., a co-interpretation session), inviting community members and stakeholders so that they can “engage [with] and discuss the data. These parties allow participants and community stakeholders to discuss patterns within the data, the implications of the data, and what changes can be made in their community” (Andrews et al., 2019, p. 25). Such a session also could occur during the analysis phase, prior to dissemination.

Centralized repositories now can house data and make it available to researchers, such as the Inter-university Consortium for Political and Social Research (ICPSR) at the University of Michigan. ICPSR also houses the Registry of Educational Effectiveness Studies, where researchers can preregister their designs and then provide findings in a public database.

Guiding Questions

Consider the following questions to implement this stage with an equity-focused lens.

Reporting

- To what extent is the interpretation consistent with the definitions, context, and perspectives represented in the research design? Are the interpretations consistent with the methods and do they reflect the appropriate amount of certainty?
- Whose perspective is represented in the narrative created from the research findings? To what extent is this perspective transparent to the consumer of the research?
- Does the narrative emphasize the systemic nature of the issues and abstain from blaming individuals?
- Have representatives from the groups being studied reviewed the findings and recommendations? Have those groups provided input on messaging and language?

Dissemination

- What audiences are appropriate for this research? Are the research participants one of those audiences?
- Is the content appropriate for the targeted audience?
- Is the information disseminated through a variety of media that are appropriate to the audience?
- Have representatives from different audiences provided input on dissemination strategies?
- Is the work accessible in terms of language and mode of delivery? Does it meet accessibility guidelines for individuals who are visually or auditorily impaired?
- Is dissemination occurring at a time that aligns with organizational planning cycles?

The Urban Institute's *Guide for Racial Equity in the Research Process* has an excellent selection of specific questions related to the different types of dissemination strategies, including consideration of equity in events, communications planning, use of social media, and stakeholder outreach.

Data Sharing

- Honoring data security and privacy concerns, what data can be made available to stakeholders and other researchers?
- Where can those data be housed so that they are accessible? Has the research team explored data repositories such as the one at ICPSR?

Potential Barriers

Most barriers to dissemination occur because this stage is usually an afterthought, with insufficient resources dedicated to it. Best practices would have researchers plan for dissemination at the beginning of the project, specifically allocating adequate staffing, funding, and time. Effective dissemination requires specific skills, but not all researchers will possess those skills or have access to a team with those skills. This concern can be assuaged if CTE researchers recognize this fact at the beginning and plan to contract out a portion of the dissemination work to a group that understands the targeted audiences and integrates an equity-focused lens into their practices.

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Zuberi, T. (2001). *Thicker than blood: How racial statistics lie*. University of Minnesota Press.

Zuberi, T., & Bonilla-Silva, E. (Eds.). (2008). *White logic, White methods: Racism and methodology*. Rowman & Littlefield.

Resources

The workgroup found the following resources very useful in developing this framework.

Andrews, K., Parekh, J., & Peckoo, S. (2019). *How to embed a racial and ethnic equity perspective in research: Practical guidance for the research process*. Child Trends. https://www.childtrends.org/wp-content/uploads/2019/09/RacialEthnicEquityPerspective_ChildTrends_October2019.pdf

> This working paper provides guidance, toolkits, and resources on how to incorporate a racial and ethnic equity-focused lens into child and youth research.

Association for Career & Technical Education. (2018). *High-quality CTE: Access and equity*. https://www.acteonline.org/professional-development/high-quality-cte-tools/high-quality-cte-library/access-and-equity/

> ACTE's Quality CTE Program of Study Framework lists toolkits, articles, and guides for researchers, educators, state agencies, implementers, and funders. The goal is to provide resources and strategies to help you develop and support access and equity in high-quality CTE programs.

Cerna, O., & Condliffe, B. (with Wilson, A.). (2021). *Guiding questions for supporting culturally responsive evaluation practices and an equity-based perspective.* MDRC. https://www.mdrc.org/sites/default/files/Equity-Guiding_Questions.pdf

> This document offers guiding questions, definitions, and considerations for each stage of evaluation to encourage culturally responsive evaluation and an equity-based perspective.

Gaddy, M., & Scott, K. (2020). *Principles for advancing equitable data practice*. Urban Institute. https://www.urban.org/sites/default/files/publication/102346/principles-for-advancing-equitable-data-practice.pdf

> This document promotes common values, relevant resources, and the importance of an equity-focused lens throughout the data life cycle.

Krenn, H., & Community Science. (2021). *Doing evaluation in service of racial equity*. W.K. Kellogg Foundation, Every Child Thrives. https://everychildthrives.com/doing-evaluation-in-service-of-racial-equity/

> This three-part series of practice guides shows how to incorporate racial equity as a core value into evaluation.

Urban Institute. (2020). *Urban Institute guide for racial equity in the research process.* https://www.urban.org/sites/default/files/publication/103102/urban_institute_guide_for_racial_equity_in_research_process_0.pdf

> This guide provides equity-focused questions for researchers to consider while developing each stage of the research process.

We All Count. (n.d.). *The data equity framework.* https://weallcount.com/the-data-process/

> This framework breaks down data projects into a seven-stage systematic process with tools, checklists, and practices for researchers and data scientists to make more intentional and equitable decisions.

1400 Crystal Drive, 10th Floor
Arlington, VA 22202-3289 | www.air.org

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www.air.org

www.acteonline.org

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www.vanderbilt.edu

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