Career & Technical Education
RESEARCH NETWORK 2.0

Impacts of Work-Based Learning Programs on Student Outcomes

A Systematic Review and Synthesis

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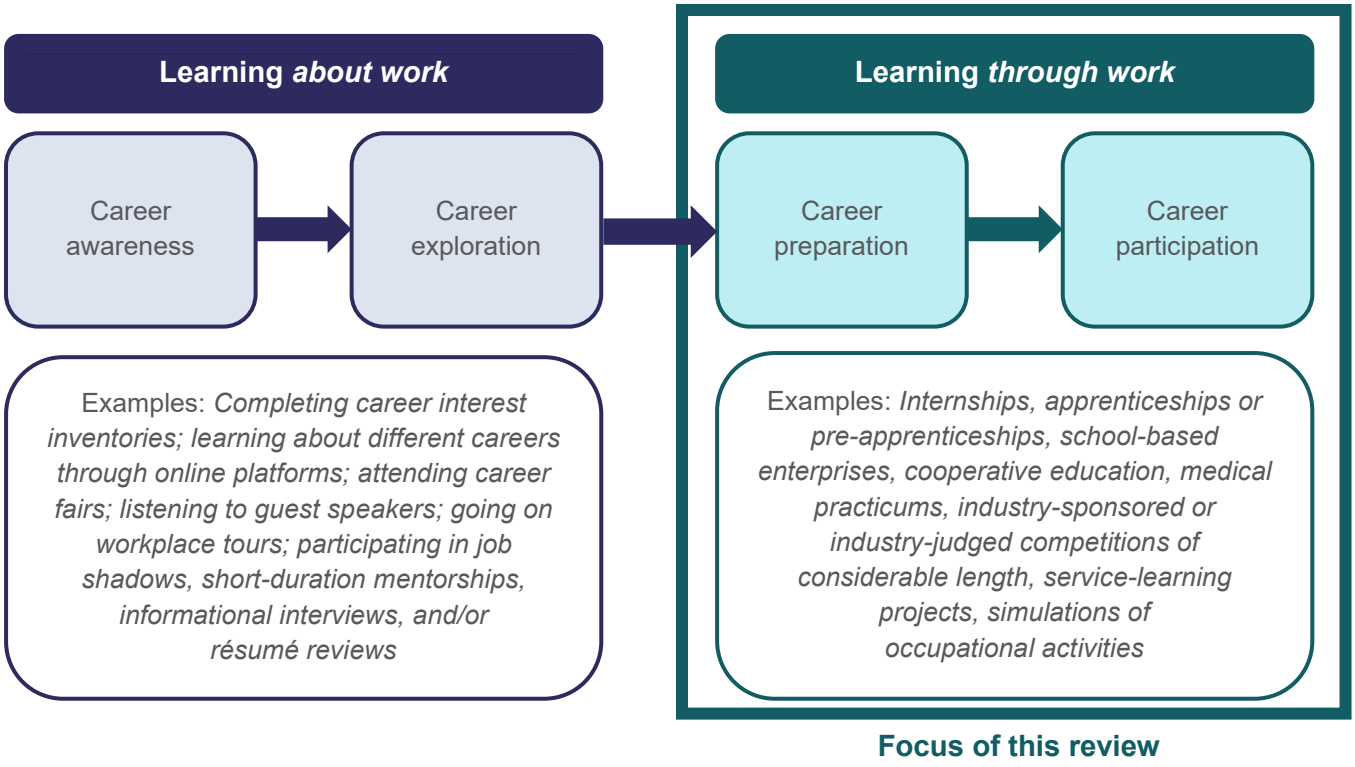
Introduction: What Is Work-Based Learning?

Work-based learning (WBL) incorporates authentic, real-world work exposure into a learner's educational experience. Many career and technical education (CTE) programs and career-connected learning models feature WBL as a prominent component (e.g., Association for Career and Technical Education [ACTE], n.d.; Jobs for the Future, n.d.; Linked Learning Alliance, n.d.; NAF, n.d.). Definitions and implementations of WBL vary, but most frameworks situate it as a continuum of experiences (e.g., ConnectED, 2021). Early WBL experiences often begin for students in middle school and focus on career awareness and exploration activities, described as "learning about work." Engagement with industry professionals and work activities typically increases for participants in age-appropriate durations over time. Moving along the WBL continuum, experiences shift into "learning through work," focusing on career preparation, participation, or immersion activities. Exhibit 1 shows four phases of this continuum, with examples of WBL activities.

Exhibit 1. Typical continuum of work-based learning



Text Box 1. Increasing Prevalence of Work-Based Learning in Education Policy and Practice

Work-based learning (WBL) participation and policy requirements are expanding. For example, more than half of states now include annual reporting of WBL participation as a career and technical education (CTE) program quality indicator. Among those states, WBL participation for students concentrating in CTE is projected to reach nearly 50 percent by 2029 (based on state-determined performance levels in the 2023–24 national state profile summary; Office of Career, Technical, and Adult Education, n.d.a). While this would represent a large increase in WBL participation, it likely underestimates future student participation, given the growing interest in WBL among policymakers and demonstrated bipartisan support (U.S. Congress, 2025). Tracking WBL engagement is challenging, however, due to the varied opportunities available (e.g., summer work programs, apprenticeships) and a lack of comprehensive data systems recording student participation beyond formal CTE programs (Goldring & Urban, 2024; Shields et al., 2024).

Our Study

The CTE Research Network conducted a systematic review and meta-analysis to document the impacts of WBL programs that are specifically at the "learning through work" end of the continuum (exhibit 1).[1] The review was motivated by two realities: (a) WBL is prevalent and increasingly common in the United States, and (b) current understanding of WBL impacts on participant outcomes is limited. To provide insights for practitioners and policymakers seeking to optimize their WBL programming, we comprehensively searched, cataloged, and synthesized all available evidence from eligible WBL program evaluations. Our goal was to quantify the presence and magnitude of WBL impacts on participant outcomes, and to identify effective conditions for types of WBL.

For the purposes of this review, we focused on types of WBL that most closely align with those described in Perkins V, which is the current reauthorization of legislation that provides funding for CTE (*Strengthening Career and Technical Education for the 21st Century Act,* 2018*;* see subsection below for full definition). Specifically, we focused on WBL experiences that require participants to have "sustained" and "firsthand" engagement in work connected to their education or training. Studies included in our review involved a wide range of participant groups and spanned WBL programs originating in secondary and postsecondary education, as well as adult training programs connected to educational objectives. Our analysis was guided by the following research questions (RQs):

RQ 1: What are the overall impacts of WBL on different **participant groups**: secondary education students, postsecondary education students, and adults in training programs?

RQ 2: What are the overall impacts of different **types of WBL** (e.g., apprenticeships, service learning) on participant outcomes?

RQ 3: What are the overall impacts of WBL on various **outcome domains** (e.g., academic achievement, employment)?

Defining Work-Based Learning for This Review. To determine study eligibility, we assessed whether each study met our working definition of WBL adapted from Perkins V. To reflect the broader scope of this review, we

[1] The U.S. Department of Education's Office of Career, Technical, and Adult Education and the Institute of Education Sciences commissioned this review to improve our understanding of WBL and identify ways in which WBL research can be strengthened to answer the most pertinent questions in the field. This study is the second synthesis and meta-analysis conducted by the CTE Research Network. The first review and synthesis focused on CTE research conducted from 2003 to 2023 (Lindsay et al., 2024).

expanded the Perkins V definition—which emphasizes WBL in secondary and postsecondary education settings—to include programs serving adults (with additions noted in square brackets). Our working definition was:

> Sustained interactions with industry or community professionals in real workplace settings, to the extent practicable, or simulated environments at an educational institution [or learning environment intended for the pursuit of a certificate, credential, or degree], that foster in-depth, firsthand engagement with the tasks required in a given career field(s) and/or cluster(s), that are aligned to curriculum and instruction [or learning objectives].

Based on this definition and the existing research on WBL (e.g., Fletcher et al., 2020; Plasman & Thompson, 2023; Sun & Spinney, 2017), we required studies to report participants' engagement in three key elements of their WBL program to be included in the review:

- sustained interactions (at least 6 hours, which did not need to be consecutive) with industry professionals;
- firsthand engagement with career-specific tasks (not just observing, but doing); and
- connection to an educational institution of some kind, or to an organization with explicit education objectives for participants.

Our literature search returned many studies; however, most did not meet the Perkins V definition of WBL. In many cases, reports lacked sufficient detail to determine whether all participants engaged in WBL that included all three key elements—sustained interaction, firsthand engagement, and connection to an educational institution or program. Such information was often unclear or missing.

Additionally, many studies were excluded based on their research design. To ensure that effect sizes could reasonably be interpreted as evidence of impact, we required studies to use a group comparison design (i.e., comparing participants who received WBL with those who did not; Dougherty et al., 2020). Many WBL studies did not meet this standard. Of the 7,015 potentially relevant studies returned by our literature search, only 23 unique studies compared participants in a WBL program that met all components of the Perkins V definition with participants in a business-as-usual comparison group. Of those 23 studies, only 21 reported sufficient information to calculate effect sizes for inclusion in the meta-analysis.

Key Findings

Our review produced several key findings and important insights. Overall, our analysis revealed some evidence of positive impacts of WBL. But, as our findings suggest, more rigorous research is needed to determine the generalizability of impacts and whether WBL impacts are consistent across participant groups, types of WBL, and outcomes.

Key findings include the following:

- **Despite the prevalence of WBL, few studies met our review criteria.** Although many studies examine WBL, few evaluate it against a comparison group and report sufficient information to verify key elements of the Perkins V definition. Of the 7,015 potentially relevant studies returned by our literature search, only 23 unique studies compared participants in a WBL program that met all components of the Perkins V definition with participants in a business-as-usual comparison group.

- **Among studies that met the review requirements, evidence suggests that eligible WBL programs benefit both secondary and postsecondary education participant groups.** WBL impacts were positive and statistically significant for participant groups enrolled in both secondary and postsecondary education programs. Evidence regarding adults enrolled in training programs was inconclusive, likely due to the limited number of studies focused on this participant group.
- **Conclusions from the synthesis are limited to a handful of program types and outcomes.** Despite the range of immersive WBL activities being implemented in the field, only one program type (internships) and two outcome domains (the Academic Achievement & Advancement domain and the Social & Emotional Health domain) reached statistical significance. The Employment domain showed positive impacts approaching statistical significance. Strong causal conclusions are limited by the small number of rigorous studies (and thus the available evidence) on other program types and outcome domains.[2] Evidence on several outcome domains conceptually linked to WBL—such as the Career Skills & Job Readiness domain and the Earnings domain—was surprisingly scarce.
- **Descriptions provided in WBL studies were limited and often did not clearly articulate the components of the type of WBL being studied.** In many cases, we could not verify whether a program met the Perkins V WBL definition criteria from the study information provided. We excluded reports that did not provide enough information to confirm that the WBL intervention met each of the components of the Perkins V definition.
- **Both employer-driven and educator-driven approaches to WBL appear to be effective.** In the review, aggregated employer-driven models (e.g., internships, apprenticeships, medical practicums) and educator-driven models (e.g., research projects, service learning, simulations) showed statistically significant, practically meaningful benefits when they included sustained interaction with industry professionals and hands-on, career-related tasks.

Our Approach

Variables and Definitions

Exhibit 2 lists our focal variables, along with definitions for each designation and category.

Participant Groups. We first estimated WBL program impacts separately by **participant group**. Participant groups were defined by the education status of the sample at baseline, before the intervention began (exhibit 2). *Secondary education students* were enrolled in grades 6–12 at baseline, *postsecondary education students* were enrolled in a college or university at baseline, and *adults in training programs* were participating in training programs but were not formally enrolled in secondary or postsecondary education at the time they entered the study. Although participants' baseline education status often aligned with the setting in which the WBL program was implemented (e.g., secondary education students participated in WBL at their middle or high school), this was not always the case. For example, in one program (Year Up), participants were categorized as adults in a training program because they were not required to be formally enrolled in a college or university at the start of the intervention. However, they may have been receiving training on a college campus as part of Year Up.

[2] We note that in some instances the magnitude of synthesized impacts was large enough to be relevant for policy or practice. However, the small number of available studies that matched our criteria limited the precision of the estimates and therefore the strength of the inferences we could make.

Types of WBL. We examined impacts separately for various **types of WBL**, representing the range of possible WBL programs delivered to participants. During coding, we assigned each study to a WBL program type based on common distinctions in the literature and the field, drawing on materials from the Association for Career and Technical Education, Advance CTE, and Jobs for the Future (ACTE, 2022; Advance CTE, 2022; Jobs for the Future, 2025). When a study did not fit neatly into a single program type, we assigned it to the category that represented the majority of WBL activities in the program. We also aggregated program types into two higher level categories to reflect the extent to which programming was educator-driven (while still incorporating interactions with industry professionals, realistic job tasks, and possibly time in a workplace) or employer-driven (with education components, per our definition). These higher-level groupings captured commonalities across program types and increased statistical power to detect effects. Finally, we coded whether an intervention had other mandatory elements in addition to WBL programming. Participants in *WBL-only* programs received one mandatory WBL component and no other required components, while participants in *WBL+* programs received WBL plus one or more mandatory components (e.g., job placement, childcare vouchers). Programs that offered, but did not require, additional WBL or non-WBL components—such as career academies—were deemed WBL-only if we could not verify whether additional components were required for all participants.

Outcome Domains. We estimated WBL program impacts for various **outcome domains**. We generated a list of 10 outcome domains based on a prior systematic review (Lindsay et al., 2024) and then refined the list after identifying our final set of eligible studies to reflect the measures and indices we observed in the literature. We also aggregated some outcomes into higher order groupings to bolster statistical power (given the small number of included studies) and support the interpretation of results.

Exhibit 2. Defining key variables, categories, and designations

Variable	Category (base)	Definition
Participant group	Individuals in adult training programs	Individuals in adult training programs who are not enrolled in formal secondary or postsecondary education at baseline.
	Individuals in postsecondary education	Students enrolled in college or university at baseline.
	Individuals in secondary education	Students enrolled in grades 6–12 at baseline.
Type of work-based learning	Apprenticeship	Paid, on-the-job workplace learning experiences combined with related technical instruction (apprenticeships) or programs that prepare individuals for apprenticeships (pre-apprenticeships).
	Internship	Internships and cooperative work opportunities that are characterized by work for an employer in a real or virtual workplace.
	Medical practicum	Opportunities for students to provide health care to patients under the supervision of professionals.
	Research project	Replication of a professional research position in an educational setting; often educator-driven.
	Service learning	Community service activities that include academic instruction; often educator-driven.
	Simulation	Real workplace tasks conducted in an educational setting.

Variable	Category (base)	Definition
Aggregate types of work-based learning	WBL-only[a]	WBL programs that do not include any non-WBL services or supports. Comparison aggregate designation is WBL+.
	WBL+[a]	WBL programs that include at least one core component unrelated to WBL (e.g., job placement, childcare vouchers). Comparison aggregate designation is WBL-only.
	Employer-driven[b]	Types of WBL that include activities based in the workplace and where the learner experience is typically dictated by the employer (e.g., internships, apprenticeships, medical practicums). The comparison indicator is the educator-driven aggregate.
	Educator-driven[b]	Types of WBL that are typically dictated by the educator (e.g., research projects, service learning, occupational simulations). For the purposes of this review, these experiences meet all of the established criteria, including direct experience with hands-on career tasks and sustained interaction with industry professionals. The comparison indicator is the employer-driven aggregate.
Outcome domain	Academic Achievement & Advancement	K–12 and postsecondary grades, standardized exam scores, and progression in postsecondary/college settings (e.g., accumulation of college credits).
	Career Skills & Job Readiness	Employability skills (e.g., soft or durable skills), job readiness (e.g., résumé development), and technical skills (e.g., using Excel).
	Postsecondary Enrollment	Enrollment in a 2- or 4-year institution.
	Earnings	Hourly or annual wages and personal income.
	Economic Well-Being	Indicators of economic self-sufficiency that are not employment/earnings (e.g., health insurance, public benefit receipt).
	Employment	Paid full- or part-time work, number of work hours.
	High School Completion	Attainment of a high school diploma or equivalent.
	Postsecondary Educational Attainment	Attainment of a postsecondary degree (2- or 4-year) or credential (e.g., license, certificate, certification).
	School Attendance	Percentage of time a student is absent/present in school.
	Social & Emotional Health	Attitudes and beliefs about self (e.g., self-efficacy) or others (e.g., empathy), mental health indicators (e.g., depression), discipline (e.g., detention), and prosocial behaviors.

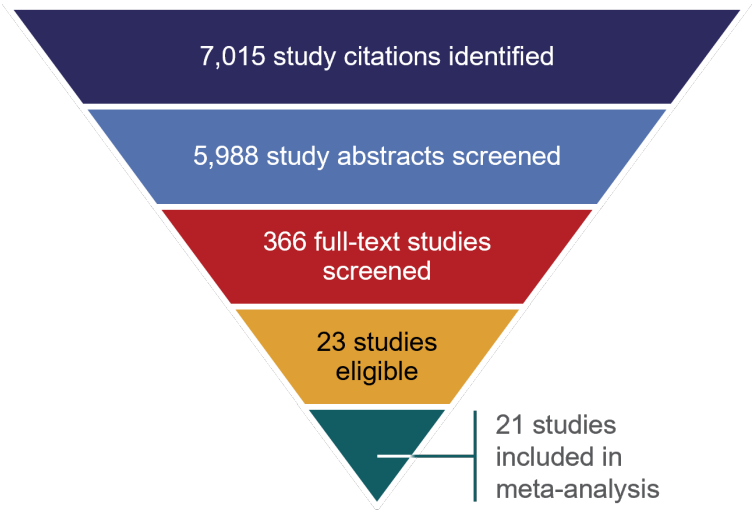
Variable	Category (base)	Definition
Aggregate outcome domains	Educational Milestones[c]	Measures of degree attainment and academic enrollment comprising outcomes in the High School Completion, Postsecondary Enrollment, and Postsecondary Educational Attainment domains. The comparison indicators are Skills & Knowledge and Economic Indicators.
	Skills & Knowledge[c]	Measures of educational and vocational proficiency comprising outcomes in the Academic Achievement & Advancement domain and the Career Skills & Job Readiness domain. The comparison indicators are Educational Milestones and Economic Indicators.
	Economic Indicators[c]	Measures of vocational and financial stability comprising outcomes in the Employment, Earnings, and Economic Well-Being domains. The comparison indicators are Educational Milestones and Skills & Knowledge.

Note. WBL = work-based learning. Other types of WBL were eligible for inclusion in this review, including student teaching, school-based enterprises, industry-involved competitions, and college or university jobs that met the review's WBL definition. However, no studies of such programs met other review requirements for inclusion, so these program types are not represented in our final set of studies.
[a] Program designations indicating the presence or absence of additional core components unrelated to WBL. These are not mutually exclusive with WBL program types.
[b] Aggregate groupings comprising WBL program types.
[c] Aggregate groupings comprising outcome domains.

Searching and Screening

More than 7,000 citations were returned by our initial search for WBL studies. From these, we identified 23 studies that met our review criteria, 21 of which contained the required effect sizes for meta-analysis. Exhibit 3 illustrates the review's breadth and process for identifying eligible studies.

Exhibit 3. Study identification review process



Step 1: Literature Review. We conducted a comprehensive, systematic literature search to identify the full set of WBL evidence available for testing the research questions (page 2). Our literature search used a multipronged strategy to identify all relevant reports in the published and unpublished literature. To execute the literature search, we first consulted with a research librarian and multiple internal and external content experts to develop a search string containing keywords that captured WBL and other review criteria. We then used that search string to query electronic databases that index scholarly publications in social and behavioral science journals. We also scanned the websites of major research organizations and solicited

suggestions from CTE research experts. These efforts produced a pool of 7,015 reports for consideration. Of these, 1,027 reports were duplicates, leaving 5,988 unique reports to be screened for relevance and eligibility.

Step 2: Abstract Screening. We excluded 5,620 reports based on titles and abstracts for three primary reasons: (a) they were not relevant to WBL, (b) they did not include quantitative analysis, and/or (c) they did not compare two groups. For example, some reports returned by our literature search only incidentally contained our required WBL search terms and were excluded for being completely unrelated to WBL. Others were excluded at this stage despite being relevant to WBL because they did not report research findings (e.g., opinion pieces, implementation resources) or did not have an eligible study design (e.g., qualitative research with no comparison group).

Step 3: Full-Text Screening. Of the 368 remaining citations following abstract screening, we were able to retrieve 366 full-text PDFs. We excluded 338 of these because they did not meet (or did not provide enough information to confirm that they met) the Perkins V definition criteria for WBL (providing career immersion experiences in education settings with clear learning objectives or pathways toward a degree or certificate) and/or did not examine our defined target participant groups (secondary education students, postsecondary education students, adults in a training program). This left 28 eligible reports spanning 23 unique studies. (A few reports examined the same target sample and WBL program—for example, a technical report and a scholarly article written about the same evaluation.)

Step 4: Full Review. We thoroughly reviewed and coded the final set of 23 eligible studies to obtain details on the participant groups they tested, the types of WBL they implemented, and the outcomes they examined. In addition, we coded details on the rigor of each study's evaluation design and execution to assess the extent to which our review conclusions might be limited by the validity of inferences drawn from individual studies.[3] We coded and validated each study with separate analysts for quality assurance. In the end, only 21 of the 23 eligible studies were represented in our meta-analysis, as two of the eligible studies did not report adequate quantitative information to calculate effect sizes. These 21 studies contained 387 unique effects, with several studies reporting on multiple outcomes or time points.

Step 5: Meta-Analysis. After extracting and validating the data, we computed descriptive summaries of focal variables to examine patterns of existing evidence. We then analyzed quantitative data from the studies that provided effect sizes to quantify the strength, significance, and variability of WBL impacts on various outcomes, using state-of-the-art meta-analytic methods that accounted for the correlated and hierarchical structure of effects within studies (Pustejovsky & Tipton, 2022; Tipton, 2015). Finally, we plotted combinations of program types by outcome domains and study designs to illustrate clusters of existing evidence and highlight evidence gaps.

[3] See exhibit A6 in the appendix for information on risk-of-bias variables.

Text Box 2. Why Were So Few Work-Based Learning Studies Eligible for Inclusion?

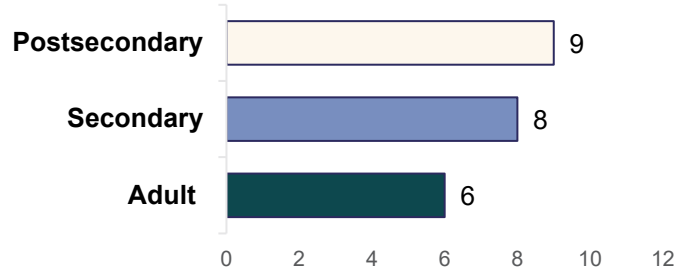
Work-based learning (WBL) is a prevalent strategy (Education Commission of the States, 2023) supported by a growing body of research. However, at the time of this analysis, only 21 studies met our review's requirements for WBL implementation and research design and provided effect sizes that could be included in our meta-analysis. Where is the rest of the evidence? Many studies did not provide sufficient information on the actual content of programming received by participants for us to verify whether it constituted WBL, per our Perkins V definition. Others used single-group designs (i.e., no comparison group), precluding strong inferences about whether WBL confers any measurable benefits relative to business as usual**. For researchers conducting WBL studies, describing the program in detail is critical, as is using a rigorous research design that provides information on impact to support causal inferences.** Future studies should address these limitations to expand the evidence base.

Findings

Characteristics of Included Studies

The 23 eligible studies identified by our comprehensive search and systematic screening process represent all the available evidence from our search sources on the impacts of WBL on student outcomes for programs that fulfilled all components of the Perkins V definition of WBL, were tested against comparison groups, and met other review criteria.[4] In the paragraphs that follow, we summarize the landscape of evidence in a descriptive analysis of all 23 eligible studies. We then discuss our meta-analysis of impacts, based on the 21 studies that provided quantitative effects.

Exhibit 4. Number of eligible studies by participant group



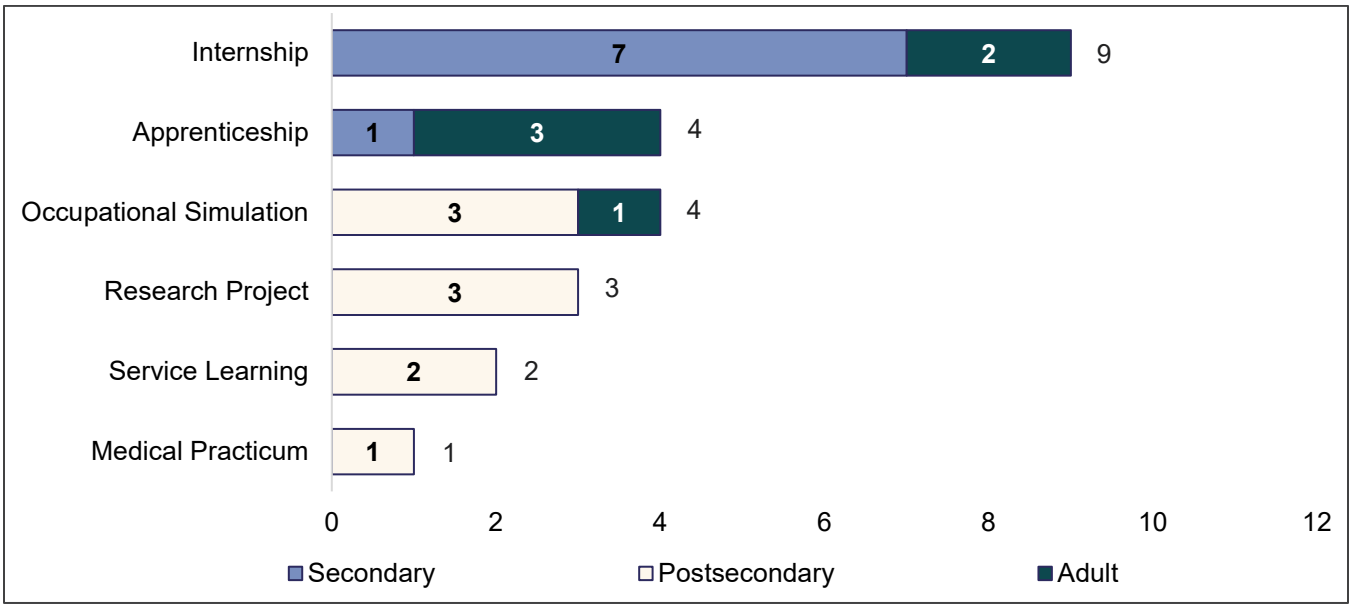
Note. Twenty-three eligible studies were used for descriptive information, but only 21 studies provided sufficient information to compute effect sizes for inclusion in the meta-analysis.

WBL impacts were tested across all three participant groups: (a) secondary education students, (b) postsecondary education students, and (c) adults in training programs. Across the 23 studies that met our review criteria, 39 percent focused on individuals enrolled in postsecondary education at baseline (nine studies), 35 percent focused on individuals enrolled in secondary education at baseline (eight studies), and 26 percent focused on adults in training programs who were not enrolled in secondary or postsecondary education at baseline (six studies) (exhibit 4). Studies of adults in training programs were less common than studies of individuals in secondary or postsecondary education. In addition, the two studies that did not report sufficient quantitative information to compute effect sizes both belonged to the adults in training programs participant group, further limiting this category to just four studies in the meta-analysis.

[4] See exhibit A5 in the appendix for a detailed summary of the characteristics of included studies.

Among the types of WBL examined, nearly 40 percent of studies (nine studies) were confined to the impacts of WBL internships on participant outcomes (exhibit 5). The remaining studies were spread across different types of WBL programs. None showed a significant impact on outcomes, likely because there were too few studies on each type of WBL program to detect statistical differences. We identified only four eligible studies of apprenticeship programs (17 percent), four studies of classroom-based occupational simulations (17 percent), three studies of research projects (13 percent), two studies of service learning (9 percent), and one study evaluating a medical practicum or residency program (4 percent). Of the four studies examining apprenticeship programs, only two contained sufficient quantitative information to compute effect sizes, leaving a total of two apprenticeship program studies for inclusion in the meta-analysis. Other types of WBL were eligible for inclusion in this review, including student teaching, school-based enterprises, industry-involved competitions, and college or university jobs that met the review's WBL definition criteria. However, no studies of such programs met the other review requirements for inclusion, meaning that these program types were not represented in our final set of studies. Roughly half of the 23 eligible studies reported on programs that included at least one core component unrelated to WBL and were therefore considered WBL+ in our coding scheme (11 studies, 48 percent).

Exhibit 5. Number of eligible studies by type of work-based learning and participant group

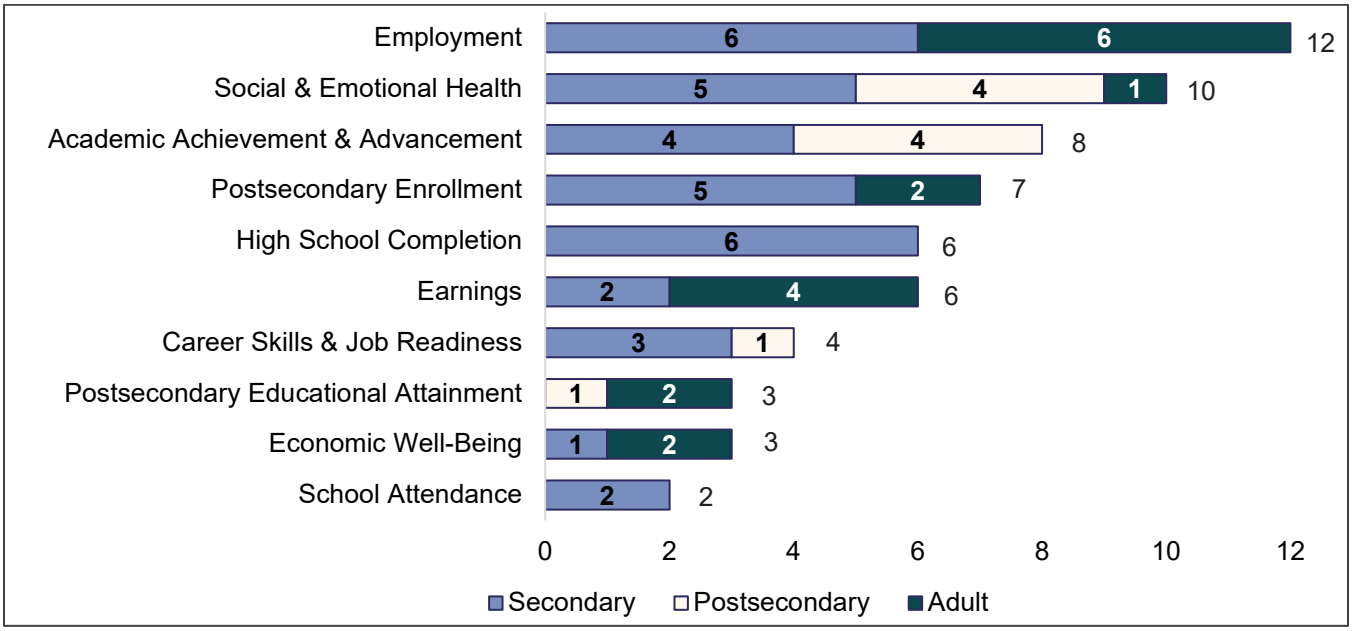


Note. Twenty-three eligible studies were used for descriptive information, but only 21 studies provided sufficient information to compute effect sizes for inclusion in the meta-analysis. The two studies that were not included in the meta-analysis were both apprenticeship studies conducted with adult participants. The work-based learning (WBL) "apprenticeship" type includes one study of a pre-apprenticeship program. Values displayed at the end of each bar reflect totals for each WBL type.

Most studies evaluated the impacts of WBL programs on the Employment domain and the Social & Emotional Health domain (12 studies [52 percent] and 10 studies [43 percent], respectively; exhibit 6). Remaining outcomes were clustered within the following domains: Academic Achievement & Advancement (eight studies, 35 percent), Postsecondary Enrollment (seven studies, 30 percent), Earnings (six studies, 26 percent), and High School Completion (six studies, 26 percent). Fewer than five studies reported outcomes in each of the domains of Economic Well-Being, Postsecondary Educational Attainment, Career Skills & Job Readiness, and School Attendance.

Exhibit 6 displays the number of eligible studies by outcome and participant group. Notably, studies with postsecondary education students were represented in only 4 of the 10 possible outcome domains coded. Several domains that are routinely featured as logical outputs of WBL programs—such as Employment and Earnings—were not evaluated by any studies with postsecondary education students. Studies with secondary education students and adults in training programs had more representation across outcome domains (six and nine outcome domains, respectively).

Exhibit 6. Number of eligible studies by outcome and by participant group



Note. Twenty-three eligible studies were used for descriptive information, but only 21 studies provided sufficient information to compute effect sizes for inclusion in the meta-analysis. Totals in this exhibit do not sum to the number of eligible studies because several studies reported more than one outcome. The number of distinct domains reported within individual studies ranged from one to eight (mean = 2.75).

Meta-Analysis on the Impacts of Work-Based Learning

We estimated a series of meta-analytic models aligned with our research questions for the 21 studies that provided quantitative effects (drawn from the set of 23 studies that met our review criteria). For each research question, we report the number of studies (*k*) and effects *(m*) within each category of the focal analysis variable, the effect size representing the difference between the intervention and control groups in standard deviation units (*ES*), the standard error representing the precision of the effect size estimate (*SE*), the *p*-value representing the probability that the effect occurred by chance (*p*), and the prediction interval (PI) representing the expected range of effects in any future studies.

The following paragraphs summarize the results of our analysis separately for each research question, focusing on participant groups, types of WBL, and outcomes.

RQ1: What Are the Overall Impacts of WBL on Secondary Education Students, Postsecondary Education Students, and Adults in Training Programs?

WBL had positive, statistically significant impacts among students enrolled in both secondary and postsecondary education programs, collapsing across outcome domains (for secondary education students, g = .06, SE = .01, p = .02; for postsecondary education students, g = .23, SE = .07, p = .02) (exhibit 7). Although we did not anticipate differences in WBL impacts between participant groups, we observed effects that were nearly four times larger for postsecondary education students than for secondary education students. We conducted follow-up analyses to investigate the robustness of this difference and test whether it may be due to chance. This pairwise comparison was statistically significant—$F(1, 4.51) = 12.1$, β = 0.13, SE = 0.04, p = .02—but may be attributable to the fact that statistically significant program types and outcome measures were relatively more common among postsecondary education participant groups than secondary education participant groups. Impacts for adults in training programs were not statistically significant, likely due to the small number of eligible studies. However, the magnitude of impacts among adults in training programs was comparable to that of secondary education students, despite the presence of relatively more variation.

Exhibit 7. Estimated impacts of work-based learning by program participants

Participant group	Studies	Effects	ES	SE	95% PI	*p*	Significant?
Secondary education students	8	221	0.06	0.01	-0.40, 0.52	0.02	**
Postsecondary education students	9	45	0.23	0.07	-0.26, 0.72	0.02	**
Adults in training programs	4	121	0.07	0.04	-1.25, 1.28	0.27	

Note. ES = effect size value (Hedges' g). SE = standard error value. 95% PI = 95 percent prediction interval. p = alpha level. Significant? = statistical significance, with *** for values ≤.01, ** for values >.01 and ≤.05, and * for values >.05 and ≤.10.

RQ2: What Are the Overall Impacts of Different Types of WBL on Participant Outcomes?

Across different types of WBL programs, only internships had statistically significant impacts on participant outcomes, though few studies of other WBL program types were eligible for review (g = .07, SE = .02, p < .01; exhibit 8). The impacts of most other WBL program types were positive but not statistically significant. The null estimate for apprenticeship programs may be particularly surprising to some readers, given the promising qualitative evidence on these programs (Butrica et al., 2023; Walton et al., 2022) and increased national investment in this WBL model. However, only two apprenticeship/pre-apprenticeship studies were eligible for inclusion in our meta-analysis, one of which was a pre-apprenticeship program with a sample comprising youth recruited from substance use interventions. As a result, the imprecise null results for apprenticeship programs in our review are restricted to a small number of studies, drawn from samples that may not be representative of the general population. Additional evidence is needed to draw strong inferences about any potential impacts in other settings.

Exhibit 8. Estimated impacts of types of work-based learning

Program type	Studies	Effects	ES	SE	95% PI	*p*	Significant?
Internship	9	257	0.07	0.02	-0.37, 0.52	< 0.01	***
Occupational Simulation	4	13	0.32	0.14	-0.60, 1.23	0.12	
Research Project	3	15	0.33	0.27	-1.98, 2.63	0.35	
Service Learning	2	10	0.17	0.09	-1.63, 1.96	0.31	
Apprenticeship	2	84	-0.01	0.02	-3.16, 3.14	0.66	
Medical Practicum	1	8	0.17	0.21	-2.88, 3.22	0.56	

Note. ES = effect size value (Hedges' *g*). SE = standard error value. 95% PI = 95 percent prediction interval. *p* = alpha level. Significant? = statistical significance, with *** for values ≤.01, ** for values >.01 and ≤.05, and * for values >.05 and ≤.10. Only one study reported results from a medical practicum, so this is the precision-weighted average of the eight effects within one study.

After aggregating programs into two categories, both employer-driven and educator-driven WBL programs displayed positive, statistically significant impacts on learner outcomes (for educator-driven programs, $g = .25$, $SE = .07$, $p = .01$; for employer-driven programs, $g = .06$, $SE = .02$, $p < .01$) (exhibit 9). The average effect was larger for educator-driven programs than employer-driven programs, which aligns with patterns at the individual program level. (Effect sizes from educator-driven programs were larger in magnitude than those from employer-driven programs, though less precisely estimated, hence their failure to achieve statistical significance prior to aggregation.) Educator-driven programs tend to measure impacts on proximal academic outcomes that are closely aligned with the setting in which the programs are implemented (exhibit 14), which may explain why they produce effect sizes that are larger in magnitude than employer-driven programs that measure more distal outcomes.

Exhibit 9. Estimated impacts of work-based learning by aggregate program types

Aggregate program type	Studies	Effects	ES	SE	95% PI	*p*	Significant?
Employer-driven programs (internships, apprenticeships, medical practicums)	12	349	0.06	0.02	-0.37, 0.49	< 0.01	***
Educator-driven programs (occupational simulations, research projects, service learning)	9	38	0.25	0.07	-0.25, 0.74	0.01	***

Note. ES = effect size value (Hedges' *g*). SE = standard error value. 95% PI = 95 percent prediction interval. *p* = alpha level. Significant? = statistical significance, with *** for values ≤.01, ** for values >.01 and ≤.05, and * for values >.05 and ≤.10.

Both WBL-only and WBL+ programs had positive and statistically significant impacts on student outcomes, but impacts for WBL-only programs were significantly larger in magnitude (for WBL-only programs, g = .21, SE = .04, p = .01; for WBL+ programs, g = .06, SE = .02, p < .01; difference is F[1, 4.35] = 12.51, β = -0.15, SE = .04, p = .02) (exhibit 10). However, programs were only classified as WBL+ if the additional supports and services were considered core components of the program and we could verify that they were received by all participants. Such programs likely differ from WBL-only programs in ways beyond just the additional services or supports offered, and we do not know how common this structure is in practice. As a result, differences between WBL-only and WBL+ programs should be interpreted with caution and do not necessarily reflect the value of additional services.[5]

Exhibit 10. Estimated impacts of WBL-only and WBL+ programs

Program services	Studies	Effects	ES	SE	95% PI	*p*	Significant?
WBL+	11	331	0.06	0.02	-0.36, 0.48	< 0.01	***
WBL-only	10	56	0.21	0.04	-0.34, 0.76	0.01	***

Note. WBL = work-based learning. WBL-only = programs with a mandatory WBL component and no other required components. WBL+ = programs with a mandatory WBL component plus other mandatory component(s). ES = effect size value (Hedges' g). SE = standard error value. 95% PI = 95 percent prediction interval. p = alpha level. Significant? = statistical significance, with *** for values ≤.01, ** for values >.01 and ≤.05, and * for values >.05 and ≤.10.

RQ3: What Are the Overall Impacts of WBL on Various Outcomes?

Of the 10 outcome domains examined, WBL had statistically significant impacts on 2 domains: Academic Achievement & Advancement (g = .09, SE = .03, p = .04) and Social & Emotional Health (g = .10, SE = .02, p < .01). The remaining 8 outcomes had synthesized impact estimates that were positive but not statistically significant. Employment, School Attendance, and Postsecondary Educational Attainment were approaching statistical significance (p-values between .05 and .10). Results were particularly notable for the latter two, given the few studies available for synthesis (two studies and three studies, respectively). With more studies included, impacts on these outcomes might be strong enough to show clear statistical significance. The magnitude of some of these point estimates is also noteworthy and may suggest dimensions to prioritize in future inquiry. Exhibit 11 provides an overview of estimated impacts by outcome domain.

[5] See the Limitations section for further discussion of this comparison.

Exhibit 11. Estimated impacts of work-based learning by outcome domain

Outcome domain	Studies	Effects	ES	SE	95% PI	*p*	Significant?
Employment	10	66	0.09	0.03	-0.40, 0.58	0.07	*
Social & Emotional Health	10	122	0.10	0.02	-0.44, 0.63	< 0.01	***
Academic Achievement & Advancement	8	68	0.09	0.03	-0.09, 0.27	0.04	**
Postsecondary Enrollment	7	51	0.05	0.05	-0.35, 0.44	0.40	
High School Completion	6	11	0.16	0.06	-0.57, 0.89	0.11	
Earnings	4	15	0.14	0.12	-0.78, 1.07	0.33	
Career Skills & Job Readiness	4	9	0.23	0.11	-0.56, 1.02	0.16	
Economic Well-Being	3	14	0.07	0.05	-0.33, 0.47	0.29	
Postsecondary Educational Attainment	3	18	0.20	0.04	-2.68, 3.09	0.10	*
School Attendance	2	13	0.05	0.01	-0.07, 0.17	0.09	*

Note. ES = effect size value (Hedges' *g*). SE = standard error value. 95% PI = 95 percent prediction interval. *p* = alpha level. Significant? = statistical significance, with *** for values ≤.01, ** for values >.01 and ≤.05, and * for values >.05 and ≤.10. Totals do not sum to the overall number of eligible studies (*k* = 23) because two studies did not report quantitative information.

In the second set of models that aggregated across groups of conceptually similar outcomes, **WBL had positive, statistically significant impacts on Skills & Knowledge** (*g* = .09, *SE* = .03, *p* = .03), but with nearly identical point estimates just approaching significance for Educational Milestones and Economic Indicators. The Skills & Knowledge aggregate domain included outcomes in the Academic Achievement & Advancement domain and the Career Skills & Job Readiness domain. The effect size was identical to that of Academic Achievement & Advancement alone, suggesting the Career Skills & Job Readiness outcomes were not particularly influential. Impacts were marginal for Economic Indicators (comprising the Employment, Earnings, and Economic Well-Being domains) and Educational Milestones (comprising the High School Completion, Postsecondary Enrollment, and Postsecondary Educational Attainment domains). Exhibit 12 provides an overview of estimated impacts for the aggregate outcome domains examined.

Exhibit 12. Estimated impacts of work-based learning by aggregate outcome domain

Aggregate outcome domain	Studies	Effects	ES	SE	95% PI	*p*	Significant?
Educational Milestones (High School Completion, Postsecondary Enrollment, Postsecondary Educational Attainment)	10	80	0.09	0.04	-0.43, 0.61	0.07	*
Skills & Knowledge (Academic Achievement & Advancement, Career Skills & Job Readiness)	**10**	**77**	**0.09**	**0.03**	-0.09, 0.28	**0.03**	**
Economic Indicators (Employment, Earnings, Economic Well-Being)	10	95	0.09	0.04	-0.35, 0.54	0.07	*

Note. ES = effect size value (Hedges' *g*). SE = standard error value. 95% PI = 95 percent prediction interval. *p* = alpha level. Significant? = statistical significance, with *** for values ≤.01, ** for values >.01 and ≤.05, and * for values >.05 and ≤.10. Aggregate outcomes represent groupings of conceptually similar outcomes, determined post hoc by the review team. The School Attendance domain and Social & Emotional Health domain did not fit neatly into any of the aggregate outcome domains and were therefore excluded from this analysis.

Evidence Gaps

Evidence gap maps (EGMs) from the 23 studies that met our review criteria illustrate the prevalence of WBL evidence across various cross-tabulations and inform future research directions for the field. These EGMs display the frequency with which various combinations of WBL characteristics have been studied and highlight where additional research is needed. EGMs include all 23 eligible studies (rather than the 21 studies included in our meta-analysis) because EGMs do not require effect sizes.

Text Box 3. Summary of Evidence Gaps: Additional Research Needed

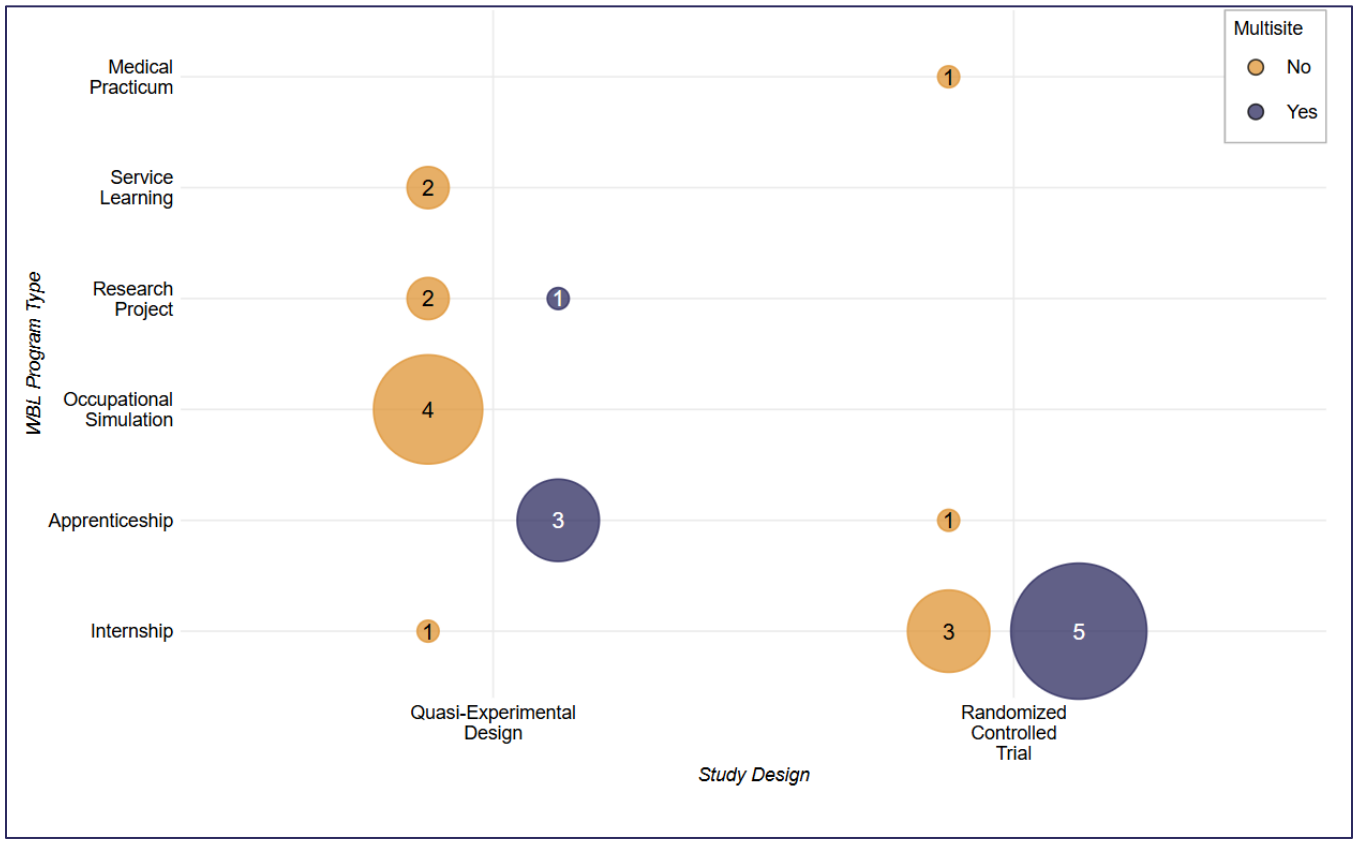
- Randomized controlled trials on WBL are rare and mostly focused on internships, limiting strong causal conclusions across program types.
- Impacts of WBL on economic outcomes have not been tested among educator-driven programs (e.g., service learning, research projects, and occupational simulations).
- Null findings for certain groups, program types, and outcomes may reflect the limited evidence base, not an absence of impact.

Internship evaluation designs were high quality and rigorous, but evaluations of other types of WBL were lacking in quality, prevalence, or both, limiting the strength of causal inferences and the generalizability of the available evidence (exhibit 13). Studies of internships were the most prevalent among the WBL program types we examined. These studies were generally high quality, using multisite evaluations and randomized controlled trial (RCT) designs. In contrast, most studies of apprenticeships or pre-apprenticeships (k = 4) and occupational simulations (k = 4) used quasi-experimental designs (QEDs), while studies of service learning and research projects were uncommon and relied exclusively on QEDs.

Among group comparison research designs, QED evaluations outnumbered RCT evaluations across nearly every type of WBL. Existing RCT evidence was confined primarily to studies of internships, limiting causal inferences for impacts of other WBL programs. Future RCTs of non-internship WBL programs could help strengthen claims about overall WBL impacts, especially given the emergence of newer apprenticeship models.

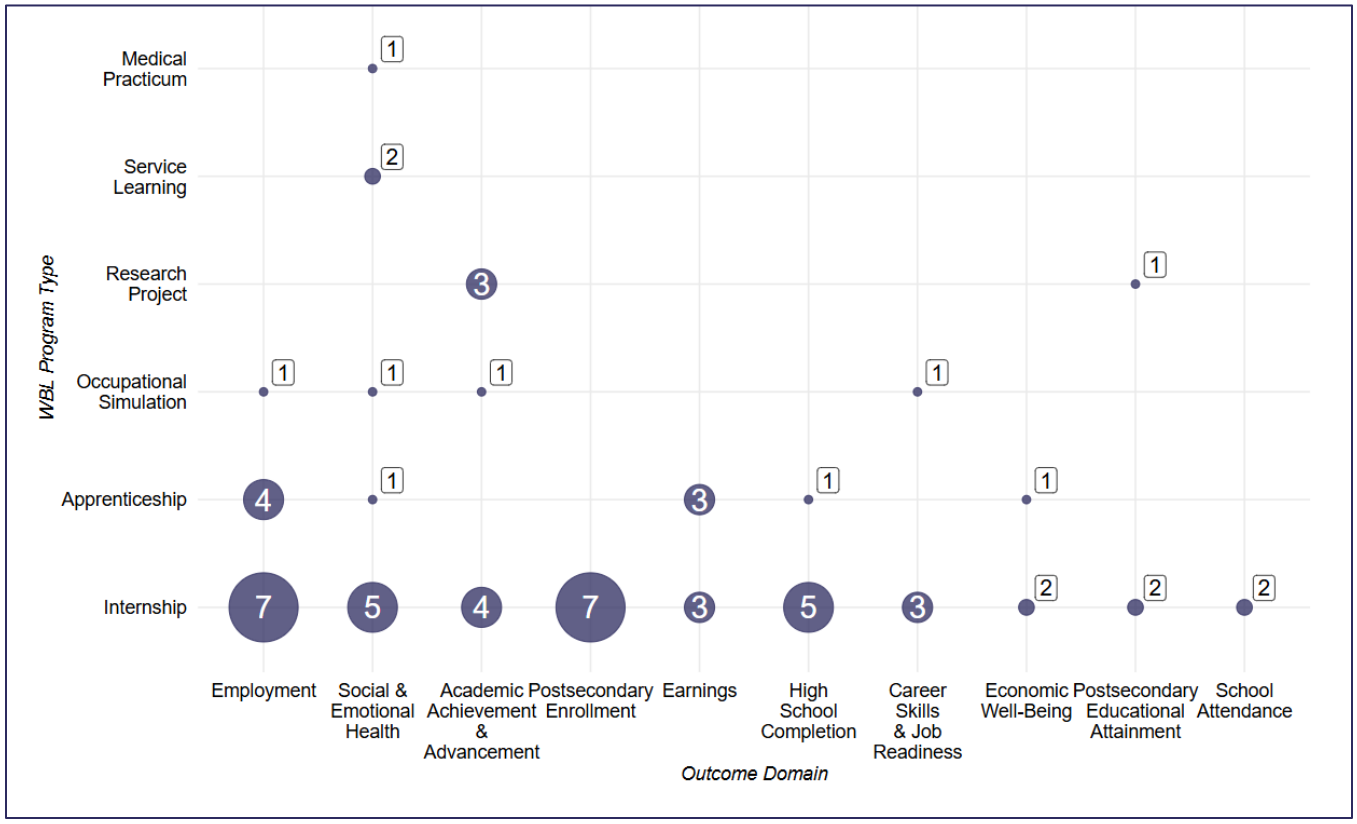
Studies of employer-driven programs, particularly internships, measured a broader array of outcomes than educator-driven programs (exhibit 14). Most educator-driven programs—including research projects, service learning, and occupational simulations—focused almost exclusively on academic and socioemotional outcomes. Only one study of an educator-driven program measured impacts on employment, and none measured other distal outcomes such as postsecondary enrollment, earnings, or economic well-being. For example, all known evidence about the impacts of service learning was confined to the Social & Emotional Health domain. Future evaluations should explore whether benefits extend to academic and career-oriented domains as well.

Exhibit 13. How common are various research designs when studying different types of work-based learning programs?



Note. WBL = work-based learning. This exhibit reports the frequency with which different designs were used to measure different program types for each study eligible for inclusion in this review (*N* = 23). Larger bubbles indicate a greater number of studies per combination.

Exhibit 14. How frequently are different outcomes measured across different types of work-based learning programs?



Note. WBL = work-based learning. This exhibit reports the frequency with which different outcomes were measured by type of work-based learning for each study eligible for inclusion in this review (*N* = 23). Larger bubbles indicate more studies per combination.

Distal impacts of WBL are relatively underrepresented in the literature. Future research should prioritize connections between WBL programming and outcomes in employment, earnings, and related domains, such as career skills and job readiness. This will require investment in longitudinal data systems linking students' education and workforce outcomes. For example, none of the four studies examining apprenticeships reported on academic outcomes, which may be due to difficulties linking data across workforce and education systems. These linkages are important, given the role of educational institutions (such as community and technical colleges) in supporting technical instruction through apprenticeships. Academic outcomes may serve as early indicators of apprenticeship program impacts and/or a mechanism through which apprenticeships confer benefits to more distal employment-related outcomes.

Co-occurrences between variables among eligible studies in our review may explain patterns of statistical significance, and our results should be interpreted with this in mind. For example, studies of educator-driven WBL programs primarily measured outcomes in the two domains that were statistically significant (the Academic Achievement & Advancement domain and the Social & Emotional Health domain; exhibit 11). This may explain why educator-driven WBL programs had larger impacts on participant outcomes than employer-driven programs. Future research should explore whether educator-driven programs can also impact more distal outcomes, such as employment and earnings. Differences in the outcomes measured may also

explain why WBL displayed larger impacts for postsecondary education students than secondary education students and adults in training programs. For example, studies of secondary education students measured outcomes across most domains, while studies of postsecondary education students were clustered around proximal outcomes such as the Academic Achievement & Advancement domain and the Social & Emotional Health domain (exhibit 6). As such, the apparent benefits of WBL for postsecondary education students (relative to secondary education students and adults in training programs) may be an artifact of the outcome domains that tend to be measured by studies of those students.

Conclusions

In this review, we systematically identified and synthesized available evidence[6] on the impacts of various WBL programs on a range of outcomes for secondary education students, postsecondary education students, and adults in training programs. Our review included 23 eligible studies and meta-analyzed 21 studies that met the Perkins V definition of WBL, along with our other review criteria. We cataloged features of each study's research design, measures, samples, and program components, then computed 387 effect sizes representing standardized estimates of program impacts. Overall, we found that **evidence from comparison group design WBL studies on student outcomes was scarce across the published literature**. Despite widespread federal legislative endorsement, financial investment, and state and local adoption of WBL policies (Advance CTE, 2023; Office of Career, Technical, and Adult Education, n.d.b), few studies have documented the impacts of WBL (as defined in Perkins V) against a comparison group.

Given the scant evidence base, our **inferences are restricted to a narrow set of participant groups, types of WBL, and outcomes**. First, a greater concentration of studies was available from evaluations conducted with secondary education and postsecondary education students than adults in training programs. Second, relatively more evidence was available on employer-driven WBL, such as internships, compared to more educator-driven WBL programs such as research projects, occupational simulations, and service learning. Other types of commonly implemented WBL—such as student teaching, school-based enterprises, and industry-involved competitions—are not represented in our review because no eligible studies were identified. Finally, studies tended to measure the impacts of WBL on outcomes related to the Academic Achievement & Advancement, Employment, and Social & Emotional Health domains, with little evidence available on other eligible outcomes.

Still, in areas with sufficient evidence, **WBL appears to benefit secondary education and postsecondary education students**, with positive and statistically significant impacts for both groups (exhibit 7). Interestingly, WBL was notably more effective among postsecondary education students than secondary education students, with effect sizes that were nearly four times larger for participants enrolled in postsecondary institutions at baseline, relative to middle and high school students. However, we cannot rule out the possibility that this is due to differences in the types of WBL programs offered to secondary education versus postsecondary education students, or to differences among individuals who select to attend postsecondary education, differences in outcomes measured between participant groups, or a combination of these differences.

Educator-driven programs (occupational simulations, research projects, service learning) demonstrated a significant impact. They were implemented almost exclusively with postsecondary education students and primarily measured outcomes in the Academic Achievement & Advancement domain and the Social & Emotional

[6] The search for studies focused on those published between 2003 and 2023.

Health domain. **Future research should consider whether educator-driven programs positively impact more distal outcomes**, like earnings, and are effective for other participant groups.

Evidence on adults in training programs and apprenticeship programs was inconclusive, likely due to a lack of statistical power resulting from few eligible studies. We identified six studies of adults in training programs that were eligible for inclusion in our review, but only four provided sufficient information to compute effect sizes and enable their inclusion in our quantitative meta-analysis. Of these four studies, two reported on a specific program (Year Up), one reported on multiple apprenticeship programs, and one reported on an occupational simulation. Similarly, we identified four studies that examined apprenticeship models, but only two provided sufficient information for inclusion in the meta-analysis. Although WBL only had positive impacts on 2 of our 10 outcome domains of interest (the Social & Emotional Health domain and the Academic Achievement & Advancement domain), they were also the most studied domains (exhibit 11). These patterns illustrate a serious limitation of the available evidence, tempering the strength of any conclusions drawn from our meta-analysis.

Limitations

First, while WBL appears to confer consistent benefits in the areas with sufficient evidence to support inferences, many of our individual meta-analytic models were underpowered and unable to detect statistically significant impacts. As a result, null findings from our review do not suggest that WBL does not work for the associated participant groups, types of WBL, or outcome domains. Given that few eligible studies exist for participant groups with nonsignificant findings, more research is needed to determine the robustness and generalizability of WBL program benefits. Further, because many eligible studies evaluated WBL programs outside of formal CTE or Perkins V-funded settings, findings may not fully generalize to secondary CTE programs. Differences in program structure, participant populations, implementation contexts, and policy requirements mean that impacts observed in non-CTE settings may not translate directly to CTE environments.

Second, the rigor of primary studies included in our review varied widely, affecting the validity of conclusions drawn from our synthesis (exhibit A6). Future evaluations could strengthen inferences by using well-powered RCTs or valid QEDs that establish baseline equivalence and test generalizability by including samples across multiple sites.

Third, our inferences may be limited due to the difficulty of attaining necessary information from published reports. For example, we found that WBL-only programs were significantly more effective than WBL+ programs, but reporting ambiguities in the included studies limit the interpretability of this finding. We only categorized programs as WBL+ if (a) services other than the primary intervention were offered, and (b) all participants in the intervention group received those services (i.e., they were core components of the program, rather than optional add-ons). When reports mentioned the availability of additional non-WBL services but did not specify whether they were core components, we coded programs as WBL-only. Further, the category of “additional services” was broad and could include work-related supports (such as job placement) and supportive services (like childcare vouchers). For this reason, we cannot attest to the relative importance of any additional services that were provided or their uptake among participants. Finally, nearly all WBL-only programs in our review were implemented with postsecondary education students, while WBL+ programs tended to be implemented with adults in training programs. This may mean that the WBL+ programs served populations who were more in need of additional supports, relative to WBL-only programs. The apparent advantage of WBL-only programs over WBL+ programs may therefore be driven by characteristics of the participant group, or by the outcomes that tended to be measured for each participant group, rather than the presence of multiple program services.

Implications

WBL experiences aimed at career preparation and participation—i.e., the "learning through work" section of the WBL continuum—appear to hold promise for improving learner outcomes that are important both to individuals and society as a whole. However, evidence is scarce and further research is needed to identify the types of WBL, strategies, and components that are most effective, especially in career-preparatory and career-participatory WBL. In the meantime, given the increase in WBL requirements and opportunities throughout the United States (Education Commission of the States, 2023), we offer the following implications from our synthesis of the existing evidence to guide future implementation and evaluation work.

For Practitioners and Program Developers

- **Continue developing WBL programs that connect learners' education to authentic work experiences with clear parameters.** When doing so, consider the elements of the Perkins V definition of WBL: connection to education, sustained interaction with industry professionals, and learners directly completing hands-on work tasks. Program developers should specifically define and identify criteria for WBL to ensure learner experiences are optimized and received as intended.
- **Develop coherent data systems connecting student-level academic outcomes, CTE and WBL program participation, and employment information to support longitudinal tracking of WBL programs, experiences, and related outcomes.** Understanding what is received at the individual learner level is critical to examining whether programs are delivering high-quality experiences for participants as intended, and whether those experiences lead to positive benefits for participants, demonstrated through academic and employment outcomes.
- **Support research on whether WBL activities geared toward career awareness and exploration are beneficial for participants.** This review focused on the "learning through work" end of the WBL continuum and is not designed to evaluate earlier WBL continuum activities focused on "learning about work." Research on the efficacy of career awareness and exploration approaches is still needed.

For Researchers and Evaluation Teams

- **Clearly and comprehensively describe the WBL program components and dosage being studied.** WBL programming varies in content, intensity, and core components. To meaningfully estimate and convey WBL program impacts, evaluation reports must provide clear and comprehensive detail on what WBL participants actually experienced during the intervention.
- **Establish whether WBL is better than business-as-usual conditions.** Investments in WBL are only justified if WBL confers benefits. Benefits cannot be established without comparing individuals who participated in WBL with those who did not participate and examining what might have occurred in the absence of the program. What comparison individuals who did not receive WBL *did* receive should also be investigated and defined to the extent possible. This could take the form of either RCTs or well-executed QEDs that attend to (and transparently report on) the equivalence of their intervention and control groups at baseline before WBL participation.

- **Test whether WBL impacts generalize across participant groups, types of WBL, outcome domains, and implementation contexts.** Our synthesis identified several participant groups, types of WBL, and outcome domains that are relatively underrepresented in their respective categories. Additionally, multisite evaluations are lacking overall. Future evaluation work should fill these gaps by (a) prioritizing studies with adult participants; (b) focusing on apprenticeship programs, service learning, and occupational simulations; (c) measuring impacts on school attendance, as well as distal outcomes including postsecondary educational attainment, economic indicators, and career skills; and (d) conducting multisite evaluations to ensure future findings are robust across implementation contexts.
- **Investigate core program components and features.** Consider whether characteristics of WBL implementation—such as program duration or wraparound supports—influence WBL impacts. For example, compare programs with a single WBL intervention to programs that provide WBL plus wraparound supports to see whether "add-on" components enhance or dilute WBL impacts. Vary program duration to explore whether lengthier programs provide greater benefits.
- **Clearly and comprehensively report methods and results.** Provide sufficient information in study reports for others to determine whether the program was implemented with fidelity to the established definition of WBL and to estimate an effect size (including group sample sizes, means and standard deviations, regression estimates, standard errors, and standard deviations). See Text Box 4 for more guidance on clear and comprehensive reporting.

For Policymakers

- **Prioritize funding for linked or coherent data systems to support learning about the benefits of WBL.** Data systems that link educational and workforce data at least within a state would enable researchers to determine the impacts of WBL programs on short-term (e.g., educational) and long-term (e.g., employment) outcomes.
- **Fund and require rigorous causal evaluations of immersive WBL programs that adhere to high-quality standards.** Incentivize researchers to use comparison group designs, and encourage practitioners to measure and track the extent to which learners receive the full, high-quality experience that is intended.

Text Box 4. How to Ensure Your WBL Study Is Represented in Systematic Reviews

- Future studies should clearly report the key methodological details required to assess the rigor of their evaluation designs and the strength of their conclusions. Important information related to baseline equivalence, methods of randomization, and potential confounds were frequently missing from reports.
- Additionally, primary studies must report study setting and sample information, including location and participant demographic characteristics (e.g., race, sex, mean age), along with clear and complete within- and between-group statistical information for key outcomes that is sufficient to calculate an effect size and its precision, to enable inclusion in a high-quality quantitative synthesis (Chow et al., 2023). Such transparency would strengthen both the rigor of individual studies and the reliability of subsequent meta-analyses aggregating across primary study impacts.
- Lastly, few studies in this review reported comprehensive program characteristics, such as duration, delivery method, and uptake of additional program components when offered. Additional information on program characteristics is needed to support more nuanced and informed analyses of WBL program design and effectiveness.

- **Invest in WBL simulations and other educator-driven experiences when access to direct workplace training may be limited.** Our findings suggest that educator-driven and employer-driven experiences can both be beneficial for certain outcomes. Educator-driven WBL that incorporates sustained interaction with industry professionals and real workplace tasks may be more feasible in areas where access to workplaces for internships or apprenticeships is limited.

Given the growing popularity and legislative endorsement of WBL programs, our comprehensive review provides a much-needed synthesis of existing evidence and identifies priority areas for future research and policy considerations. By documenting known impacts and highlighting promising directions for further study, this work advances the field and supports broader efforts to strengthen educational and workforce outcomes through high-quality, immersive learning experiences.

References

Association for Career and Technical Education (ACTE). (2018). *Quality CTE Program of Study Framework*. https://www.acteonline.org/wp-content/uploads/2024/09/HighQualityCTEFramework2018-Aug2024.pdf

Association for Career and Technical Education (ACTE). (2022). *What is work-based learning?* https://www.acteonline.org/wp-content/uploads/2022/10/WBL_Fact-Sheet_Final.pdf

Association for Career and Technical Education (ACTE). (2025, February). The impact of service learning. *ACTE Online*. https://www.acteonline.org/blog/2025/02/10/the-impact-of-service-learning/

Advance CTE. (2022). *State work-based learning innovation tracker analysis.* https://careertech.org/resource/state-work-based-learning-innovation-tracker-analysis/

Advance CTE. (2023). *Perkins V.* https://careertech.org/what-we-do/engaging-policymakers/federal-policy-agenda/perkins-act/

Butrica, B. A., Jones, E., Rosenberg, L., Sattar, S., & Sotelo, V. (2023). *A review of the literature on registered apprenticeships*. Urban Institute. https://www.dol.gov/sites/dolgov/files/ETA/publications/ETAOP_2023_17_ERAI_Literature_Review_Final.pdf

ConnectED. (2021). *ConnectED continuum: A work-based learning system*. https://connectednational.org/wp-content/uploads/2021/09/ConnectEd-Continuum-WBL_System_September-2021.pdf

Chow, J. C., Sandbank, M., & Hampton, L. H. (2023). Guidance for increasing primary study inclusion and the usability of data in meta-analysis: A reporting tutorial. *Journal of Speech, Language, and Hearing Research*, *66*(6), 1899–1907. https://doi.org/10.1044/2023_JSLHR-22-00318

Clearinghouse for Labor Evaluation and Research (2025). *Registered apprenticeship and work-based learning*. U.S. Department of Labor. https://clear.dol.gov/topic-area/registered-apprenticeship-and-work-based-learning

Dougherty, S. M., Kamin, S. J., & Klein, S. (2020). *Improving measurement in career and technical education to support rigorous research*. American Institutes for Research, Career and Technical Education Research Network. https://cteresearchnetwork.org/resources/improving-measurement-cte

Education Commission of the States. (2023). *50-state comparison: Work-based learning*. https://www.ecs.org/50-state-comparison-work-based-learning/

Fletcher, E. C., Jr., Dumford, A. D., Hernandez-Gantes, V. M., & Minar, N. (2020). Examining the engagement of career academy and comprehensive high school students in the United States. *The Journal of Educational Research*, *113*(4), 247–261. https://doi.org/10.1080/00220671.2020.1787314

Goldring, T., & Urban, C. (2024). *Work-based learning for CTE: A multi-state analysis of data collection and usage.* Georgia State University. https://scholarworks.gsu.edu/server/api/core/bitstreams/3fbd1d1c-4360-4269-8fa0-69a74411d93e/content

Grames, E. M., Stillman, A. N., Tingley, M. W., & Elphick, C. S. (2019). An automated approach to identifying search terms for systematic reviews using keyword co-occurrence networks. *Methods in Ecology and Evolution*, *10*(10), 1645–1654. https://doi.org/10.1111/2041-210X.13268

Hedges, L. V. (1981). Distribution theory for Glass's estimator of effect size and related estimators. *Journal of Educational Statistics*, *6*(2), 107–128. https://doi.org/10.3102/10769986006002107

Jobs for the Future. (n.d.). *Guided Career Pathways*. https://info.jff.org/guided-career-pathways-framework

Jobs for the Future. (2025).*Work-Based Learning: From Information to Action.* https://www.jff.org/idea/work-based-learning-framework/

Lindsay, J., Hughes, K., Dougherty, S. M., Reese, K., & Joshi, M. (2024). *What we know about the impact of career and technical education: A systematic review of the research*. American Institutes for Research, Career and Technical Education Research Network. https://cteresearchnetwork.org/resources/2024-systematic-review

Linked Learning Alliance. (n.d.). *About the Linked Learning approach*. https://www.linkedlearning.org/about/linked-learning-approach

NAF. (n.d.). *Outcomes-driven work-based learning*. https://naf.org/innovation-and-products/outcomes-driven-work-based-learning/

Office of Apprenticeship. (2025). *Explore pre-apprenticeship*. https://www.apprenticeship.gov/employers/explore-pre-apprenticeship

Office of Career, Technical, and Adult Education. (n.d.a). *2023–2024 secondary CTE concentrators by gender*. Perkins Collaborative Resource Network. https://cte.ed.gov/pcrn/profile/national/enrollment/2024/concentrator/secondary/gender/allstudents

Office of Career, Technical, and Adult Education (n.d.b). *Perkins V*. Perkins Collaborative Resource Network, U.S. Department of Education. https://cte.ed.gov/legislation/perkins-v

Plasman, J., & Thompson, C. (2023). The value of informal learning within work-based learning: The economic benefits of WBL. *International Journal of Training and Development*, *27*(3–4), 305–326. https://doi.org/10.1111/ijtd.12299

Polanin, J. R., Austin, M., Peko-Spicer, S., Ezzat, Y., Katragadda, S. A., Michaelson, L., Iacocca, M. O., Williams, S., Ebersole, C., Lam, T., & Clements, J. (2025). *MetaReviewer* (Version 1.4.0) [Computer software]. American Institutes for Research.

Pustejovsky, J. E. (2025). *clubSandwich: Cluster-robust (sandwich) variance estimators with small-sample corrections* (Version R package version 0.6.0) [HTML]. (Original work published 2015.) https://doi.org/10.32614/CRAN.package.clubSandwich

Pustejovsky, J. E., & Tipton, E. (2022). Meta-analysis with robust variance estimation: Expanding the range of working models. *Prevention Science*, *23*(3), 425–438. https://doi.org/10.1007/s11121-021-01246-3

R Core Team. (2025). *R: A language and environment for statistical computing* [Computer software]. R Foundation for Statistical Computing. https://www.R-project.org/

Shenk, M., Welch, E., & Dolfin, S. (2023). *Evidence snapshot: Work experience and work-based learning* (OPRE report #2023-056). U.S. Department of Health and Human Services. https://acf.gov/opre/report/evidence-snapshot-work-experience-and-work-based-learning

Shields, K. A., Hutchins, B. C., Reese, K., Fletcher, E. C., & Hughes, K. (2024). *Building robust district work-based learning data collection systems.* https://cteresearchnetwork.org/resources/district-work-based-learning-data-collection

Sun, J., & Spinney, S. (2017). *Transforming the American high school experience: NAF's cohort graduation rates from 2011–2015*. ICF.

Tanner-Smith, E. E., Tipton, E., & Polanin, J. R. (2016). Handling complex meta-analytic data structures using robust variance estimates: A tutorial in R. *Journal of Developmental and Life-Course Criminology*, *2*(1), 85–112. https://doi.org/10.1007/s40865-016-0026-5

Tipton, E. (2015). Small sample adjustments for robust variance estimation with meta-regression. *Psychological Methods*, *20*(3), 375–393. https://doi.org/10.1037/met0000011

Tipton, E., & Pustejovsky, J. E. (2015). Small-sample adjustments for tests of moderators and model fit using robust variance estimation in meta-regression. *Journal of Educational and Behavioral Statistics*, *40*(6), 604–634. https://doi.org/10.3102/1076998615606099

U.S. Congress. (2018). *Strengthening Career and Technical Education for the 21st Century Act*. https://www.congress.gov/115/plaws/publ224/PLAW-115publ224.pdf

U.S. Congress. (2025). *H.Res.115—Supporting the goals and ideals of "Career and Technical Education Month."* https://www.congress.gov/bill/119th-congress/house-resolution/115

Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software*, *36*, 1–48. https://doi.org/10.18637/jss.v036.i03

Walton, D., Gardiner, K. N., & Barnow, B. (2022). *Expanding apprenticeship to new sectors and populations: The experiences and outcomes of apprentices in the American Apprenticeship Initiative*. Abt Associates. https://files.eric.ed.gov/fulltext/ED625833.pdf

What Works Clearinghouse. (2022). *What Works Clearinghouse procedures and standards handbook, version 5.0*. U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance. https://ies.ed.gov/ncee/wwc/Handbooks

Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L., François, R., Grolemund, G., Hayes, A., Henry, L., Hester, J., Kuhn, M., Pedersen, T., Miller, E., Bache, S., Müller, K., Ooms, J., Robinson, D., Seidel, D., Spinu, V., Takahashi, K., Vaughan, D., Wilke, C., Woo, K., & Yutani, H. (2019). Welcome to the tidyverse. *Journal of Open Source Software*, *4*(43), 1686. https://doi.org/10.21105/joss.01686

Appendix

Literature Search

We applied a comprehensive systematic search strategy to ensure that we considered all relevant research on work-based learning (WBL) programs. First, we developed a search string containing terms relevant to WBL and other review criteria using *litsearchr* (Grames et al., 2019) to maximize the sensitivity and specificity of our results. The search terms are presented in exhibit A1. We used that search string to query eight electronic databases: PsycInfo, ERIC, Academic Search Premier, Education Source, SocIndex, Web of Science, Scopus, and ProQuest. These databases index both published peer-reviewed articles and gray literature, mitigating the risk that our review conclusions would be affected by publication bias. A total of 5,677 unique reports were returned by this search.

We supplemented our electronic database search by combing the websites of research organizations, relevant government agencies, and career and technical education (CTE) professional associations for reports and white papers. Specifically, we screened abstracts from reports categorized in the "Registered Apprenticeship and Work-Based Learning" topic area on the U.S. Department of Labor's Clearinghouse for Labor Evaluation and Research website and reports cited in a *Work Experience and Work-Based Learning Evidence Snapshot* published by the Office of Planning, Research, and Evaluation's Pathways to Work Evidence Clearinghouse (Shenk et al., 2023; U.S. Department of Labor, 2025). We also reviewed proposals submitted to the CTE Network 2.0, identified works cited in these proposals that appeared to be related to WBL, searched for the reports, and screened the abstracts for all identified reports. Finally, we solicited lists of other potential studies from researchers specializing in CTE, including CTE Network 2.0 members. Specifically, we shared the study eligibility criteria and the list of studies that we had identified as meeting those criteria and asked network members to share citations that met these criteria and were not already on the list. A total of 311 unique reports were returned by this search.

Exhibit A1. Literature search terms

Category	Search terms
Evaluation terms	"Analys*" OR "Assess*" OR "Compar*" OR "Estimat*" OR "Evaluat*" OR "Evidence" OR "Examin*" OR "Literature review*" OR "Measur*" OR "Meta-analys*" OR "Metaanalys*" OR "Predict*" OR Systematic W1 review* OR "Varia*" OR "Impact*" OR "Random*" OR "Experiment*" OR Analyz* OR quasiexperiment* OR "propensity score matching" OR "matching" OR "matched group*" OR "difference-in-difference" OR "ABAB" OR "regression discontinuity" OR "single case design*" OR "control group*" OR "control condition*" OR "controlled" OR assign* OR "causal" OR "Post-test*" OR Treatment* OR Baseline OR "Changing criterion" OR "Single subject" OR "Alternating treatment" OR "Simultaneous treatment" OR "Reversal design" OR "Withdrawal design*" OR Posttest* OR "multiple probe" OR "multi-probe" OR "multiple baseline" OR "multi-baseline"

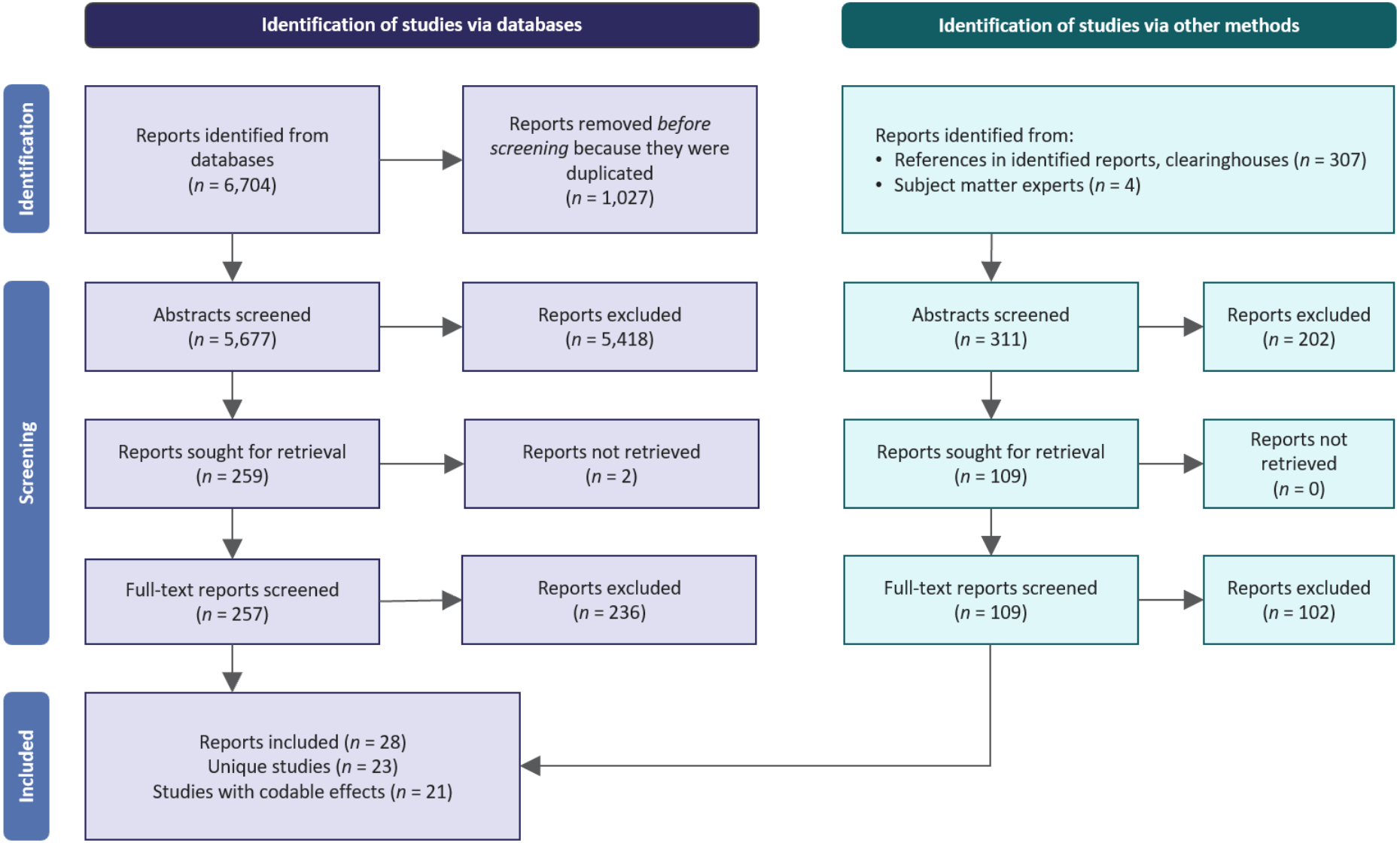
Category	Search terms
Population terms	"Middle school*" OR "High school*" OR "Secondary student*" OR "Secondary school*" OR "Career technical education student*" OR "Career and technical education student*" OR "CTE student*" OR "Vocational student*" OR "Vocational education student*" OR "School aged" OR "Youth" OR "Adolesc*" OR "Young adult*" OR "emerging adult*" OR "Grade* 6" OR "Grade* 7" OR "Grade* 8" OR "Grade* 9" OR "Grade* 10" OR "Grade* 11" OR "Grade* 12" OR "postsecondary" OR "postsecondary" OR "two-year college*" OR "2-year college*" OR "technical college*" OR "community college*" OR "associate's degree program*" OR "vocational college*" OR "career college*" OR "adult learn*" OR "adult educat*" OR "displaced work*" OR "unemploy*" OR "secondary education" OR "junior high" OR "youths" OR teen* OR "young people" OR "grade* six" OR "sixth grade*" OR "6th grade*" OR "grade* seven" OR "seventh grade*" OR "7th grade*" OR "grade* eight" OR "eighth grade*" OR "8th grade*" OR "grade* nine" OR "ninth grade*" OR "9th grade*" OR "grade* ten" OR "tenth grade*" OR "10th grade*" OR "grade* eleven" OR "eleventh grade*" OR "11th grade*" OR "grade* twelve" OR "twelfth grade*" OR "12th grade*"
Intervention terms	"work-based learning" OR "WBL" OR "work based learn*" OR "work-based-learn*" OR "intern*" OR "pre-apprentic*" OR "apprentic*" OR "earn and learn" OR "earn & learn" OR "integrated education and training" OR "IET" OR "on-the-job training" OR "on the job training" OR "career experience" OR "career immers*" OR "capstone" OR "student enterprise" OR "student business" OR "student commerce" OR "student company" OR "simulated business" OR "simulated enterprise" OR "simulated commerce" OR "simulated company"
Analysis modifiers	"Affect*" OR "Benefit*" OR "Declin*" OR "Decreas*" OR "Develop*" OR "Effect*" OR "Efficac*" OR "Gain*" OR "Growth" OR "Higher" OR "Increas*" OR "Impact*" OR "Improv*" OR "Lower*" OR "Progress" OR "Reduc*" OR "Statistic*" OR "Success*" OR "influence" OR "likelihood" OR "associat*" OR "correlat*" OR "weak*" OR "streng*"

Category	Search terms
Outcome terms	"career and technical" OR "CTE" OR "career-technical" OR "Vocation*" OR "occupation* education" OR "workforce education" OR "Area Technical Centers" OR "Career academy" OR "Career academies" OR "Technical high school*" OR "Magnet school*" OR "Magnet high school*" OR "Pathways in Technology Early College High School" OR "Career pathway*" OR "career education" OR "technical education" OR "tech-prep" OR "concentrat*" OR "Career read*" OR "Career matur*" OR "College prep*" OR "College read*" OR "Work habit*" OR "absence*" OR "punctual*" OR "attire" OR "critical think*" OR "communication skill*" OR "problem solving" OR "teamwork" OR "team work" OR "credential*" OR "certificat*" OR "career-related skill*" OR "career skill*" OR "skill proficien*" OR "concept* know*" OR "concept* understanding" OR "ASVAB" OR "Workkeys" OR "Work keys" OR "self-efficacy" OR "academic achiev*" OR "attendance" OR "effort" OR "engage*" OR "grade point average" OR "graduat*" OR "high school completion" OR "GED" OR "drop* out*" OR dropout* OR "college enroll*" OR "postsecondary enroll*" OR "postsecondary enroll*" OR "college attendance" OR "progress* in college" OR "college persist*" OR "credit accumulat*" OR "credit attain*" OR "credit* earn*" OR "continue* enroll*" OR "course* pass*" OR "standard* test*" OR "certificate complet*" OR "attain* degree*" OR "associate's degree" OR "associates degree" OR "bachelor's degree" OR "bachelors degree" OR "attain* licens*" OR "employment" OR "employed" OR "military enlist*" OR "earning*" OR "salary" OR "wage" OR "wages" OR "pay" OR "work read*" OR "workplace read*" OR absenteeism OR "work skill*" OR "workplace skill*" OR "interpersonal skill*" OR "following directions" OR "time management" OR "work-related skill*" OR "employability skill*" OR "college success" OR "college completion" OR "degree completion" OR "degree attainment" OR "soft skills" OR "skill* acquisition" OR "letter grade*" OR "final grade*" OR "student grade*" OR "students grade*" OR "GPA" OR "Attrition" OR "immediate outcome*" OR "intermediate outcome*" OR "medium-term outcome*" OR "long-term outcome*" OR "proximal outcome*" OR "distal outcome*" OR "education* outcome*" OR "job readiness" OR "job skills" OR "job performance" OR "student outcome*" OR "income"

The full results of our comprehensive literature search and screening process are summarized in a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram (exhibit A2). In total, our literature search returned 7,015 reports across the above-described methods. We removed 1,027 duplicates and screened the titles and abstracts of the remaining 5,988 unique reports for relevance. From these, we excluded 5,620 reports, most of which were not relevant to WBL or did not use a group design evaluation. We attempted to retrieve the full-text PDFs for the remaining 368 reports. Two of these reports were not retrievable, but we screened the full text of the remaining 366 reports for eligibility. Of these, we excluded 338 reports, most of which failed to meet the required elements of our WBL definition. Our final eligible sample contained 28 reports of 23 unique studies, 21 of which contained effect sizes that could be included in our quantitative synthesis.[7]

[7] A study is a unique evaluation of a particular program with a particular sample. Some studies are published in multiple reports (e.g., a technical report and a scholarly manuscript).

Exhibit A2. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart of the search and screening process



Screening Studies for Eligibility

Screening Approach

We screened articles returned by our literature search in two stages. First, we used the Systematic Review Data Repository to review the titles and abstracts of all reports identified in the database search. Two independent screeners reviewed each abstract, along with a reconciler if there were conflicts. Difficult reconciliations were discussed during weekly screener meetings. Second, after identifying potentially relevant articles based on titles and abstracts, we retrieved the full text of all reports and used MetaReviewer (Polanin et al., 2025; a free, browser-based hierarchical database software for research syntheses) to conduct full-text screening. We first screened full-text reports for overall eligibility. Two screeners screened each full-text report, a reconciler resolved any discrepancies, and the report was discussed during weekly team meetings if needed. Third, we conducted a more thorough screening for WBL program eligibility. Studies were excluded if screeners could not verify that the WBL program satisfied all components of the Perkins V definition. Studies were required to provide sufficient information on program components for the team to ensure that they met the criteria to be included. A validator reviewed all screening decisions and was instructed to verify the screener's rationale for their decisions and resolve any discrepancies through discussion with the screener and with the full screening team if needed.

Inclusion and Exclusion Criteria

Study inclusion and exclusion criteria are listed in exhibit A3 and described below.

Methods. Studies had to report on primary research with quantitative designs that compared at least two non-overlapping groups, one of which was required to participate in a WBL program (the intervention group). We included studies that relied on randomized controlled trials (RCTs) or quasi-experimental designs (QEDs) to compare an intervention group to a comparison group. Individuals in the comparison group could not receive WBL. If all groups were exposed to a WBL program, the study was not eligible for inclusion in the review. The comparison group could receive an alternative intervention, as long as that intervention did not meet our definition of WBL. However, all studies that met the eligibility criteria had "business as usual" comparison groups.

Units. Program participants had to be in secondary education (grades 6–12), postsecondary education, or adult training programs. Studies examining WBL among elementary school students were excluded.

Intervention. Studies had to examine the impact of an immersive WBL program that was implemented in the United States and had educational objectives. To define immersive WBL, we drew directly from Perkins V legislation and made small updates (provided in square brackets below) to ensure we were inclusive of adult populations:

> *Sustained interactions with industry or community professionals in real workplace settings, to the extent practicable, or simulated environments at an educational institution [or learning environment intended for pursuit of a certificate, credential, or degree], that foster in-depth, firsthand engagement with the tasks required in a given career field(s) and/or cluster(s), that are aligned to curriculum and instruction [or learning objectives] (U.S. Congress, 2018).*

To assess whether studies evaluated a WBL program that met this definition, we operationalized the components of the definition in the following way:

- **Sustained interactions.** Regardless of overall program length, participants needed to have a duration of at least 6 hours interacting with industry professionals in some way. If instructors held current industry certifications and verified industry skills, they were counted as industry professionals. The hours of sustained interaction did not need to be consecutive. They could occur on different days.
- **Real or simulated workplace settings.** If the program was simulated (e.g., conducted in a classroom), either industry professionals or classroom instructors with current or recent industry experience had to deliver the program.
- **Educational institution.** The program had to be connected to an educational institution. Programs not based in or connected to a secondary or postsecondary institution could meet this requirement if the provider organization had clear learning objectives or a curriculum that was intended to support participants in pursuit of a certificate or credential of some kind.
- **Firsthand engagement.** The program had to ensure that participants had firsthand engagement with tasks (i.e., they did activities they would do on the job and were not just observing others conduct those activities).

We excluded studies that did not provide enough information to confirm that they met all the components of the Perkins V WBL definition. Additionally, studies were only included if all participants in the intervention group received the WBL intervention. Many studies of CTE programs were not eligible for inclusion in this review because not all students in the CTE program were required to participate in WBL (e.g., some career academy programs offered WBL, but it was not a requirement).

Outcomes. Studies were eligible if they measured at least one eligible outcome and the outcome was measured consistently for the intervention and comparison groups. Studies had to provide enough information about the outcome for us to confidently categorize it into an outcome domain.

Setting and Time Frame. Studies had to be conducted in the United States, published in or after 2003, and available in English.

Exhibit A3. Study eligibility criteria

Category	Included	Excluded
Methods	• Group design studies comparing the impacts of a WBL program to business as usual or an alternative intervention program were eligible. Participants in business-as-usual groups are exposed to standard/routine practices and procedures that would be experienced in the absence of the intervention. Examples include the following: – In formal education settings (e.g., grades 6–12, postsecondary education, adult education), business-as-usual participants include students exposed to the typical curriculum which does not include WBL. – For students in CTE, business-as-usual participants include those who do not participate in WBL as a component of their CTE (intervention students are in CTE and have WBL too). – Participants in an alternative intervention group participate in another intervention that is not WBL. For example, WBL participants may be compared to a group of people who are assigned to receive job-search training (e.g., interviewing or résumé skills).	• Studies were excluded if participants in the comparison group received a WBL program at the same time as the intervention group. • Studies were also excluded if they compared one group who received enhanced WBL to another group who received standard WBL.
Units	Eligible participants included students in all secondary education settings (grades 6–12) and postsecondary education settings and adults in training programs. Secondary and postsecondary education students are typically age 11 and older.	Students in preschool or elementary school (grades PK–5) were not eligible participants.

Category	Included	Excluded
Intervention	An intervention was eligible for inclusion if it met Perkins V requirements for WBL: • The intervention involved sustained interactions with industry or community professionals in real workplace settings, to the extent practicable, or in simulated environments. – Sustained interactions consisted of 6 or more hours, over 1 or more days. – Industry or community professionals were active in industry. Instructors could meet this requirement if they were doing industry tasks in addition to teaching. – Examples include internships, service learning, and other experiences where students worked directly with industry or community professionals in real or simulated environments. • The intervention fostered in-depth, firsthand engagement with the tasks required in a given career field and/or cluster. – Participants performed tasks that would be done in an actual workplace (i.e., hands-on engagement), rather than just watching someone else do the tasks. For example, students carried out workplace activities, such as updating medical records in a hospital setting. – Engagement did not need to align with the student's intended career field. • The intervention had a connection to an educational institution or learning environment. – This included schools offering secondary education, postsecondary institutions (any type, including technical colleges and 2-year and 4-year institutions), and industry-based learning institutes, as well as WBL programs not associated with K–12 and postsecondary education institutions that offered a path to a degree, certification, or credential, or had learning objectives. – Examples: WBL offered as a program or class requirement or as a way of earning credits; adult education programs offered at a postsecondary institution; programs for adults or out-of-school students (e.g., during the summer) that were not associated with a grade 6–12 or postsecondary education institution but could lead to a credential and included learning objectives; apprenticeship programs; programs offered by industry-based educational institutes.	• An intervention was not eligible for inclusion if it did not meet our WBL definition criteria: • The amount of interaction with industry or workplace professionals was less than 6 hours. • Learning came exclusively from a course instructor who was not an industry or community professional (e.g., a lecture-based training course provided by an instructor who was not an active professional or practitioner). • Participants did not engage in any hands-on tasks for a career field or cluster (e.g., students learned about different careers without participating in any hands-on career activities). • Programs were not connected to an education institution or learning environment. Examples include the following: – a program offered by a community center to students enrolled in middle school, where the program was not part of their middle school curriculum/requirements; or – a program for adults that did not offer the opportunity to earn a credential or did not have any learning objectives.

Category	Included	Excluded
Outcome	• Studies measured one or more eligible outcomes at posttest or follow-up: academic achievement, attitudes, and beliefs; college degree attainment; postsecondary enrollment; college readiness; discipline; earnings; employment; job readiness; employability skills; high school completion; mental health; progressing in college; prosocial behaviors; school attendance; other (describe). • The outcome was measured in a consistent manner for both intervention and comparison groups.	• Outcomes measured characteristics of participants' institutional affiliations, such as the ranking of the college they attended. • Outcomes were measured before the conclusion of the intervention. • Outcomes were measured inconsistently between intervention and comparison groups.
Setting, language, and time frame	• Studies were conducted in the United States or its territories. • Studies were available in English. • Studies were published between 2003 and 2023.	• Studies were conducted in countries other than the United States and its territories. • Studies were not available in English. • Studies were published before 2003 or after the literature search took place in 2023.

Note. CTE = career and technical education. PK = prekindergarten. WBL = work-based learning.

Coding and Data Extraction

We used MetaReviewer to code information from eligible studies. We created a codebook that detailed the information to code, including study-level information (e.g., details on assignment of participants to conditions); characteristics of the intervention and comparison conditions (e.g., type of WBL program, presence of multiple components); sample information (e.g., grade-level, construct-level information [e.g., measurement domain and timing]); and summary data used to estimate effect sizes (e.g., means and standard deviations for the intervention and comparison conditions). MetaReviewer merged the hierarchical database tables to output data, with each row of the spreadsheet representing a single effect size.

Author Queries

Some studies did not provide enough information for us to code effect sizes for one or more outcomes. If the coder could not find the necessary information, they brought the issue to the team, who reviewed the study report again to look for the required information. If the necessary information still could not be identified, the author query manager provided an additional review and contacted the original study authors to ask whether they had access to the needed effect size information.[8] We could not identify codable effects for nine studies. To conduct author queries, we identified authors' e-mail addresses from the reports or through web searches. We then emailed the authors to let them know we were conducting a systematic review but needed more information to include one or more outcomes from their study, and to ask whether those data were available. If data were available, we planned to follow up with a request for the specific information we needed to code the effects. Of the nine authors we queried for information, three stated that data from the study were no longer available and six did not reply. Seven of the nine studies had some codable information in their reports and were included in the meta-analysis. However, two of the nine studies had no codable effect size information and were excluded from the meta-analytic impact models.

Focal Variables

Types of WBL. We coded WBL program types into the following categories,[9] based on the primary intervention:

- **Internship or cooperative education.** Work for an employer in a real or virtual workplace (ACTE, 2022).
- **Apprenticeship.** Paid, on-the-job learning experiences combined with related technical instruction. Participation in registered apprenticeships leads to a nationally recognized certificate of completion (ACTE, 2022). Pre-apprenticeships prepare individuals to participate in an apprenticeship program (Office of Apprenticeship, 2025).
- **Medical practicum or residency.** Opportunity for students to provide health care to patients under the supervision of professionals (ACTE, 2022).
- **Simulation of an occupational activity in a classroom.** Simulations of real workplace tasks in an educational setting. For example, these may include business, nursing, or welding simulations.
- **Service learning.** Community service activities that include academic instruction, designed to enhance students' learning experience, teach civics, and strengthen communities (ACTE, 2025).

[8] If there were multiple outcomes of the same type (e.g., annual earnings and hourly earnings) and we could code effects from at least one of the outcomes, we did not conduct an author query.
[9] Other types of WBL were eligible for inclusion in this review, including student teaching, school-based enterprises, industry-involved competitions, and college or university jobs that met the WBL definition criteria. However, no studies that were eligible for this review studied these types of programs.

- **Research project.** Replication of a professional research position or team in an educational setting, such as a course-based undergraduate research experience.

After completing the coding process and conducting the first set of analyses, we aggregated types of WBL to create higher level groups and increase the power of the models to detect statistically significant effects. We categorized programs into two groups: those that were employer-driven and those that were educator-driven. Although all WBL programs included in this review had connections to work and education, educator-driven programs primarily operated out of a classroom (e.g., occupational simulations, service learning, and research projects) and employer-driven programs primarily operated out of the workplace (internships, apprenticeships, and medical practicums).

Education Setting at Baseline. We coded participants' grade levels at baseline, when they were assigned to the intervention or comparison group. Participants in secondary schools were in grades 6–12; those in postsecondary education settings were in 2-year or 4-year colleges or universities; and those in adult training programs were in industry-based learning or adult education programs sponsored by public or private institutions that were designed to offer a path to a degree, certification, or credential.

Outcome Domains. We categorized study outcomes into 1 of 10 possible domains (exhibit A4). If outcomes did not fit into any of our a priori categories, we coded them as "other." After reviewing the outcomes coded as "other," the study team found that several of the items fit together. We called this new domain Economic Well-Being, which included items such as having health insurance, owning a home, and receiving fewer social supports (e.g., unemployment insurance). Some outcomes coded as "other" still did not fit neatly into any domains and were excluded from the models subset by outcome domain. These outcomes were retained for all other analyses.

After completing the coding process and beginning analysis, we aggregated outcome domains to create higher level groups that were still conceptually meaningful. This was useful because there were very few studies that measured some outcome domains. The team relied on an iterative process to aggregate outcomes, where the study team proposed groupings and the leadership team reviewed and provided feedback. The aggregate outcome domains were Economic Indicators (composed of the Employment, Earnings, and Economic Well-Being domains); Educational Milestones (composed of the High School Completion, Postsecondary Enrollment, and Postsecondary Educational Attainment domains); and Skills & Knowledge (composed of the Academic Achievement & Advancement domain and the Career Skills & Job Readiness domain). The School Attendance domain and Social & Emotional Health domain did not fit neatly with other groups, so they were excluded from the aggregated outcome domains.

All outcomes were coded so that higher values indicated more favorable outcomes. If an outcome was collected across multiple time points, we coded effects at each time point. Effects were eligible for inclusion if they were measured at the conclusion of the intervention, or later. Outcomes assessed during the intervention were excluded.

Exhibit A4. Outcome domains

Outcome domain	Definition and examples
Academic Achievement & Advancement[a]	• Academic achievement (secondary): Secondary school grades or grade point averages, scores on standardized achievement tests (excluding college placement tests), and the accumulation of high school credits • Academic achievement (postsecondary): College or university course grades or grade point averages • Postsecondary progression: Outcomes that measure returning to college at the beginning of each semester or school year, or college credit accumulation • Postsecondary readiness: Completion of Advanced Placement courses, scores on college placement tests (ACT, SAT), and earning college credits in high school
Career Skills & Job Readiness[a]	• Employability skills: Skills that employers value regardless of field, such as critical thinking, the ability to work in teams, interpersonal skills, communication skills, self-management and initiative, resource and time management, and problem solving. These are commonly referred to as soft skills or durable skills. • Job readiness: Job-specific or technical skills, including résumé development, completing job applications, interviewing skills, and skills in general office work, including self-reported abilities (e.g., "Comfort level performing general office work, such as using Excel, making photocopies, or filing papers")
Earnings[b]	Any type of earnings, including hourly wages and amount earned in a week, month, quarter, or year, and personal income
Economic Well-Being[b]	Outcomes that capture economic self-sufficiency but are not employment or earnings, including reduction in public benefit receipt (e.g., unemployment insurance), poverty status, financial hardship, having health insurance, having a savings or checking account, owning a home, or having money in savings
Employment[b]	Whether the individual is employed in either full- or part-time work, or is advancing in employment
High School Completion[c]	Attainment of a high school diploma or its recognized equivalent, including graduating from high school, time to completion, on-time graduation, and dropping out of high school
Postsecondary Enrollment[c]	Enrollment in a postsecondary institution, including 2-year and 4-year colleges and universities
Postsecondary Educational Attainment[c]	Attainment of a postsecondary or college degree (e.g., associate's degree, bachelor's degree) or a credential, such as a license, certificate, or certification, including industry recognized credentials attained in high school or after
School Attendance	Outcomes that capture the time a student spends in or out of school

Outcome domain	Definition and examples
Social & Emotional Health	• Attitudes & beliefs (self): Attitudes and beliefs about oneself, including self-efficacy, career aspirations, career attitudes or beliefs, confidence in one's career field, feelings of general preparation, school engagement, and attitudes toward learning • Attitudes & beliefs (others): Attitudes and beliefs about other individuals or groups, such as attitudes toward people with disabilities or elderly people (e.g., empathy) • Discipline & behavior: Behaviors, such as counts of disciplinary referrals (i.e., sending students to the principal's office for disruptive behavior), detentions, suspensions, substance use, and positive behaviors (e.g., prosocial behaviors) • Mental health: Mental health indicators, including depression, anxiety, fear, and social isolation

Note. Outcomes that did not fit into any of the domains in this table were coded as "other." After coding and before analysis, the team reviewed all "other" outcomes to determine whether (a) they could fit into one of the outcome codes above, or (b) new outcome categories had emerged (e.g., Economic Well-Being). Outcomes that did not meet either criterion were kept as "other" and excluded from models subset by outcome domains.
[a] Outcomes that fall into the Skills & Knowledge aggregated outcome domain.
[b] Outcomes that fall into the Economic Indicators aggregated outcome domain.
[c] Outcomes that fall into the Educational Milestones aggregated outcome domain.

Number of Program Components. We coded whether a program had required components in addition to the primary WBL component. Studies were not coded as multicomponent if the additional components were voluntary. Additional components could include any of the following:

- attending a different type of educational program in addition to receiving WBL (e.g., intervention group attending a career academy, technical high school, vocational high school, technical community college);
- direct monetary stipends;
- transportation or vouchers/payment for transportation;
- childcare or vouchers/payment for childcare;
- mental health or substance abuse services;
- career exploration or job search services (résumé support, mock interview support, supporting the job seeker in identifying positions and submitting applications);
- job placement support (direct coordination with employers);
- employability skills/soft skills training;
- assistance navigating federal or state benefits (Temporary Assistance for Needy Families, housing, and others); and/or
- other.

Characteristics of Included Studies

Exhibit A5 provides key study characteristics for each of the studies included in this review.

Sample Characteristics. The median sample size per study was 173 participants. The mean sample size per study was 1,655 (*SD* = 4,978). There was a wide range of sample sizes across the 23 studies (ranging from 6 to 21,426). Participants' average age was 21.8 years (*SD* = 6.0), ranging from 13 years to 30.7 years. The mean percentage of participants reported as male was 55.7 percent (*SD* = 25 percent). The majority of participants' reported race was White (*M* = 45 percent, *SD* = 32.4 percent), followed by Black (*M* = 30.1 percent, *SD* = 27.8 percent), mixed race (*M* = 12 percent, *SD* = 18.1 percent), Asian (*M* = 9.2 percent, *SD* = 10.6 percent), and "other" (*M* = 5.1 percent, *SD* = 37 percent), which studies may have classified differently. Nearly one-fifth of participants were reported as Latino (*M* = 18.8 percent, *SD* = 14.7 percent). Two studies did not report any participant demographic characteristics regarding race, sex, or age.

The plurality of studies focused on students in a postsecondary setting (*k* = 9; 39 percent), followed by secondary students (*k* = 8; 35 percent), and adult learners *(k* = 6; 26 percent). Studies were conducted in 19 states[10] and Washington, D.C. Some studies were conducted in multiple states (*k* = 5; 22 percent). Studies were conducted primarily with participants located in the following areas: urban (*k* = 11; 48 percent), suburban (*k* = 3; 13 percent), rural (*k* = 2; 9 percent), and multiple urbanicities (*k* = 2; 9 percent). Five studies did not report sample location (22 percent).

Almost half of the studies reported targeting participants who belonged to at least one of the nine "special populations" prioritized in the Carl D. Perkins Career and Technical Education Act (*k* = 11; 48 percent). Nearly one-third of studies included participants with disabilities (*k* = 7; 30 percent); five included low-income participants (22 percent); two included English learners (9 percent); and one each included participants experiencing homelessness (4 percent), military families (4 percent), or individuals preparing for non-traditional fields (4 percent). Percentages may exceed 100 as studies could include multiple populations of interest.

WBL Program Characteristics. The majority of WBL programs were nationally branded programs (e.g., Urban Alliance, Year Up; *k* = 16; 70 percent). Nine studies were conducted at more than one site (39 percent); the remainder were single-site programs (*k* = 14; 61 percent). Regarding types of WBL, the plurality of programs focused on internships or cooperative education (*k* = 9; 39 percent), followed by apprenticeships (*k* = 4; 17 percent), simulation of an occupational activity in a classroom (*k* = 4; 17 percent), research projects (*k* = 3; 13 percent), service learning (*k* = 2; 9 percent), and medical practicum or residency (*k* = 1; 4 percent). Roughly half of programs were considered multicomponent (*k* = 11; 48 percent). One study (4 percent) did not report sufficient information to determine the number of components. The median program length was 31 weeks (ranging from 3 weeks to 208 weeks); four studies (17 percent) did not report intervention length. Industry professionals most frequently delivered WBL programming (*k* = 16; 70 percent), followed by instructional and academic support staff (*k* = 12; 52 percent), program-specific facilitators (*k* = 11; 48 percent), students (*k* = 2; 9 percent), and professional development providers (*k* = 1; 4 percent). Two studies reported "other" intervention delivery methods (9 percent).

Nearly half of programs were aligned with students' educational areas (*k* = 11; 48 percent), one-quarter had "mixed" educational alignment (i.e., the WBL was in the same educational field for some, but not all, participants within the program; *k* = 6; 26 percent), and alignment was unclear for six studies (26 percent). For the majority of

[10] California, Connecticut, Florida, Georgia, Iowa, Illinois, Kentucky, Massachusetts, Maryland, Missouri, North Carolina, New Jersey, Ohio, Pennsylvania, Rhode Island, Texas, Virginia, Vermont, Washington.

studies (*k* = 17; 74 percent), participation in the WBL program was separate from educational requirements. In one study (4 percent), participation in the WBL program was required to receive a degree; in three studies (13 percent), participation was required to receive a certification; and two studies (9 percent) did not clearly specify the relationship between participation in the WBL program and educational requirements. Nine studies indicated that participants were paid for their participation (39 percent), six studies indicated they were unpaid (26 percent), and eight studies did not clearly report participant compensation information (35 percent).

Measurement. Studies reported various approaches to outcome measurement. Studies reported both continuous outcomes (e.g., earnings, percentage employed) and dichotomous or categorical outcomes (e.g., employed/not employed). Many studies reported at least one outcome collected via administrative data, such as transcripts or school or wage records (*k* = 13; 57 percent), or survey data (*k* = 11; 48 percent). Only one study reported using observational methods to collect an outcome (*k* = 1; 4 percent). Four studies reported using "other" unclear collection methods or did not report their collection methods (*k* = 4; 17 percent). Most studies reported at least one standardized or established measure (*k* = 17; 74 percent) and about half of the studies reported at least one author- or researcher-developed measure (*k* = 10; 43 percent).

Outcome Domains. All studies reported at least one outcome domain, and just over half (*k* = 13; 57 percent) reported outcomes in at least two domains. The most frequently reported domains were Employment (*k* = 12; 52 percent) and Social & Emotional Health (*k* = 10; 43 percent), followed by Academic Achievement & Advancement (*k* = 8; 35 percent), Postsecondary Enrollment (*k* = 7; 30 percent), High School Completion (*k* = 6; 26 percent), and Earnings (*k* = 6; 26 percent). Fewer than five studies reported outcomes in the domains of Economic Well-Being, Postsecondary Educational Attainment, Career Skills & Job Readiness, and School Attendance.

Exhibit A5. Characteristics of included studies (*k* = 23)

Author, year	Program name	Education setting	Type of WBL	WBL+	Program length (weeks)	Outcome domain(s)	Design	Peer reviewed	Baseline equivalence	Confounds present
Bowers, 2021	Course-based undergraduate research experience	Postsecondary	Research project	No	NR	Academic Achievement & Advancement	QED	Yes	No differences	Yes
DeSimone, 2013	Marketing Incubator	Postsecondary	Simulation of an occupational activity in a classroom	No	16	Career Skills & Job Readiness	QED	Yes	NR	No
Dula, 2021	Registered apprenticeship	Adult	Apprenticeship	Yes	NR	Employment, Earnings, Economic Well-Being	QED	No	No differences	No
Fein, 2018	Year Up	Adult	Internship or cooperative education	Yes	52	Earnings, Employment, Social & Emotional Health, Postsecondary Educational Attainment, Economic Well-Being, Postsecondary Enrollment	RCT	No	NR	No
Fialho, 2022	Integrated Business Curriculum Program (IBCP)	Postsecondary	Simulation of an occupational activity in a classroom	No	16	Social & Emotional Health	QED	No	NR	No

Author, year	Program name	Education setting	Type of WBL	WBL+	Program length (weeks)	Outcome domain(s)	Design	Peer reviewed	Baseline equivalence	Confounds present
Fogg, 2016	Shipbuilding/ Marine Advanced Manufacturing Institute (SAMI)	Adult	Simulation of an occupational activity in a classroom	Yes	NR	Employment	QED	No	No differences	Yes
Goldstein, 2012	School to Work Internship Pilot	Secondary	Internship or cooperative education	No	31	Employment, Postsecondary Enrollment, Social & Emotional Health	QED	No	NR	No
Hemelt, 2019	Academy of Information Technology	Secondary	Internship or cooperative education	No[a]	144	High School Completion, Academic Achievement & Advancement, Career Skills & Job Readiness, Postsecondary Enrollment	RCT	Yes	NR	No
Hollenbeck. 2016[b]	Registered apprenticeship	Adult	Apprenticeship	No	208	Employment, Earnings, Other	QED	No	Differences present	No
Lee, 2020	Service learning	Postsecondary	Service learning	No	8	Social & Emotional Health	QED	Yes	No differences	Yes
Marshall, 2016	Immersive problem-solving lab	Postsecondary	Simulation of an occupational activity in a classroom	No	4	Academic Achievement & Advancement	QED	Yes	No differences	Yes
Modestino, 2021	Boston Summer Youth Employment Program	Secondary	Internship or cooperative education	Yes	6	High School Completion, School Attendance, Academic Achievement & Advancement	RCT	Yes	NR	No

Author, year	Program name	Education setting	Type of WBL	WBL+	Program length (weeks)	Outcome domain(s)	Design	Peer reviewed	Baseline equivalence	Confounds present
Pate, 2013	Registered nursing program with nursing elder care practicum	Postsecondary	Medical practicum or residency	No	3	Social and Emotional Health	RCT	No	NR	No
Reed, 2012[b]	Registered apprenticeship	Adult	Apprenticeship	Unclear	208	Earnings, Employment	QED	No	NR	No
Rodenbusch, 2016	Freshman Research Initiative	Postsecondary	Research project	No	45	Postsecondary Educational Attainment, Academic Achievement & Advancement	QED	Yes	NR	No
Roder, 2011	Year Up	Adult	Internship or cooperative education	Yes	52	Employment, Postsecondary Enrollment, Postsecondary Educational Attainment	RCT	No	NR	No
Schaeffer, 2013	Community Restitution Apprentice-Focused Training (CRAFT)	Secondary	Apprenticeship	Yes	24	Employment, High School Completion, Social and Emotional Health	RCT	Yes	NR	No
Sevak, 2021	Linking Learning to Careers (LLC)	Secondary	Internship or cooperative education	Yes	NR	Postsecondary Enrollment, High School Completion, Social & Emotional Health, Career Skills & Job Readiness, Earnings, Employment	RCT	No	NR	No

Author, year	Program name	Education setting	Type of WBL	WBL+	Program length (weeks)	Outcome domain(s)	Design	Peer reviewed	Baseline equivalence	Confounds present
Theodos, 2016	Urban Alliance	Secondary	Internship or cooperative education	Yes	41	Social & Emotional Health, High School Completion, School Attendance, Academic Achievement & Advancement, Career Skills & Job Readiness, Postsecondary Enrollment, Employment, Earnings	RCT	No	NR	No
Theodos, 2021	Urban Alliance	Secondary	Internship or cooperative education	Yes	35	Economic Well-Being, Postsecondary Enrollment, Employment, Academic Achievement & Advancement, High School Completion, Social & Emotional Health	RCT	No	NR	No
Weiler, 2013	Campus Corps	Postsecondary	Service learning	Yes	15	Social and Emotional Health	QED	Yes	Differences present	No

Author, year	Program name	Education setting	Type of WBL	WBL+	Program length (weeks)	Outcome domain(s)	Design	Peer reviewed	Baseline equivalence	Confounds present
Weisbrod, 2023	Biology or physics course with course-based undergraduate research experience sections	Postsecondary	Research project	No	16	Academic Achievement & Advancement	QED	No	NR	Unclear
Whittenburg, 2020	Project SEARCH	Secondary	Internship or cooperative education	Yes	36	Employment	RCT	Yes	NR	No

Note. NR = not reported. QED = quasi-experimental design. RCT = randomized controlled trial. WBL = work-based learning. WBL+ = work-based learning plus other mandatory element(s).

[a] The program in this study offered additional components but they were not described as mandatory, so it was coded WBL-only rather than WBL+.

[b] Denotes studies not included in the meta-analytic impact models because the reports did not provide enough information to estimate effect sizes.

Effect Size Estimation and Analytic Approach

We entered the data needed to compute effect sizes in MetaReviewer, then exported the long-format dataset for processing and analysis. We calculated inverse-variance weighted effect sizes in R (R Core Team, 2025) using the *escalc* package (Viechtbauer, 2010). Most outcomes were continuous, so we estimated Hedges' *g* effect sizes as our standardized mean difference metric to adjust for small-sample bias (Hedges, 1981). When data to compute multiple effect size types were available from study reports, we prioritized raw, unadjusted means and standard deviations for baseline and outcome measures. For dichotomous outcomes, we coded information to estimate the log odds ratio and then converted it into Hedges' *g* using established formulas (What Works Clearinghouse, 2022, pp. 160–187).

We used complete case analysis for missing moderator data and dropped studies that did not provide quantitative information to compute an effect size (rather than imputing effect sizes). We estimated random-effects models for quantitative synthesis, given our assumption that effects in our review were derived from a normal underlying distribution and that our sample of effect sizes would generalize beyond the included studies. We relied on the *tidyverse* package for cleaning (Wickham et al., 2019). We conducted analyses using the *rma.mv*() command within the *metafor* package (Viechtbauer, 2010) with restricted maximum likelihood estimation, along with the *clubSandwich* package (Pustejovsky, 2025). These techniques account for dependencies between effect sizes due to correlated hierarchical effects (Pustejovsky & Tipton, 2022) and adjust the standard errors and degrees of freedom for regression coefficients with robust variance estimation using the Satterthwaite approximation (Tanner-Smith et al., 2016; Tipton, 2015; Tipton & Pustejovsky, 2015).

Our research questions were as follows:

RQ 1: What are the overall impacts of WBL on different **participant groups**: secondary education students, postsecondary education students, and adults in training programs?

RQ 2: What are the overall impacts of different **types of WBL** (e.g., apprenticeships, service learning) on participant outcomes?

RQ 3: What are the overall impacts of WBL on various **outcome domains** (e.g., academic achievement, employment)?

To address our first research question, we estimated three unconditional meta-analytic models, one for each of the three baseline educational settings: secondary education, postsecondary education, and adult training programs. We aggregated across outcomes for this analysis.

To address our second research question, we estimated two sets of unconditional meta-analytic models. The first set included individual models for each of the six types of WBL we identified a priori. This set likely contained several models that were underpowered to detect statistically significant effects due to the small number of studies examining certain types of WBL, but the results provide insights on the state of evidence on WBL and help direct attention to where additional research is needed. The second set included two individual models containing groups of types of WBL that we aggregated post hoc based on their conceptual cohesion. This second set aggregated types of WBL into conceptually similar higher level groups and increased the models' power to detect statistically significant impacts.

To continue exploring program type impacts, we estimated one meta-analytic model with a moderating variable: whether the WBL intervention included a single component or multiple components. The intercept of this model was set at zero so that we could estimate the mean effect at each level. We also estimated a post hoc analysis of variance (ANOVA) to determine whether the levels were significantly different from each other.

To address our third research question, we estimated two sets of unconditional meta-analytic models. The first set included individual models for each of the 10 outcome domains we identified a priori, based on their relevance to the field. The second set included three individual models containing groups of outcome domains that we aggregated post hoc based on their conceptual cohesion. The first set likely contained several models that were underpowered to detect statistically significant effects due to the small number of studies within outcome domains, but the set as a whole provides a snapshot of the state of evidence on WBL and helps direct attention to where additional investigations are needed. The second set of models provided better estimates of WBL impacts, but at a coarser level of description.

Risk of Bias

To assess risk of bias, we considered several factors (exhibit A6). Regarding study design, just over half of the 23 studies were QEDs (k = 13; 57 percent) and the remainder were RCTs (k = 10; 43 percent). None of the RCT studies reported compromised randomization.

Study designs are strongest when the groups are equivalent at baseline, before they are exposed to the intervention. RCT groups are typically equivalent at baseline because participants are randomized into their condition, creating groups that are equivalent on observable and non-observable characteristics. For this reason, we did not collect data on baseline equivalence for the 10 studies that randomized participants to an intervention or comparison condition (k = 10; 43 percent). Of the 13 QED studies, five reported no significant differences between intervention and comparison groups at baseline on key demographic or outcome characteristics (22 percent), six did not report baseline equivalence (26 percent), and two reported statistically significant differences between groups at baseline (9 percent).

Study confounds are another indicator of possible bias because they make it impossible to isolate the impact of the intervention alone. A study design is confounded if either the intervention or comparison condition contains a study component that aligns with only one of the study conditions and is not a component of the intervention. For example, if there is no overlap in the instructors who teach the comparison and control groups, the instructor represents a study confound. Of the 23 studies, the majority did not have confounds (k = 18; 78 percent), four did have confounds (17 percent), and one did not present the relevant information with enough clarity to determine if confounds were present (k = 1; 4 percent).

Some other study factors may or may not represent a risk of bias. Over half of the 23 studies had not been peer reviewed (k = 13; 57 percent). No studies were identified as having a conflict of interest, either as declared by the author or identified by the coder (k = 23; 100 percent). Most studies explicitly declared a source of funding (k = 15; 65 percent). Only one study reported preregistering study methods and hypotheses (k = 1; 4 percent).

Exhibit A7 provides citations for all included studies.

Exhibit A6. Risk-of-bias characteristics

Characteristic	*k*	% *k*
Study design		
RCT	10	43%
QED	13	57%
Randomization compromised		
Yes	0	0%
No	10	43%
Not applicable (QEDs)	13	57%
Baseline equivalence		
No differences	5	22%
Differences present	2	9%
Not reported	6	26%
Not applicable (RCTs)	10	43%
Confounds present		
No	18	78%
Yes	4	17%
Unclear	1	4%
Peer reviewed		
Yes	10	43%
No	13	57%
COI identified		
Yes	0	0%
No	23	100%
Study preregistered		
Yes	1	4%
No	22	96%

Note. COI = conflict of interest. *k* = number of studies. QED = quasi-experimental design. RCT = randomized controlled trial.

Exhibit A7. List of eligible studies

Bowers, G. M., Larsen III, R. K., & Neiles, K. Y. (2021). Scholarship-based undergraduate laboratory courses modeled on a graduate school research rotation. *Journal of Chemical Education*, *98*(4), 1152–1162.

DeSimone, F., & Buzza, J. (2013). Experiential learning: Improving the efficacy of an undergraduate business degree. *American Journal of Business Education*, *6*(1), 7–24.

Dula, C. (2021). *The 2021 net impact and cost-benefit evaluation of Washington state's Workforce Development Programs.* Washington Workforce Training & Education Coordinating Board. https://www.wtb.wa.gov/wp-content/uploads/2021/05/Net-Impact-Study_FINAL.pdf

Engstrom, W., Fein, D., & Gardiner, K. (2014). *Pathways for Advancing Careers and Education Career Pathways Program Profile: Year Up* (OPRE Report #2014-51). U.S. Department of Health and Human Services, Administration for Children and Families, Office of Planning, Research and Evaluation.

Fein, D., & Dastrup, S. (2022). *Benefits that last: Long-term impact and cost-benefit findings for Year Up*. U.S. Department of Health and Human Services, Administration for Children and Families, Office of Planning, Research and Evaluation.

Fein, D., & Hamadyk, J. (2018). *Bridging the opportunity divide for low-income youth: Implementation and early impacts of the Year Up program. Pathways for Advancing Careers and Education* (OPRE Report 2018-65). U.S. Department of Health and Human Services, Administration for Children and Families, Office of Planning, Research and Evaluation.

Fein, D., Dastrup, S., & Burnett, K. (2021). *Still bridging the opportunity divide for low-income youth: Year Up's longer-term impacts* (OPRE Report 2021–56). U.S. Department of Health and Human Services, Administration for Children and Families, Office of Planning, Research and Evaluation.

Fialho, F. S. (2022). *The impact of an integrated business curriculum program on career decision-making self-efficacy* [Unpublished doctoral dissertation]. University of La Verne.

Fogg, N. P., Harrington, P. E., & Khatiwada, I. (2016). *Impact evaluation of the New England Institute of Technology's Shipbuilding/Marine Advanced Manufacturing Institute (SAMI) Program TAACCCT II grant*. Drexel University, Center for Labor Markets and Policy.

Goldstein, D. S. (2012). *Evaluation of a school-to-work internship pilot program for high school seniors with special needs*. Rutgers, Graduate School of Applied and Professional Psychology.

Hemelt, S. W., Lenard, M. A., & Paeplow, C. G. (2019). Building bridges to life after high school: Contemporary career academies and student outcomes. *Economics of Education Review*, *68*, 161–178.

*Hollenbeck, K., & Huang, W.-J. (2014). *Net impact and benefit-cost estimates of the workforce development system in Washington state* (Upjohn Institute Technical Report No. 13-029). W.E. Upjohn Institute for Employment Research.

Lee, J., Chang, S. H., & Haegele, J. A. (2020). Does service learning work? Attitudes of college students toward individuals with disabilities. *Journal of Experiential Education*, *43*(4), 365–380.

Marshall, M. M., Carrano, A. L., & Dannels, W. A. (2016). Adapting experiential learning to develop problem-solving skills in deaf and hard-of-hearing engineering students. *Journal of Deaf Studies and Deaf Education*, *21*(4), 403–415.

Modestino, A. S., & Paulsen, R. (2023). School's out: How summer youth employment programs impact academic outcomes. *Education Finance and Policy*, *18*(1), 97–126.

Pate, J. D. (2013). *Bridging community generational gaps through experiential learning: A college nursing student practicum for elderly patients* [Unpublished doctoral dissertation]. Walden University.

*Reed, D., Liu, A. Y. H., Kleinman, R., Mastri, A., Reed, D., Sattar, S., & Ziegler, J. (2012). *An effectiveness assessment and cost-benefit analysis of registered apprenticeship in 10 states*. Mathematica Policy Research.

Rodenbusch, S. E., Hernandez, P. R., Simmons, S. L., & Dolan, E. L. (2016). Early engagement in course-based research increases graduation rates and completion of science, engineering, and mathematics degrees. *CBE—Life Sciences Education*, *15*(2), ar20.

Roder, A., & Elliott, M. (2011). *A promising start: Year Up's initial impacts on low-income young adults' careers*. Economic Mobility Corporation.

Roder, A., & Elliott, M. (2014). *Sustained gains: Year Up's continued impacts on young adults' earnings*. Economic Mobility Corporation

Schaeffer, C. M., Henggeler, S. W., Ford, J. D., Mann, M., Chang, R., & Chapman, J. E. (2014). RCT of a promising vocational/employment program for high-risk juvenile offenders. *Journal of Substance Abuse Treatment*, *46*(2), 134–143.

Sevak, P., Feeney, K., Honeycutt, T., & Peterson, E. (2021). *Linking learning to careers demonstration: Impacts 24 months after enrollment*. Mathematica.

Theodos, B., Pergamit, M. R., Hanson, D., Edelstein, S., & Daniels, R. (2016). *Embarking on college and career: Interim evaluation of Urban Alliance*. Urban Institute.

Theodos, B., Pergamit, M., Hanson, D., Teles, D., Gerken, M., Thomas, K., Gedo, S., & Park, J. (2023). *Evaluation of the Urban Alliance High School Internship Program*. Urban Institute.

Theodos, B., Pergamit, M., Hanson, D., Teles, D., Mackenzie-Liu, M., & Rashid, A. (2025). *Long-term evaluation of the Urban Alliance High School Internship Program.* Urban Institute.

Weiler, L., Haddock, S., Zimmerman, T. S., Krafchick, J., Henry, K., & Rudisill, S. (2013). Benefits derived by college students from mentoring at-risk youth in a service-learning course. *American Journal of Community Psychology*, *52*, 236–248.

Weisbrod, J. (2023). *An evaluation of a course-based undergraduate research program at a community college*. New Jersey City University.

Whittenburg, H. N., Schall, C. M., Wehman, P., McDonough, J., & DuBois, T. (2020). Helping high school-aged military dependents with autism gain employment through project SEARCH+ ASD supports. *Military Medicine*, *185*, 663–668.

Note. Twenty-eight reports are listed for 23 eligible studies because some studies produced multiple reports (e.g., a technical report and a scholarly article on the same evaluation).

* Studies met review criteria but did not report sufficient quantitative information to compute effect sizes for meta-analysis.

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