Making sense of K-12 competency-based education: A systematic literature review of implementation and outcomes research from 2000 to 2019

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Abstract

Background: Competency-based education (CBE) is a systems-change approach intended to re-shape traditional understandings of what, when, where, and how students learn and demonstrate academic knowledge and skills. Research on the factors that affect K-12 CBE implementation and the efficacy of different approaches has not yet been meticulously reviewed.

Aims: The purpose of this literature review was to examine the research on K-12 CBE for factors that affect implementation, student outcomes, and the relationship between implementation and student outcomes.

Methods: A systematic literature review was conducted that included 25 peer-reviewed studies and unpublished reports from 2000 to 2019 related to K-12 students.

Results: Facilitators and barriers that affect K-12 CBE implementation were fairly consistent across studies. Factors perceived as barriers in some contexts were viewed as facilitators in others—it all depended on stage of implementation. Findings about the outcomes of CBE for K-12 students reflected mixed results with respect to claims that CBE implementation supports (a) academic achievement and progress; (b) intrinsic motivation and engagement; and (c) other important academic outcomes.

Discussion: Undergirding all findings in this review is the difficulty of isolating the research on implementation and outcomes of K-12 CBE approaches in some "pure form." It may make more sense for the field to coalesce around a common continuum of practices in relation to the key elements of CBE from more traditional models to more competency-based models. Also, assessment as a key feature of CB implementation was absent from most of the studies reviewed which is notable given that determining competence is fundamentally an assessment decision. Directions for future research are discussed.

Conclusion: For many, the promise of CBE and related practices is that student achievement will improve and minimize equity gaps. This systematic review serves to amplify what is known about CBE approaches and what still needs investigation.

Keywords
competency-based education, education reform, elementary secondary education, implementation, literature review, outcomes
Competency-based education (CBE) in K-12 schools is a systems-change approach intended to re-shape traditional understandings of what, when, where, and how students learn and demonstrate academic content knowledge and skills (Casey & Sturgis, 2018; Levine & Patrick, 2019; Lopez et al., 2017). CBE prioritizes flexible pacing along various pathways and requires students to demonstrate mastery of complex and transferable learning targets before moving on to new material (Sturgis & Casey, 2018). In the American context, CBE is often coupled with other approaches such as personalized learning and student-centered learning, and is also called mastery-based, proficiency-based, and performance-based education (Patrick, Kennedy, & Powell, 2013; Wolfe & Steinberg, 2013). CBE has a stronger research base in higher education where there continues to be growth and interest in self-paced pathways to postsecondary degrees or certificates (Burnette, 2016; Kelly & Columbus, 2016; Mason & Parsons, 2019; Nodine, 2015).

The current K-12 CBE movement began around the year 2000 when states such as Rhode Island and New Hampshire added demonstration of proficiency (or competency) to their minimum graduation requirements and/or removed credit hour requirements for graduation (Evans, Graham, & Lefebvre, 2019; Le, Wolfe, & Steinberg, 2014). According to a recent overview, forty-nine states plus the District of Columbia now permit or actively enable CBE approaches (iNACOL, 2019). These approaches draw on earlier K-12 reforms such as mastery learning (Anderson, 1994; Block, 1979; Block & Anderson, 1975; Block & Burns, 1976; Cotton & Savard, 1982; Guskey & Gates, 1986; Guskey & Pigott, 1988; Kulik, Kulik, & Bangert-Drowns, 1990; Slavin, 1987), outcomes-based education (Evans & King, 1994; Guskey, 1994; Mitchell & Spady, 1978), and the previous competency-based education movement (Spady, 1977; Spady & Mitchell, 1977).

Proponents of CBE argue that elementary and secondary schools in the United States focus on outdated instructional models that allow students to progress from grade-to-grade without having to demonstrate mastery of key learning targets (Le et al., 2014). This can exacerbate achievement gaps and perpetuate educational inequities (Lewis et al., 2014), which is why equity is a central goal of CBE approaches (Levine & Patrick, 2019).

After twenty years of CBE systems-change efforts, there has been research conducted to identify factors that influence the fidelity of implementation and the effect of different approaches on student outcomes. However, this body of literature has not yet been meticulously reviewed or integrated. Specifically, there is no review that establishes what is already known and what needs further investigation with respect to these factors. Without such a review, it is difficult for policymakers, researchers, and practitioners to identify themes, isolate gaps in the existing knowledge base, and chart questions that need further research.

Therefore, the purpose of this systematic literature review is to examine the research on K-12 CBE from 2000 to 2019 to give insight to policymakers and researchers, in particular, with respect to the following research questions:

1. What are the factors that serve as facilitators or barriers to K-12 CBE implementation? To what extent are the factors invariant across contexts and conditions?
2. What are the academic and nonacademic outcomes of CBE for K-12 students?
3. What is known about the relationship between K-12 CBE implementation and student academic and nonacademic outcomes?

2 | BACKGROUND

2.1 | Previous K-12 CBE Efforts (1960–1980)

Most of the research related to K-12 CBE is from the 1970s and 1980s. The CBE movement during this time period aimed to reconfigure patterns of teaching and learning, as well as school structures such that learning was held constant, but time was viewed flexibly. In other words, all students were considered capable of and expected to learn challenging academic content, but it was anticipated that students would need varying amounts of time, re-teaching, and differentiated supports to attain the same performance standards.

During this time period, a lack of conceptual clarity about the features of K-12 CBE and piecemeal implementation affected the efficacy of systems-change efforts (Block, 1978; Spady, 1977, 1978; Spady & Mitchell, 1977). Spady (1978) was especially pessimistic about the longevity of these reforms because they required “educators and the public to give up decades of habits and assumptions regarding the structures and methods of schooling, just at the time when accountability looks cheaper and safer than another version of school reform” (p. 22). In fact, when A Nation at Risk (The National Commission on Excellence in Education, 1983) was released many policymakers turned to accountability as the answer to education reform and away from other reform initiatives, including CBE.

Most of the research on K-12 CBE as defined and implemented in the 1970s and 1980s comes from the mastery learning movement. This movement focused on the element of time and the need to restructure the school system so that mastery of content was the emphasis, rather than the number of school days a student completed. Multiple research reviews found that there were positive effects on primary and secondary student achievement associated with the implementation of mastery-based programs, including stronger effects for low-achieving students (Anderson, 1994; Block & Burns, 1976; Cotton & Savard, 1982; Guskey & Gates, 1986; Guskey & Pigott, 1988; Kulik et al., 1990; Slavin, 1987). However, the effects of mastery learning on student achievement varied depending on the outcome measure used in the study. Most studies evaluating the effects of mastery learning used researcher-created student achievement outcome measures with a pre-test and post-test design. A few used both researcher-created and standardized achievement tests. Slavin (1987) was the first to examine effects based upon
the type of outcome measure used. He found that the effects of mastery learning were small on researcher-created exams, but trivial and insignificant on standardized achievement tests.

2.2 | Defining the Boundaries of Current K-12 CBE Reforms (2000-present)

The CBE movement of the 2000s and 2010s has similar, yet distinct emphases compared with the previous instantiations of this reform (Le et al., 2014). The goals, however, remained unchanged—to improve student achievement and equity. CBE is often coupled with other approaches such as student-centered learning, personalized learning, and proficiency-based education. According to the Nellie Mae Education Foundation, student-centered learning is the umbrella concept, under which personalized and competency-based education reside. The four tenets of student-centered learning include learning is personalized; learning is competency-based; learning happens anytime, anywhere; and students take ownership over their learning (Reif, Shultz, & Ellis, 2015).

The definition of student-centered learning overlaps with many elements of CBE. For example, three of the four tenets of student-centered learning (all except “learning is personalized”) are elements used to define CBE, as discussed in more detail below. Additionally, the Aurora Institute (formerly INACOL) argues that personalized learning and CBE go hand-in-hand (Patrick et al., 2013). Personalized learning is defined as a mixture of four attributes and tactics seen in varying degrees in school contexts. These attributes include learner profiles, competency-based progressions, personal learning paths, and flexible learning environments (Bill & Melinda Gates Foundation et al., 2014). The Aurora Institute states that CBE offers a “foundation for personalized learning, shaping the culture, structure, and pedagogy, that allow students to play an active role in their learning and achieve this broader definition of success” (Casey & Sturgis, 2018, p. 1). According to proponents, without CBE, personalization may result in variable achievement because the learning targets are not shared or common. Without personalization, on the other hand, CBE reforms are unlikely to help all students reach the intended academic achievement and equity outcomes because every student has a different constellation of learning strengths, needs, and interests. The inter-relatedness and somewhat overlapping definitions of student-centered learning, CBE, and personalized learning make it difficult to clearly demarcate each approach.

CBE is also sometimes inaccurately referred to as proficiency-based education. A proficiency-based system is one in which standards are used to guide curriculum and instruction and a system in which student advancement and graduation is supposed to be based on student demonstration of proficiency in meeting important educational standards (Silvernail, Stump, Duina, & Gunn, 2013). Although proficiency-based education is not synonymous with competency-based education, they do share common elements. These common elements include: shared learning targets, common performance expectations, and student progress based on evidence of proficiency or demonstration rather than seat time (i.e., the number of hours a student has completed in a given year). The overlap in elements is likely one of the reasons these terms are often used interchangeably in practice. However, unlike proficiency-based education, competency-based education tends to cluster standards into broad competency statements that students must demonstrate throughout a course of instruction rather than discrete lists of standards that are often assessed one-by-one (Sturgis, 2012, p. 8).

In 2011, at the National Summit on K-12 Competency-Based Education, a group of policymakers and practitioners came together to create a five-part working definition of high-quality K-12 CBE (Sturgis, Patrick, & Pittenger, 2011). The 2011 working definition was intended to help congeal the field around common understandings of key elements in competency-based systems and reduce the variability in implementation. An updated definition of CBE was created after the second National Summit on K-12 Competency-Based Education in 2017 and published in 2019 (Levine & Patrick, 2019). The updated definition added two additional elements—student agency and equity—to the previous five elements. The updated 2019 definition also explicitly mentions different pathways and varied pacing, which were not in the original 2011 definition, along with slight updates to most of the original five elements based on new understandings. The revised definition of CBE is as follows—the two new elements are in italics:

1. Students are empowered daily to make important decisions about their learning experiences, how they will create and apply knowledge, and how they will demonstrate their learning.
2. Assessment is a meaningful, positive, and empowering learning experience for students that yields timely, relevant, and actionable evidence.
3. Students receive timely, differentiated support based on their individual learning needs.
4. Students progress based on evidence of mastery, not seat time.
5. Students learn actively using different pathways and varied pacing.
6. Strategies to ensure equity for all students are embedded in the culture, structure, and pedagogy of schools and education systems.
7. Rigorous, common expectations for learning (knowledge, skills, and dispositions) are explicit, transparent, measurable, and transferable.

Given the timeframe of the research reviewed, we would not expect student agency or equity to feature prominently in how CBE was defined or measured from 2000 to 2019. We would expect, however, that at some point between 2011 and 2019 the field may have started to solidify around the five elements in the 2011 working definition—or at least some aspects therein. It is these five essential elements of CBE as represented in the 2019 working definition that we use to define CBE and cull the research literature, as described in more detail in the next section.
3 | METHOD

We conducted a systematic literature review (Xiao & Watson, 2017) using the PRISMA preferred reporting items for systematic reviews as a guide (Moher, Liberati, Tetzlaff, & Altman, 2009). PRISMA coheres with recent methodological guidance for quality systematic reviews (Alexander, 2020). The main purpose of our systematic literature review is to describe the state of the research literature as it pertains to the field of K-12 CBE in the United States. There are different types of descriptive systematic literature reviews (Xiao & Watson, 2017) and we chose to use a textual narrative synthesis approach (Lucas et al., 2007; Popay et al., 2006; Xiao & Watson, 2017). The textual narrative synthesis approach uses a standardized review process to extract data and write commentaries about identified studies such as study characteristics, context, quality, and findings. Using this common reporting framework, a textual narrative synthesis allows researchers to compare similarities and differences across studies in order to draw conclusions (Xiao & Watson, 2017). We chose the textual narrative synthesis approach for several reasons, including: (a) it is generally considered more rigorous than the narrative review and (b) fits with an analysis of both qualitative and quantitative studies.

4 | LITERATURE SEARCH AND EVALUATION

The commonly accepted steps in conducting a systematic literature review are as follows: (a) establish inclusion/exclusion criteria; (b) search for, retrieve, and select studies for inclusion; (c) extract and code study features and findings; (d) synthesize findings across studies; (e) explore variability in study findings; and (f) interpret outcomes. Each is discussed in turn below.

4.1 | Inclusion and exclusion criteria

We included peer-reviewed studies and gray literature (e.g., reports, dissertations) written in English from 2000 to 2019 related to the American elementary and secondary (K-12) educational context. Studies could be qualitative, quantitative, or mixed methods.

We included gray literature, which is not peer-reviewed, because of the relative nascence of this field of study. We thought searching only traditional peer-reviewed articles would likely result in an underrepresentation of applicable research. We decided that including the gray literature would capture a wider array of findings thereby reducing the threat of publication bias. We attended to possible variability in study quality and reporting by carefully reviewing the limitations of the studies (whether stated or not) and publication source (e.g., organization, funding) in our systematic review, noting strength of evidence alongside findings.

The beginning of our search timeframe marks the start of current state and district policies around CBE in the United States (Evans et al., 2019; Le et al., 2014). We only included studies conducted in the American context because the organization and structure of schools in the United States differs from other countries and we did not want this factor to confound our findings.

To ensure we captured research studies rather than white papers or other advocacy reports, we included only literature that described the research methodology used to gather data for the study. We also looked for research questions. We did not judge the quality of the research questions or methodology at this juncture.

Studies were excluded from the systematic review when the research study did not (a) focus on K-12 students (e.g., Kelly & Columbus, 2016); (b) include key features of competency-based education; namely, studies must reference at least flexible pacing (otherwise known as competency-based progression), common expectations for learning, and demonstration of mastery or proficiency (e.g., Zeiser, Scholz, & Cirks, 2018); or (c) relate to any of the research questions of this systematic review (e.g., Surr, Zeiser, Briggs, & Kendziora, 2018). We focused on these key elements of CBE because they are generally considered the hallmarks of the systems-change approach, though there is still a lack of uniformity around the term and definition of CBE (Levine & Patrick, 2019). This allowed us to capture research studies investigating CBE approaches, even if they used slightly different terms.

4.2 | Literature identification

We searched in several major research databases: ERIC, JSTOR, PsycINFO, ProQuest’s dissertation abstracts, and Google Scholar. We also used reference lists from relevant research to do forward and backward searches for other studies that fit within the search parameters. Because CBE is often coupled with other approaches, the key words were intentionally broad. For example, we searched titles containing “competency-based education,” “proficiency-based education,” or “personalized learning.”

The flow diagram in Figure 1 summarizes each step in the culling process, and the total number of studies removed at each step. We started by identifying all potentially relevant research studies based on key search terms, which resulted in 226 studies for review. We then read the abstracts for those studies and excluded studies if they were not in the K-12 context, or did not include key features of CBE. This is where most of the studies were excluded. Ultimately, 30 studies were retrieved for a more detailed evaluation. Of those 30 studies, twenty-five were included in the final review because they related to the research questions in this study.

4.3 | Data extraction and analysis

We created a review protocol a priori that each of the three researchers independently used to extract data and analyze the 25 studies. The review protocol identifies: (a) author and year; (b) content category; (c) research methodology; (d) key term used in the study; (e) type of data used in study and study context; and (f) number of participants. The
content category reflects whether the study focused on implementation (policy scans or general implementation research), outcomes, or a mixture of implementation and outcomes. The research methodology category was divided into three groups: quantitative, qualitative, or mixed methods. The key terms included: competency-based education, proficiency-based education, and/or personalized learning.

Table 1 provides a cross-tabulation of the number of studies reviewed by key term, research methodology, and content category. Proficiency-based education returned the greatest proportion of studies due to a collection of annual research studies required under Maine state statute. Of the 25 research studies reviewed, 64% used qualitative research methods, 20% mixed methods, and 16% quantitative methods. The predominantly coded content category was CBE implementation (64%), followed by studies that examine both implementation and outcomes (24%). Given that two-thirds of the research is qualitative by design, the implementation and outcomes research is mainly descriptive, based on case studies, interview/focus group data, and document analyses.

The process to review and analyze each study followed a specific order. The research team independently reviewed each study and then met to discuss each study’s findings, the quality of the research, and their independent responses to the review protocol. This resulted in a consensus version of the review protocol.

Table 2 contains the consensus version of the review protocol, which is organized by key term. Studies that use the term “competency-based education” are listed first, followed by “proficiency-based education” and “personalized learning.” They are roughly sorted by year and content category. We decided to group studies based on research conducted in a similar context and/or with shared authors. These clusters are represented with a value of 1–12 in the first column for twelve distinct research study clusters. For example, the two studies that comprise Cluster #6 use data from similar school districts in New Hampshire and the first author of both articles is the same. In some cases, the cluster represents a series of studies conducted over time in a similar context—see Cluster #8 (Maine’s proficiency-based diploma system from 2012 to 2019) and

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**TABLE 1** Cross-tabulation of studies reviewed by key term and content category (n = 25)

<table>
<thead>
<tr>
<th>Key term</th>
<th>Implementation (policy scans)</th>
<th>Implementation (general)</th>
<th>Implementation and outcomes</th>
<th>Outcomes</th>
<th>Row totals</th>
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</thead>
<tbody>
<tr>
<td>Competency-based education</td>
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<td>1</td>
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<td>Qualitative</td>
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<td>5</td>
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<tr>
<td>Mixed Methods</td>
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<td>3</td>
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<tr>
<td>Proficiency-based education</td>
<td>9</td>
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<td>Quantitative</td>
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<td>Qualitative</td>
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<td>Mixed Methods</td>
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<td>Personalized learning</td>
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<td>3</td>
<td>6</td>
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<td>12</td>
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<tr>
<td>Quantitative</td>
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<td>1</td>
<td>1</td>
<td></td>
<td>5</td>
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<td>Qualitative</td>
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<td>Mixed Methods</td>
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<td>Column Totals</td>
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<td>6</td>
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<td>25</td>
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<td>Author(s), year</td>
<td>Content category</td>
<td>Methodology</td>
<td>Key term</td>
<td>Research questions</td>
<td>Data and context</td>
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<tr>
<td>Scheopner Torres et al. (2015)</td>
<td>Implementation (policy scan/general)</td>
<td>Qualitative</td>
<td>Competency-based education</td>
<td>1. How is competency-based learning defined in state and district policies in the REL Northeast and Islands Region? 2. How is competency defined by the states and districts within the REL Northeast and Islands Region? What are the requirements for demonstrating mastery of competencies that lead to credit toward graduation? 3. What are the perceived barriers and facilitators for implementing competency-based learning in states and districts?</td>
<td>Seven REL Northeast Region states (MA, CT, ME, VT, NH, RI, NY); policy review in all states; interviews in ME, MA, and RI; fall 2014</td>
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<tr>
<td>Brodersen et al. (2017)</td>
<td>Implementation (policy scan)</td>
<td>Qualitative</td>
<td>Competency-based education</td>
<td>1. What policies do the seven REL Central Region states and five advanced competency-based education states have on how students earn academic credits and qualify for high school graduation, how and when students can progress from one academic course or grade to another, and when and where K-12 education can occur? 2. What types of supports do the seven REL Central Region states and five advanced competency-based education states provide to facilitate the implementation of competency-based education?</td>
<td>Seven REL Central Region states (CO, KS, MO, NE, ND, SD, WY) and five states that are advancing CBE policies (IA, KY, ME, NH, OR); reviewed laws, regulations, documents and webpages between March and May 2015</td>
</tr>
<tr>
<td>Steele et al. (2014)</td>
<td>Implementation and Outcomes</td>
<td>Mixed Methods</td>
<td>Competency-based education</td>
<td>1. What materials did the Project Mastery sites develop and implement during the pilot period, and to what extent did their efforts align with the defining features of competency-based education? 2. What were the key tensions or challenges that emerged in the implementation of competency-based approaches? 3. Among students exposed to the Project Mastery pilot programs, how did their self-reported learning experiences vary within and across programs? 4. To what extent did students’ exposure to competency-based education models predict their academic performance in mathematics, reading, attendance, or promotion to the next grade?</td>
<td>Project Mastery school grantees from Adams County District 50 in Colorado, Asia Society nonprofit intermediary organization, and Philadelphia; 2011-2013 (2 school years)</td>
</tr>
<tr>
<td>Haynes et al. (2016)</td>
<td>Implementation and Outcomes</td>
<td>Quantitative</td>
<td>Competency-based education</td>
<td>1. How do school policies and classroom practices differ between CBE and comparison schools? 2. What are students’ experiences of Competency-Based Education (CBE) and how are these experiences related to changes in learning capacities over time?</td>
<td>Three un-identified states (2014-2015); survey data</td>
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<tr>
<td>Author(s), year</td>
<td>Content category</td>
<td>Methodology</td>
<td>Key term</td>
<td>Research questions</td>
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<tr>
<td>Brodersen and Randel (2017)</td>
<td>Outcomes</td>
<td>Quantitative</td>
<td>Competency-based education</td>
<td>1. How long does it take students in the district to progress through their performance levels, especially students who are below their traditional grade level? 2. How well do teachers’ ratings of student competency align to external assessments of student academic achievement?</td>
<td>Westminster elementary and middle schools in Colorado; gradebook data from 2013–14 school year; test scores from spring 2014</td>
</tr>
<tr>
<td>Scheopner Torres et al. (2018)</td>
<td>Implementation (general)</td>
<td>Qualitative</td>
<td>Competency-based education</td>
<td>1. What changes have districts made in policy (e.g., graduation requirements, scheduling) and practice (e.g., curriculum, instruction, assessment)? 2. How have districts assessed student progress in a competency-based model?</td>
<td>New Hampshire; case study design; document review and interview data; 2017–2018 school year</td>
</tr>
<tr>
<td>Scheopner Torres (2019)</td>
<td>Implementation (general)</td>
<td>Qualitative</td>
<td>Competency-based education</td>
<td>No RQ identified; the purpose of this paper was to provide insight into implementation efforts in districts that have been working to adopt CBE in their secondary schools for at least three years, including close examination of the assessment approaches used and how those impact student motivation and equity in student learning opportunities.</td>
<td>New Hampshire; 2017–2018 school year; case study design; document review and interview data; 2017–2018 school year</td>
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<tr>
<td>Evans and DeMitchell (2018)</td>
<td>Implementation (general)</td>
<td>Qualitative</td>
<td>Competency-based education</td>
<td>1. What are barriers for implementing competency-based, proficiency-based, and/or mastery-based learning in your school? 2. What resources or supports facilitate implementing competency-based, proficiency-based, and/or mastery-based learning in your school?</td>
<td>Seven Northeast states (VT, NH, ME, RI, MA, NY, CT); open-response survey data; summer 2017</td>
</tr>
<tr>
<td>Evans et al. (2019)</td>
<td>Implementation (general)</td>
<td>Quantitative</td>
<td>Competency-based education</td>
<td>1. To what extent have the essential elements of CBE been implemented in the seven Northeast states? 2. Does implementation of the essential elements of CBE vary among states with different policies surrounding the ability of local school systems to transition to competency-based systems? 3. Does implementation of the essential elements of CBE vary within a state considered “advanced” depending upon whether the school also implements an innovative assessment and accountability system?</td>
<td>Seven Northeast states (VT, NH, ME, RI, MA, NY, CT); survey data; summer 2017</td>
</tr>
<tr>
<td>Stump and Silvernail (2014)</td>
<td>Implementation (general)</td>
<td>Qualitative</td>
<td>Proficiency-based education</td>
<td>1. What are the benefits, challenges and costs of Maine’s public schools and school districts engaged in implementing a proficiency-based diploma system?</td>
<td>Maine; 2012–2013 school year; case study design; survey, interview, focus group, and classroom observation data</td>
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<td>Author(s), year</td>
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<td>Research questions</td>
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<tr>
<td>Silvernail et al. (2014)</td>
<td>Implementation (general)</td>
<td>Qualitative</td>
<td>Proficiency-based education</td>
<td>No RQ identified; the purpose of the study was to explore the most prevalent district-level benefits of a proficiency-based system and the most commonly mentioned challenges and needs.</td>
<td>Maine; 2013–2014 school year; case study design; interview and focus group data</td>
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<tr>
<td>Stump and Silvernail (2015)</td>
<td>Implementation (general)</td>
<td>Qualitative</td>
<td>Proficiency-based education</td>
<td>No RQ identified; the purpose of the study was to explore how local school district practices and policies were affected by the passage of a proficiency-based system in ELA, Math and Science.</td>
<td>Maine; 2014–2015 school year; case study design; document review and interview data</td>
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<tr>
<td>Stump et al. (2016)</td>
<td>Implementation (general)</td>
<td>Qualitative</td>
<td>Proficiency-based education</td>
<td>1. How do Maine public school and school district educators and administrators perceive the challenges and facilitators of implementing the state’s mandated proficiency-based diploma system?</td>
<td>Maine; 2015–2016 school year; case study design; document review and interview data</td>
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<td>2. How do Maine public school and school district educators and administrators perceive?</td>
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<td>3. What are the impacts of implementing the state’s mandated proficiency-based diploma system on management systems and structures, fiscal allocations, school climate, instruction, as well as curriculum and assessment?</td>
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<td>4. How are Maine public school districts defining proficiency and developing local PK-12 proficiency-based diploma policies?</td>
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<tr>
<td>Stump, Connor, et al. (2017)</td>
<td>Implementation (general)</td>
<td>Qualitative</td>
<td>Proficiency-based education</td>
<td>1. What are the perceived facilitators, challenges and complexities of the process of developing descriptions of content area proficiency from high school educators and administrators?</td>
<td>Maine; 2016–2017 school year; case study design; interview data</td>
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### Table 2 (Continued)

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<thead>
<tr>
<th>Author(s), year</th>
<th>Content category</th>
<th>Methodology</th>
<th>Key term</th>
<th>Research questions</th>
<th>Data and context</th>
<th>Number of participants</th>
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<tbody>
<tr>
<td>Stump, Johnson, et al. (2017)</td>
<td>Implementation (general)</td>
<td>Qualitative</td>
<td>Proficiency-based education</td>
<td>Part A: Special Ed 1. How do specific federal policies regarding eligibility and opportunity for PK-12 students in public schools to access and utilize special education services and educational programming relate to Maine's proficiency-based high school graduation state laws, regulations and guidance as well as local school and district policies? 2. How do special education teachers and leaders in Maine public schools perceive the facilitators and challenges in supporting and serving students eligible for special education services to earn a proficiency-based high school diploma? Part B: CTE 1. How does Maine's proficiency-based high school graduation state policy impact opportunities for Maine secondary students to engage in learning experiences at CTE schools as well as preprofessional educational programming? 2. How do CTE instructors and leaders in Maine public schools perceive the facilitators and challenges in implementing Maine's Proficiency-based Diploma Systems?</td>
<td>Maine; 2016–2017 school year; interview data</td>
<td>Part A: 3 districts, 3 special education administrators, and 1 representative from the Office of the Maine Attorney General Part B: 5 CTE program administrators and 4 preprofessional education private organizations or state agency administrators</td>
</tr>
<tr>
<td>Stump et al. (2018)</td>
<td>Implementation (general)</td>
<td>Qualitative</td>
<td>Proficiency-based education</td>
<td>1. What are the perceived facilitators and challenges of meeting the needs of students entering high schools, including students not on track with demonstrating proficiency in grade-level standards? 2. What are perceived as the necessary resources for developing a manageable, working standards-based curriculum, successful instructional strategies and an intervention system for struggling students at the high school level? 3. What are the evident or reported resources and interventions currently available or in place to support struggling students at the high school level? 4. How are high schools and school administrative units (districts) implementing Maine's proficiency-based diploma system: How is proficiency being defined? What changes (if any) have been adopted to implement proficiency-based graduation requirements?</td>
<td>Maine; 2017–2018 school year; case study design; interview and classroom observations data</td>
<td>3 high schools; 38 interviews with range of participants (educators, administrators, education staff and local stakeholders); 46 classroom observations (5-min walk throughs)</td>
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<tbody>
<tr>
<td>Johnson (2019)</td>
<td>Implementation (general)</td>
<td>Qualitative</td>
<td>Proficiency-based education</td>
<td>1. What is the status of the proficiency-based graduation diploma policy in their district? 2. What is their level of implementation of several specific practices that have consistently emerged in prior studies?</td>
<td>Maine; superintendent survey; fall 2018</td>
<td>82 superintendents</td>
</tr>
<tr>
<td>Shakman et al. (2018)</td>
<td>Implementation and Outcomes</td>
<td>Mixed Methods</td>
<td>Proficiency-based education</td>
<td>1. To what extent do specific patterns of student exposure to student-centered, proficiency-based education exist? 2. How is student exposure to student-centered, proficiency-based education associated with student academic and engagement outcomes? 3. What is the nature of implementation and what factors contribute to variability in the implementation of practices aligned with principles of student-centered, proficiency-based education?</td>
<td>Maine; interview, survey, and test score data; 2016-17 school year</td>
<td>1,828 students from 11 high schools in quantitative study 3 high schools in qualitative study</td>
</tr>
<tr>
<td>Bill &amp; Melinda Gates Foundation, 2014</td>
<td>Implementation and Outcomes</td>
<td>Mixed Methods</td>
<td>Personalized learning</td>
<td>No RQs identified; purpose of research to: 1. Identify the most promising and important features of these new models; 2. Document the challenges schools face as they implement these models; 3. Learn which components of personalized learning are most critical in the success of these new models of teaching and learning; and 4. Provide a source of independent feedback for the foundation and its school grantees.</td>
<td>K-12 urban charter schools funded by Gates Foundation--NGLC (Next Generation Learning Challenges); teacher logs, teacher and student surveys, interview data; NWEA MAP test scores for math and reading; 2012-14 (2 school years)</td>
<td>Implementation analysis: 23 NGLC public charter schools; 1,344 students and 54 teachers completed survey; Outcome analysis: 23 schools; ~5,000 students</td>
</tr>
<tr>
<td>Pane et al., 2015</td>
<td>Implementation and Outcomes</td>
<td>Mixed Methods</td>
<td>Personalized learning</td>
<td>No RQs identified; purpose of research to: 1. Understand how the schools implemented the five key strategies of personalized learning and how implementation varied across schools; as well as those in the previous study; 2. Identify the most promising and important features of personalized learning models; 3. Document the challenges schools face as they implement these models; 4. Learn which components of personalized learning are most critical in the success of these new models of teaching and learning; and 5. Provide a source of independent feedback for the foundation and its school grantees.</td>
<td>K-12 predominantly urban charter schools funded by Gates Foundation--NGLC (Next Generation Learning Challenges); site visit, interview, and teacher log data; teacher, student, and national survey data; NWEA MAP test scores for math and reading; implementation analysis 2014-2015 school year; outcome analysis 2013-2015</td>
<td>Implementation analysis: 32 NGLC public charter and district schools; site visits = 7 schools; interviews with an administrator = 32 schools; teacher logs = 181 (fall); 153 (spring); teacher surveys = 193; student surveys = 5,338 (fall); 5,407 (spring) Outcome analysis: 62 public charter and district schools (16 NGLC and 46 non-NGLC schools); ~11,000 students</td>
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<tr>
<td>Author(s), year</td>
<td>Content category</td>
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<td>Key term</td>
<td>Research questions</td>
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<tr>
<td>Pane, Steiner, Baird, Hamilton, and Pane (2017)</td>
<td>Implementation and Outcomes</td>
<td>Mixed Methods</td>
<td>Personalized learning</td>
<td>No RQs identified; purpose of research to: 1. Explore what PL looks like in a small sample of schools that have been focused on implementing PL approaches schoolwide; 2. Consider how the approaches to personalization in these schools compare to a national sample that represents more-typical practice in the United States; 3. Briefly discuss obstacles to PL implementation; 4. Discuss how PL implementation differs between charter schools and traditional district schools in our sample, and what factors seem to support or hinder implementation; 5. Describe how achievement growth for students in these schools differs from growth for similar students in other schools; 6. Discuss implications for policymakers, implementers, and funders.</td>
<td>K-12 predominantly urban charter schools funded by Gates Foundation—NGLC (Next Generation Learning Challenges); site visit, interview, and teacher log data; teacher, student, and national survey data; NWEA MAP test scores for math and reading; implementation analysis 2012–15 school years; outcome analysis 2014–15</td>
<td>Implementation analysis: 40 NGLC public charter and district schools; site visits = 9 schools; interviews with an administrator = 40 schools; teacher logs = 228 (fall); 189 (spring); teacher surveys = 244; student surveys = 6,599 (fall); 6,250 (spring) Outcome analysis: 32 NGLC schools; ~5,500 students</td>
</tr>
<tr>
<td>Gross and DeArmond (2018)</td>
<td>Implementation (general)</td>
<td>Qualitative</td>
<td>Personalized learning</td>
<td>1. How do teachers and principals go about designing and implementing personalized learning approaches? 2. How do the capacities, policies, and structures in schools and districts support or impede school level innovation and its spread?</td>
<td>Gates Foundation launched two initiatives in 2014: Next Generation Learning Challenges and Next Generation Systems Initiative; interview, class observations, focus groups, teacher survey, and document analysis data; first two years of initiative (unclear which school years)</td>
<td>11 states; 450 interviews with &gt; 300 teachers, principals, superintendents, and central office staff; observed classrooms and conducted focus groups in 39 schools; surveyed 908 teachers; nationally representative sample ~ 3,600 teachers</td>
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<td>Author(s), year</td>
<td>Content category</td>
<td>Methodology</td>
<td>Key term</td>
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<tr>
<td>Steiner et al. (2017)</td>
<td>Implementation (general)</td>
<td>Qualitative</td>
<td>Personalized learning</td>
<td>No RQ identified; purpose of research to explore: 1. What does early implementation of the school models and the ten design principles look like? 2. What conditions facilitate and hinder implementation? 3. How did school staff address those conditions? 4. What similarities and differences are observed across districts and schools?</td>
<td>The Carnegie Corporation founded the Opportunity by Design (ObD) initiative in 2013; the first ObD high schools opened in 2014, the last will open fall 2017; interview data, site visits, document analysis, teacher and student surveys, teacher instruction logs; 2015–16 school year</td>
<td>6 urban districts; 10 ObD high schools; ~1,300 students</td>
</tr>
</tbody>
</table>
Cluster #9 (research on awardees of the Next Generation Learning Challenge initiative from 2012 to 2015).

For each research study, we also identified which of the five elements of the 2019 CBE working definition were specifically referenced as essential components of the intervention or initiative. Figure 2 summarizes these findings and shows that two of the five CBE systems-change elements were included in all 25 studies: differentiated student support and progress based on evidence of mastery. It was much less common for studies to explicitly mention the element of assessment being a meaningful, positive, and empowering learning experience \((n = 7)\). Most studies included at least three or four out of the five elements of CBE from the 2019 working definition. A detailed breakdown by study is located in Appendix A, and further explanation of these findings can be found in the Discussion section.

5 | FINDINGS

5.1 | RQ1. What are the factors that serve as facilitators or barriers to K-12 CBE implementation? To what extent are the factors invariant across contexts and conditions?

Each of the 25 reviewed studies had findings related to factors that affect K-12 CBE implementation. Identifying and isolating the factors that affect CBE is a complex endeavor given that the various components associated with it are similar to many practices in traditional education. In this review we chose to frame the factors that affected K-12 CBE implementation in terms of facilitators and barriers. Although there are other ways to analyze the existing literature, we focused on understanding driving and restraining forces for change from Kurt Lewin’s (1951) change model. Exploring the driving (facilitators) and restraining (barriers) forces is a critical first step in understanding the change process in schools and provides one lens to explore obstacles and supporting elements at various stages of implementation. Additionally, several of the research studies investigated in this systematic literature review examined barriers and facilitators to implementation, which allowed us to more easily draw connections and synthesize findings across studies and contexts (e.g., Evans & DeMitchell, 2018; Scheopner-Torres, Brett & Cox, 2015; Stump et al., 2016; Stump, Connor, et al., 2017; Stump, Johnson, et al., 2017; Stump et al., 2018).

Table 3 summarizes the facilitators and barriers to implementation with respect to the five focal elements of CBE from the 2019 working definition, as previously discussed. The factors that affect K-12 CBE implementation were relatively consistent across studies, as noted by the reference to multiple studies within each element. Some important facilitators across the key elements included: consistent assessment and grading procedures; effective learning management systems; providing student voice and choice over what they learn and how they demonstrate their learning; online curriculum; and transparent expectations and standards. Key barriers across CBE elements included the lack of models for schools or districts to follow; reluctance of teachers to change instructional methods and give students control over their learning; normative beliefs about grading; lack of common definitions of proficiency, mastery, and competency; and securing buy-in from teachers and parents—particularly at the high school level.

Several additional categories of implementation factors evolved from the review including elements of cultural reforms, systems-based reforms, and policy reforms. Even though these additional elements

![FIGURE 2](image-url)
<table>
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<tr>
<th>Elements of CBE from 2019 Working Definition</th>
<th>Facilitators</th>
<th>Barriers</th>
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</thead>
</table>
| Assessment is a meaningful, positive, and empowering learning experience for students that yields timely, relevant, and actionable evidence. | • Common standards-based assessments (Stump, Connor, et al., 2017; Stump, Fairman, et al., 2017)  
• Allowing students to retake assessments to demonstrate course competency allowing for flexible, student-paced learning (Scheopner Torres et al., 2018)  
• Consistent assessment and grading procedures (Scheopner Torres et al., 2015) | • Misalignment with standardized tests (Stump et al., 2018)  
• Wide variety in the complexity/quality of tasks used to assess mastery (Steiner et al., 2017)  
• Normative beliefs about learning and grades-reassessment & recovery (Scheopner Torres et al., 2018)  
• Fairness and student motivation concerns when students are able to reassess multiple times without consequence (Scheopner Torres, 2019) |
| Students receive timely, differentiated support based on their individual learning needs. | • Robust strategies and structures for student support (Stump, Connor, et al., 2017) | • Lack of availability of frequent reliable data on how students perform on specific standards and skills (Bill & Melinda Gates Foundation, 2014)  
• Not providing instruction and student support for students (Scheopner Torres, 2019) |
| Students progress based on evidence of mastery, not seat time. | • Effective LMS to track student progress toward proficiency and identify students in need of remediation or advancement (Stump & Silvernail, 2014)  
• Time for teachers to work together—PLCs (Evans & DeMitchell, 2018; Evans et al., 2019)  
• Common expectations of demonstrations of proficiency (Steele et al., 2014; Stump & Silvernail, 2014) and mastery and explaining mastery to parents (Bill & Melinda Gates Foundation, 2014)  
• Availability of technology and data (Evans & DeMitchell, 2018; Stump, Connor, et al., 2017; Steiner et al., 2017)  
• Common grading system (moving away from A-F) (Stump & Silvernail, 2015)  
• Professional development for staff and leadership around implementation policies and structures (Stump & Silvernail, 2014) | • Difficulty defining proficiency or mastery (Stump et al., 2018) and calibrating student grades (Bill & Melinda Gates Foundation, 2014; Steiner et al., 2017)  
• Lack of guidance on the development of competency statements (Scheopner Torres et al., 2015)  
• Different interpretations of standards, how they relate to proficiency levels and graduation (Stump, Johnson, et al., 2017; Stump & Silvernail, 2015)  
• Difficulty explaining mastery grading (Stump et al., 2018) and implementing consistently (Steiner et al., 2017)  
• Difficulty finding learning management systems to implement competency-based grading (Scheopner Torres et al., 2018; Steele et al., 2014; Stump & Silvernail, 2014)  
• Difficulty establishing consistent assessment and grading procedures (Evans & DeMitchell, 2018; Scheopner Torres et al., 2015)  
• Grading policies that do not incorporate competency-based approaches (Pane, Steiner, Baird, Hamilton, & Pane, 2017)  
• Desire not to lower graduation rates (Stump, Johnson, et al., 2017; Stump et al., 2018)  
• Normative beliefs about grading and work habits (Steiner et al., 2014)  
• Difficulty selecting a grading scale and reporting system including content and work habits for parents and colleges (Stump et al., 2016)  
• Equity issues/disengagement by struggling students (Steiner et al., 2014)  
• Concern that decreasing a focus on work habits (e.g., turning in work on time) works at odds with holding high expectations for students (Stump et al., 2018)  
• Inconsistent high school transcript expectations-procedures to estimate GPA, lack of course names, comprehensive profiles (Stump, Fairman, et al., 2017)  
• Variations in proficiency-based graduation requirements across schools and districts within a state (Stump, Johnson, et al., 2017)  
• Pressure to move students to the next grade without demonstrating proficiency (Steiner et al., 2017) |
<table>
<thead>
<tr>
<th>Elements of CBE from 2019 Working Definition</th>
<th>Facilitators</th>
<th>Barriers</th>
</tr>
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</table>
| Students learn actively using different pathways and varied pacing. | • Providing multiple pathways, including reassessment and recovery (Scheopner Torres, 2019; Scheopner Torres et al., 2018; Stump & Silvernail, 2015)  
• Lots of choices for students recognizing strengths and needs (Bill & Melinda Gates Foundation, 2014)  
• Use of online curriculum and multiple instructors (Steiner et al., 2017)  
• Robust intervention systems to help struggling students (Stump et al., 2018) and student support services (Evans et al., 2019)  
• Policy on seat time/Carnegie unit/how earn credit to graduate and online or blended learning, early college, dual or concurrent enrollment, and experiential learning opportunities (Brodersen, Yanoski, Mason, Apthorp, & Piscatelli, 2017)  
• Policy on accelerated curriculum, early high school credit, and early graduation (Brodersen et al., 2017)  
• Availability of technology (Stump, Connor, et al., 2017) | • Teachers reluctant to give students control of pacing, content and learning activities (Stump, Connor, et al., 2017)  
• Lack of time for differentiating content, structure, pacing to meeting student needs, and develop personalized lessons (Bill & Melinda Gates Foundation, 2014; Pane et al., 2017; Steiner et al., 2017)  
• Difficulty implementing a system that ensures students’ learning is valued, credentialed, and evaluated similarly and different than traditional education (Shakman et al., 2018)  
• Figuring out the extent to which internships, out-of-school learning, and experiential learning can count for course credits toward graduation requirements (Steele et al., 2014)  
• External pressures to advance students at a certain pace (Steiner et al., 2017)  
• Difficulty changing traditional school structures (especially flexible pacing and flexible assessment of student learning) (Evans & DeMitchell, 2018; Evans et al., 2019) |

| Rigorous, common expectations for learning (knowledge, skills, and dispositions) are explicit, transparent, measurable, and transferable. | • Transparent expectations and standards (Stump & Silvernail, 2014, 2015)  
• Curriculum and assessments that are competency-based (Evans & DeMitchell, 2018)  
• Common definitions of proficiency-based education (Stump & Silvernail, 2015)  
• Academically supported and challenged learners (Stump et al., 2016) | • Different definitions of proficiency (Stump et al., 2018) and relation to class assignments (Steele et al., 2014)  
• Different interpretations of standards, how they relate to proficiency levels and graduation (Stump, Johnson, et al., 2017; Stump & Silvernail, 2015)  
• Inconsistent expectations for mastery—moving students at a certain pace (Gross & DeArmond, 2018)  
• Tensions between competency-based grading and meeting grade-level expectations (Pane et al., 2017) |

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<th>Additional Identified Elements</th>
<th>Facilitators</th>
<th>Barriers</th>
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| Cultural Reforms in Schools (e.g., school climate; coaching/mentorship; collegiality, etc.) | • Development of a culture of engaged learning and supportive school climate (Stump & Silvernail, 2014); teacher collaboration (Stump et al., 2017)  
• Coaching and mentorship through professional development (Steiner et al., 2017) with appropriate staffing (Evans & DeMitchell, 2018)  
• Culture of academically supported and challenged learners (Stump et al., 2016)  
• Informal collaboration with colleagues and common planning time (Steiner et al., 2017)  
• Professional development for implementation (Evans & DeMitchell, 2018; Stump et al., 2016; Stump & Silvernail, 2014)  
• Alignment of local beliefs and practices with policies and postsecondary expectations (Stump et al., 2016) | • Unintended consequences related to student work study practices and habits of learning (e.g., turning in work on time, re-do’s/reassessment, etc.) (Stump et al., 2018)  
• Difficulty securing buy-in/support from public (Stump et al., 2016) and from parents who do not understand the reform (Evans & DeMitchell, 2018; Shakman et al., 2018)  
• Students frustrated by shifting and varying expectations; inconsistent approaches and activities; shifts in grading and assessment practices (Gross & DeArmond, 2018)  
• Teachers/schools limited by resource constraints (including staffing and teacher turnover) (Bill & Melinda Gates Foundation, 2014; Pane et al., 2017; Steiner et al., 2017), bureaucratic rules, and misaligned incentives (Gross & DeArmond, 2018)  
• Students struggling to take ownership for their own learning (Scheopner Torres, 2019) |
were not part of the 2019 definition, most of these categories are found in Sturgis and Casey (2018) and elsewhere as design principles that are essential to quality CBE implementation. For example, many CBE proponents discuss the importance of cultural reforms in schools such as changing school climate and culture. This includes: (a) securing buy-in from parents, students, teachers, and the wider community around the importance of the competency-based approach to education; (b) promoting professional collegiality and coaching models among faculty in schools; and (c) developing a culture of engaged learning and supportive school climate. Systems-based reforms focus on the ways in which all components of the broader school system must work together and pull in the same direction in order to promote change. Typical systems in schools that should be aligned include curriculum/instruction/assessment models, teacher training and professional development, school schedules, student support services, grading, and assessment procedures. Policy reforms relate to the flexibility offered to students and schools to earn credit in ways other than through seat time. However, if the state, district, or school policies are misaligned or work against competency-based progression where students are able to move on in the curriculum or earn credit to graduate through demonstration of mastery, then the quality of implementation is compromised.

One interesting finding overall was that many facilitators overlapped with barriers; meaning, what was considered a facilitator of CBE implementation in one context was considered a barrier to
implementation in another context. For example, some studies cited common definitions and expectations for demonstrating proficiency and mastery as facilitators for implementing CBE (Steele et al., 2014; Stump & Silvernail, 2014), while other studies identified these same factors as barriers to implementation (Bill & Melinda Gates Foundation, 2014; Steiner, & Stump, 2017; Stump et al., 2018). Additionally, some facilitators and barriers were applicable to different key elements. For example, consistent definitions of proficiency or competency were viewed as a facilitator and barrier for the key element: Students progress based on evidence of mastery, not seat time. This factor was also viewed as a facilitator and barrier for the element: Rigorous, common expectations for learning (knowledge, skills, and dispositions) are explicit, transparent, measurable, and transferable. Factors may, therefore, be repeated in multiple elements and categories (facilitators/barriers), as applicable.

This dynamic tension between driving and restraining forces can be explained using the analogy of a coin. Just as a coin has two sides, so too do the factors that can affect CBE implementation. It all depends on what Fullan and Stiglbauer (1991) describe as the 3Rs with respect to change in schools: (a) relevance of the innovation to the organization and its people; (b) readiness of the organization and its people to undertake the innovation; and (c) resources necessary to implement the innovation. When an organization such as a school or district sees relevance in the change, and has sufficient readiness and resources to implement the change, then what could be perceived as a barrier prior to the 3Rs may now be perceived as a facilitator. In other words, the preparation needed for successful implementation of any change in schools, which directly relates to a school's place along a continuum of implementation, affects whether different factors are perceived as facilitators or barriers to CBE implementation.

With respect to the barriers and facilitators being invariant across contexts and conditions, we found many of the factors that affected K-12 CBE implementation were repeated across the twelve clusters of research studies. In other words, there did not appear to be any factors that affected CBE implementation in some contexts or conditions, but not in others. Instead, our findings suggest that schools in early stages of CBE implementation (defined as the first 3–5 years of implementation) faced similar challenges related to the five elements of CBE. For example, schools had to consider how assessment could be a meaningful and positive experience for students that yields sufficient evidence for determining mastery in a domain, as well as the other four elements of CBE. What seemed to differ across studies was schools' preparation for and responses to these challenges. There were not enough studies spanning multiple years of implementation to be able to ascertain how specific barriers/facilitators relate to different stages of implementation, especially later stages of implementation. Future research could explore this issue.

5.2 | RQ2. What are the academic and nonacademic outcomes of CBE for K-12 students?

In most of the studies reviewed, the evaluation of student outcomes was either absent or a secondary consideration. This is consistent with previous findings suggesting the need for empirical studies exploring the outcomes of CBE approaches to inform implementation efforts and garner the support of school communities (Scheopner Torres et al., 2015). The lack of research focused on student outcomes is likely due to the nascent nature of the reform and the need to better understand the factors that influence fidelity of implementation. In fact, administrators have cautioned against conducting research on student outcomes for districts/schools in the early phases of CBE implementation because significant time is required to ensure CBE practices are implemented to their full potential and collecting data on student outcomes too early could produce misleading results (Pane & et. al., 2017; Scheopner Torres et al., 2015).

Only one of the studies reviewed focused on student outcomes alone (Brodersen & Randel, 2017); an additional six studies investigated student outcomes in combination with implementation (Bill & Melinda Gates Foundation, 2014; Haynes et al., 2016; Pane et al., 2015, 2017; Shakman et al., 2018; Steele et al., 2014). Five additional studies focused on factors related to implementation only, but the researchers made claims about potential student outcomes (i.e., Gross et al., 2018; Scheopner Torres, 2019; Scheopner Torres et al., 2018; Silvernail et al., 2014; Stump & Silvernail, 2014). Though investigating student outcomes was not the primary focus of these five studies, the researchers made inferences/hypotheses about observed or perceived student outcomes based on survey results, focus group discussions, and/or researcher observations.

Therefore, twelve studies made some statement about the outcomes of CBE for K-12 students. These outcomes can be classified in terms of the impact on (a) student academic achievement and progress; (b) student intrinsic motivation and engagement; and (c) other outcomes perceived as facilitators or barriers to student learning. Table 4 provides a brief summary of the evidence supporting impact of CBE on student outcomes within each of these classification categories. For each of the 12 studies, evidence is classified as having a positive or negative impact on the specified outcome of interest. In addition, a three-level hierarchical rating of the strength of the evidence for making causal inferences or supporting claims of generalization is provided for each study reviewed. The strength of evidence levels are defined as follows:

- Level 1: Evidence provided is mainly anecdotal or descriptive in nature; research provides rich details about a particular context; findings may not generalize across contexts (qualitative).
- Level 2: Evidence suggests a relationship exists, but the research design is not sufficient to infer causation and/or support claims of generalization (correlational).
- Level 3: Evidence suggests a causal relationship and/or supports claims of generalization due to experimental or quasi-experimental research design with matched treatment and control groups (causal).

For most of these research studies, the strength of evidence is classified as Level 1, with only a couple in the Level 2 range. This is
### TABLE 4  Summary of positive/negative evidence of CBE’s impact on student outcomes with associated study strength of evidence

<table>
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<th>Academic achievement and progress</th>
<th>Strength of evidence</th>
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<td><strong>Positive</strong></td>
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| Students who were academically behind completed math and literacy performance level requirements faster than students in a traditional school system (Brodersen & Randel, 2017). | L1  
L2  
L3 |
| Students in schools using competency-based models outperformed demographically similar peers on state tests (Steele et al., 2014). | L1  
L2  
L3 |
| Students in study schools made significantly greater gains on NWEA MAP interim assessments in ELA and Mathematics than students in matched comparison groups and relative to national averages (Bill & Melinda Gates Foundation, 2014). | L1  
L2  
L3 |
| Of students who started in the bottom quartile, students from study schools demonstrated greater gains than students in a matched comparison group on NWEA MAP ELA and Math interim assessments after 2 years (Pane et al., 2015). | L1  
L2  
L3 |
| Students in study schools showed statistically significant gains in Mathematics performance on NWEA MAP over the course of a school year (Pane, et. al 2017). | L1  
L2  
L3 |
| For all ability group (defined by quintiles), students in study schools demonstrated raw score growth on NWEA MAP ELA and Math interim assessments that met or exceeded that of a matched comparison group (Pane et al., 2017). | L1  
L2  
L3 |
| **Negative**                      |                      |
| In some schools, conversion to a CBE model was associated with lower math scores on state summative assessments over time (Steele et al., 2014). | L1  
L2  
L3 |
| Negative relationship between degree of exposure to proficiency-based education practices (e.g., minimum, low-medium, and medium) and SAT scores (Shakman et al., 2018). | L1  
L2  
L3 |

<table>
<thead>
<tr>
<th>Intrinsic motivation and engagement</th>
<th>Strength of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positive</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Some CBE practices (e.g., clarity and required attainment of learning targets; use of multiple assessment types) were perceived as increasing students’ intrinsic motivation (Haynes et al., 2016) | L1  
L2  
L3 |
| Some CBE practices (e.g., clarity around academic expectations and proficiency-based standards) were perceived as increasing student engagement/motivation (Silvernail et al., 2014; Stump & Silvernail, 2014). | L1  
L2  
L3 |
| Positive relationship between degree of exposure to CBE practices (e.g., minimum, low-medium, and medium) and self-reported student engagement (Shakman et al., 2018). | L1  
L2  
L3 |
| **Negative**                        |                      |
| Most of the learning competencies evaluated were not associated with any particular CBE practices (Haynes et al., 2016) | L1  
L2  
L3 |
| Low-achieving students were less likely than high-achieving students to take ownership of learning through the use of the reassessment and recovery opportunities afforded by CBE (Scheopner Torres, 2019; Scheopner Torres et al., 2018). | L1  
L2  
L3 |

<table>
<thead>
<tr>
<th>Other student outcomes</th>
<th>Strength of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positive</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Several student learning capacities (e.g., intrinsic motivation, utility of math/ELA; locus of control, self-management and preparation for courses) were perceived by educators as positively impacted by increased clarity of learning targets (Haynes et al., 2016) | L1  
L2  
L3 |

(Continues)
due to a variety of factors influenced by the goals of the research and the associated research design, including: (a) small, unrepresentative samples selected using purposeful or convenience sampling approaches; (b) differences in operational definitions of CBE and implementation across schools; and (c) concerns around data quality and accuracy.

5.2.1 Academic achievement and progress

Some studies suggested that students in classrooms implementing CBE practices/models demonstrated greater gains in math and reading performance when compared to similar students (e.g., academic or demographic peers) or national averages (e.g., Pane et al., 2015, 2017). In some cases, gains in student performance were found to be greater for students who were academically behind (e.g., Brodersen & Randel, 2017; Pane et al., 2015). The measures considered in these studies varied from state tests (Steele et al., 2014) to vendor developed interim assessments (e.g., NWEA MAP), to the amount of time students took to complete the learning objectives associated with a course (e.g., Brodersen & Randel, 2017). Overall, however, the findings related to impact on student outcomes were mixed, as a couple of studies did report a negative impact of CBE on student test results (e.g., Shakman et al., 2018; Steele et al., 2014). In addition, positive results, when observed, often did not generalize across grade spans and content areas.

5.2.2 Intrinsic motivation and engagement

There were six studies that discussed the impact of CBE on student engagement and intrinsic motivation. Of these, four reported a positive association between implementation of some CBE practices and student engagement or intrinsic motivation (Haynes et al., 2016; Shakman et al., 2018; Silvernail et al., 2014; Stump & Silvernail, 2014). Practices associated with positive outcomes included having clear expectations for student performance and using multiple assessment types to evaluate student proficiency. On the other hand, Haynes et al., (2016) found that CBE practices had little impact on student learning competencies and other studies suggested that some practices (e.g., allowing for retesting) did not impact student motivation as intended (Scheopner Torres, 2019; Scheopner Torres et al., 2018).

5.2.3 Other student outcomes

Finally, there were four studies that discussed the impact of CBE on “other” student outcomes, including changes in attendance (Steele et al., 2014), perceived student sentiment (Gross et al., 2018; Scheopner Torres, 2019; Scheopner Torres et al., 2018), and perceived student learning capacities such as self-management and preparation for class (Haynes et al., 2016). In general, changes in attendance and student learning capacities were reported as positively impacted by CBE, but students’ perceived sentiment toward some CBE practices was sometimes negative (e.g., assessment policies, teaching, and grading practices).

5.3 RQ3. What is known about the relationship between K-12 CBE implementation and student academic and nonacademic outcomes?

The previous research question focused on identifying student outcomes observed or hypothesized as being impacted by implementation of CBE. In contrast, this research question focuses on identifying the specific aspect(s) of CBE implementation (e.g., conditions, policies, strategies, etc.) suggested by the researchers as related to student outcomes. For consistency and coherence, we classify our results relative to the five key elements listed in the 2019 working definition of CBE.

Table 5 summarizes research evidence from the systematic review related to each CBE element. The second column answers the question: “To what extent were aspects of each of these elements suggested as positively or negatively impacting student outcomes?” Implementation components associated with positive outcomes are
TABLE 5  Reported impact of CBE implementation elements on student outcomes

<table>
<thead>
<tr>
<th>Key Elements of CBE from 2019 Working Definition</th>
<th>Reported Impact of CBE Implementation Element on Student Outcomes (Note: Positive effects = bold; Negative effects = underline; both Positive and Negative effects = bold and underline)</th>
</tr>
</thead>
</table>
| Assessment is a meaningful, positive, and empowering learning experience for students that yield timely, relevant, and actionable evidence | Haynes et al. (2016):  
- Use of authentic assessments was associated with a perceived increase in students’ intrinsic motivation.
- Being able to retake math tests was positively related to changes in efficacy and self-control.

Scheopner Torres et al. (2018):  
- The opportunity to relearn and reassess had unintended, differential impacts on student motivation for high and low achieving students. |
| Students receive timely, differentiated support based on their individual learning needs | Brodersen and Randel (2017):  
- Organization of courses into performance levels rather than grade levels supported students performing below grade level (they completed performance levels faster than grade-level peers). |
| Students progress based on evidence of mastery, not seat time | Haynes et al. (2016):  
- Awarding credit based on the attainment of established learning targets was associated with favorable increases in intrinsic motivation.
- Flexible pacing in mathematics was associated with some favorable changes in students’ intrinsic motivation, self-efficacy and perceived utility of math.* |
| Students learn actively using different pathways and varied pacing | Haynes et al. (2016):  
- Participating in activities outside of school was associated with a favorable increase in intrinsic motivation and perceived utility of math.*
- Models favoring student choice and project based learning are associated with greater gains in student performance than models which emphasize competency based grading or flexible pacing.
- Project mastery classrooms demonstrated higher attendance and promotion rates. |
| Rigorous, common expectations for learning (knowledge, skills, and dispositions) are explicit, transparent, measurable, and transferable | Haynes et al. (2016):  
- Clearly defined learning targets are associated with a favorable change in several learning capacities. |
| Unspecified - the authors did not attempt to attribute the results to one specific element or factor | Bill and Melinda Gates Foundation (2014), Pane et al. (2015), Pane et al. (2017):  
- Implementation of personalized learning approaches (in study schools) was associated with greater gains in ELA and Math performance for students at all ability levels, but especially those who started the furthest behind.
- Shakman et al. (2018):  
- Degree of exposure to CBE practices was negatively associated SAT scores and positively associated with gains in self-reported student engagement.
- Steele et al. (2014):  
- The process of transitioning to a CBE model was associated with a decrease in math achievement over time. |

*This finding held for what Haynes et al. (2016) defined as CBE and non-CBE schools (or research schools), though it is likely that schools in both research conditions fell along a continuum of implementation with respect to the competency-based practices delineated with the asterisks.

Presented in bold text, while those associated with negative outcomes are underlined. Implementation factors that had both positive and negative effects are represented by bold, underlined text. Because strength of evidence ratings for each of the studies referenced in Table 5 were already provided in the previous table they are not repeated here.

In some cases, the implementation component associated with a given outcome was clearly stated or hypothesized and fit nicely into this framework. In other cases, there were too many potential confounding factors to allow for any one thing to be identified as the primary mechanism of the impact observed. Studies falling into this last category were placed in a separate row labeled “Unspecified.” In addition, at least one study noted that the findings associated with CBE schools were also found for non-CBE schools (Haynes et al., 2016). This suggests that competency-based practices might not be easily demarcated from traditional educational practices and that many schools and teachers are likely moving along a continuum of practices from traditional to competency-based. This insight is supported by findings from Haynes et al. (2016) who found it difficult to find comparison schools that were only implementing traditional practices and noted that some findings held for what they defined as CB and non-CB comparison schools (see note in Table 5).

Overall, these studies provide little definitive information about the relationship between CBE implementation and student outcomes. While several aspects of CBE implementation were reported as having a potential impact on student outcomes (e.g., clearly
defined learning targets, flexible pacing), none were consistently identified across studies. This may be because the studies did not contain schools that were implementing all CBE practices with fidelity and/or comparison schools that would be considered purely traditional. Indeed, the Haynes et al. (2016) study suggests that schools fall along a continuum of implementation with respect to the competency-based practices whether they officially call themselves competency-based or not. This complicates research efforts that try to associate CBE implementation and student outcomes—especially for more common practices implemented across competency-based and traditional schools such as differentiated instruction and robust student support services. Pure counterfactual or comparison conditions are likely difficult to find in practice and use in research studies.

In other cases, a positive relationship was identified, but the specific aspect of implementation having an impact on student outcomes was unclear and could differ across study schools. For example, implementation of personalized learning approaches was associated with greater gains in ELA and Math performance on a commercial interim assessment in one cluster of studies (Bill & Melinda Gates Foundation, 2014; Pane et al., 2015, 2017), but the specific approaches used and how they were implemented were not detailed and could differ greatly across study schools. Furthermore, in some cases the impact of implementation provided conflicting results across grade spans or content areas suggesting that different implementation procedures were used or the effectiveness of these procedures varied depending on what or who was being taught. Due to the time required to plan and effectively implement CBE practices, the degree of effort put into the reform at the district, school, or educator level could also influence its impact on the results observed.

6 | DISCUSSION

The purpose of this systematic literature review was to take stock of what we have learned about K-12 CBE implementation and outcomes and what needs further investigation. The review was guided by questions focused on the factors that affect K-12 CBE implementation, student outcomes associated with CBE approaches, and the relationship between aspects of CBE implementation and student outcomes. Our goal was to provide a synthesis of the research literature to (a) facilitate continued research in this field that builds upon what is already known and (b) provide insight to policymakers and practitioners on some factors (facilitators/barriers) that should be considered prior to implementation. In this final section, the findings are discussed in relation to the original research questions and future directions for research.

Undergirding all findings in this review is the difficulty of isolating the research on implementation and outcomes of K-12 CBE approaches in some “pure form.” The inter-relatedness and somewhat overlapping definitions of CBE, personalized learning, student-centered learning, and proficiency-based education make such distinctions difficult at this point in time. CBE is defined and operationalized differently across studies. The field has not yet coalesced around the five (now seven) elements of CBE as put forward in the 2019 working definition nor articulated the ways in which the elements may fall along a continuum of implementation. Rather than trying to decipher some “pure” form of either competency-based or personalized learning approaches to education, it may make more sense for the field to coalesce around a common continuum of practices in relation to the seven elements of CBE from more traditional models to more competency-based models. For example, there is now broader agreement about the salient components that comprise CBE and how those elements are distinct from traditional models (Sturgis & Casey, 2018) so the two ends of the continuum could be delineated using those distinctions. Researchers and practitioners could then work together to fill in a continuum of practices between those two end points, or even delineate different implementation pathways depending on school setting, grade span, and other contextual factors. Studies could then be designed to explore similarities and differences in implementation and outcomes across schools in similar places on the continuum or pathway.

That said, there are two common elements of the CBE definition that were mentioned across all of the studies reviewed—which is not to say that they were always implemented. Specifically, each of the studies included in this review describe the reform under investigation as one in which students (a) receive timely, differentiated support based on their individual learning needs and (b) progress based on evidence of mastery, not seat time. The first aspect is not distinct from traditional education in that most school districts implement multi-tiered systems of support and encourage teachers to differentiate instruction so that all learners can be successful in mastering new knowledge and skills. The second aspect, however, gets to the heart of competency-based reforms—allowing students to move on when ready and continue working if not.

One key element of CBE was noticeably absent from most of the studies reviewed—the element about assessment and how it should be a meaningful, positive, and empowering experience for students and should also yield timely, relevant, and actionable evidence (see Figure 2). The absence of this element from all but seven of the studies is striking considering that determining competence is fundamentally an assessment decision. We have a few hypotheses as to why more studies did not describe CBE with reference to assessment. It may be the case that schools are still clinging to old assessment paradigms that align with outdated models of how students learn, rather than new assessment paradigms that align with modern conceptions of how students learn. Teachers need training to understand how to shift assessment practices to support CBE approaches and without such professional learning will likely default to traditional assessment models. Similar to that hypothesis, it may be the case that schools and teachers do not see assessment as part of the initial wave of implementing CB practices. In other words, assessment may not be the primary focus at the onset of this work so teachers are using established assessments to evaluate student mastery. Misalignment among curriculum, instruction, and assessment practices in schools can relegate systems-change approaches, such as competency-based education, to focus on practices that are
in most of the studies reviewed the evaluation of student outcomes was either absent or a secondary consideration. All of this is not to say that inferences/hypothesis about observed or perceived student outcomes (i.e., based on survey results, focus group discussions or the researchers’ observations) were not provided, just that they were not the primary focus of the research as defined. It will be important for future research and evaluation efforts to prioritize measurable student outcomes—both academic and nonacademic—in the study design such that evidence can be collected over time about whether and how students are benefiting from approaches that attempt to put them at the center of their own learning with a concerted focus on equity and student agency (empowerment, engagement, and motivation).

The moderate focus on outcomes in the reviewed literature suggests that what it takes to implement the elements of CBE with fidelity is not yet well understood. This is consistent with a new field of study whereby researchers seek to understand implementation and its nuances rather than jump straight to evaluating outcomes, which could lead to inconsistent findings and/or misleading information about the impact of the reform. Researchers have cautioned against evaluating outcomes too early, as it often takes significant time to develop the resources, expectations, policies, and practices (instructional and assessment) necessary to implement CBE as intended (Steele et al., 2014; Scheopner Torres et al., 2015). Therefore, connections between CBE implementation and student outcomes are unclear at present.

7 | DIRECTIONS FOR FUTURE RESEARCH

The weaknesses of the literature included in this review can be addressed in a few ways. First, researchers working in this area should capitalize on the discussion of different elements of CBE noted in this paper and other papers (Casey & Sturgis, 2018; Lopez et al., 2017) to operationalize profiles of implementation along a continuum. Second, there is a need to facilitate the development of theories of action that describe the manner in which a proposed CBE systems-change approach is intended to meet a state or district’s goals for student learning. Third, researchers should seek to conduct more studies that (a) focus on marginalized students, community members, parents, and educators to gain insight into the extent to which CBE is an appropriate equity strategy; and (b) employ different research study designs (e.g., using matched control/comparison groups) to investigate both academic and nonacademic outcomes of CBE interventions on K-12 students. Each is discussed in turn.

The first, and most basic, way to improve our understanding of CBE is to clarify what is essential to the reform and what is extraneous. Determining a clear and common understanding of the elements of CBE and how these elements fall along a continuum from full adherence to adaptation to more traditional education models is critical to determining what factors facilitate and impede its implementation. In other words, a clear continuum of CBE based on the key elements from the 2019 working definition is
needed to inform practice and ensure that fidelity (or adaptation) of implementation can be measured by some yardstick, and comparisons are leading to appropriate interpretations. For example, does CBE require all elements be implemented with full fidelity in order to improve student outcomes? Are the elements equal in value/impact or are certain elements more important than others when it comes to promoting a particular outcome or effect? Does this vary at certain points in the implementation continuum? Additionally, the measures designed to evaluate the level of implementation fidelity must pay particular attention and draw clarity around how CBE is distinct from traditional schooling and likely falls along a continuum.

Noticeably absent in all of the research reviewed was a theory of action for how a specified CBE element, practice, initiative, or policy would bring about the desired goals and the assumptions that are necessary for that to happen. How is each CBE component intended to facilitate change and how are the components intended to work together as a broader systems-change approach? Although there is no one, correct theory of action—the elements will vary from context-to-context—the information provided through this type of a design process will help researchers identify and understand models of implementation that are effective and/or elements that are non-negotiable to impact desired change. Consequently, researchers should advocate for the development of theories of action and provide resources that help states and districts design their reform efforts accordingly.

In order to examine the extent to which CBE approaches support an equity agenda, more studies should be conducted with a greater focus on marginalized students, community members, parents, and educators. Further exploration should include the extent to which CBE approaches are responsive to the needs of marginalized populations. The legitimacy of cultural funds of knowledge and insights from those groups who do not regularly appear in randomized control trials or quasi-experimental designs, but who are at the center of equity concerns, should be acknowledged. Researchers should explore the needs and assets of marginalized communities in relation to CBE approaches and theories of action.

Another line of future research should seek to employ more rigorous designs (e.g., using matched control/comparison groups) and investigate both academic and nonacademic outcomes of CBE interventions on K-12 students. For example, does a particular CBE reform model help students catch up to their peers and close achievement gaps? How long, in general, does the intervention take to see effects accumulate? Are some students or student groups disproportionately "harmed" by certain CBE reform models, especially those that may more strictly interpret that students should not move on in the curriculum until they have mastered precursor concepts and skills? Also, how do certain CBE reform models affect intrapersonal and interpersonal student outcomes such as motivation, engagement, and collaboration? In the end, we believe that mixing experimental research designs with more descriptive studies that focus on asking what works, for whom, and under what conditions will promote a more nuanced understanding of CBE approaches on equity goals.

8 | CONCLUSION

Competency-based education is a systems-change approach intended to re-shape traditional understandings of what, when, where, and how students learn and demonstrate academic knowledge and skills. The purpose of this literature review was to examine the research on K-12 CBE for factors that affect implementation, student outcomes, and the relationship between implementation and student outcomes. This systematic review contributes to the ongoing conversation about CBE reforms in several key ways.

First, this synthesis meticulously reviews and integrates the body of literature on K-12 CBE implementation and outcomes, identifying themes that inform research, policy, and practice. One theme is that CBE is not an all-or-nothing approach. CBE constitutes many elements that are implemented to varying degrees. Thinking about CBE approaches along a continuum of implementation eschews a binary approach to investigating schools as either fully competency-based or not, and instead recognizes that schools typically implement a range of practices some of which are more aligned with competency-based elements than others. Understanding the degree of implementation and associated effects on student outcomes can provide practitioners with a greater understanding of what is essential in different contexts to realize the equity goals at the center of reform efforts.

Second, the review isolates gaps in the existing knowledge base. For example, there is a need to better understand how assessment of student learning fits within these models, how schools think about and approach measuring competency, and the nature of assessment in competency-based systems. If determining competence is fundamentally an assessment decision, then there is a lot left to explore about assessment and CBE approaches. Also, there is a gap in the existing literature with respect to theories of action supporting competency-based systems. Designing theories of action that support CBE approaches will help elucidate the connections among the key elements of CBE, the intended role of assessment in a competency-based system, and mechanisms by which assessment serves to promote student agency, equity, and other desired outcomes.

Third, this research synthesis identifies questions that need further research. For example, there has been a fair amount of research conducted on the factors (facilitators and barriers) that affect CBE implementation. We know from this research that barriers can turn into facilitators that accelerate and improve the quality of implementation. What we do not yet know, however, is how barriers and facilitators relate to different profiles of implementation. Meaning, if a school or district decides to implement the key elements of CBE to varying degrees along a continuum thereby creating a profile of implementation, are there certain barriers or facilitators that are more relevant than others to specific profiles? Do the barriers and facilitators change or become more complex in later stages of implementation? Additionally, there is a lot still unknown about the effects of CBE on student academic and nonacademic outcomes and how
those effects may vary by prior achievement, background characteristics, grade span, content area, and so on. Given the equity goals, exploring the perceptions and effects of CBE approaches on marginalized student populations seems especially relevant.

For many, the promise of CBE and related practices is that student achievement will improve and minimize equity gaps. This systematic review serves to amplify what is known about CBE approaches and what still needs investigation.

9 | LIMITATIONS

As with any study, this systematic literature review has limitations. First, the inclusion and exclusion criteria applied meant that some studies were left out of the review. This may lead to a more narrow interpretation of CBE implementation and outcomes. We tried to mitigate this limitation by including gray literature (e.g., unpublished reports) and widening our search terms to also include personalized learning and proficiency-based education. Second, we also acknowledge that the way in which we analyzed the research studies may affect study findings. For example, we decided to analyze the factors that affect K-12 CBE implementation using a binary examination of facilitators and barriers. Had we chosen to use a different analytic approach, we may have gained different insights on the factors that affect implementation.

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References marked with an asterisk indicate studies included in the systematic review.


Casey, K., & Sturcis, C. (2018). Levers and logic models: A framework to guide research and design of high-quality competency-based education systems. iNACOL.


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Carla M. Evans, Ph.D., is an Associate at the National Center for the Improvement of Educational Assessment (Center for Assessment). Carla’s research focuses on the impacts and implementation of assessment and accountability policies on teaching and learning. She is interested in policy research related to innovative assessment and accountability systems, competency-based education, and performance-based assessments.

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# APPENDIX A

## Identification of Key Elements of CBE from 2019 Working Definition for Each Research Study

<table>
<thead>
<tr>
<th>Author(s) and year</th>
<th>Key Term</th>
<th>Total Number of Elements by Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bill et al. (2014)</td>
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</tr>
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(Continues)
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<tr>
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</table>

Assessment is a meaningful, positive, and empowering learning experience for students that yields timely, relevant, and actionable evidence.

Students receive timely, differentiated support based on their individual learning needs.

Students progress based on evidence of mastery, not seat time.

Students learn actively using different pathways and varied pacing.

Rigorous, common expectations for learning (knowledge, skills, and dispositions) are explicit, transparent, measurable, and transferable.