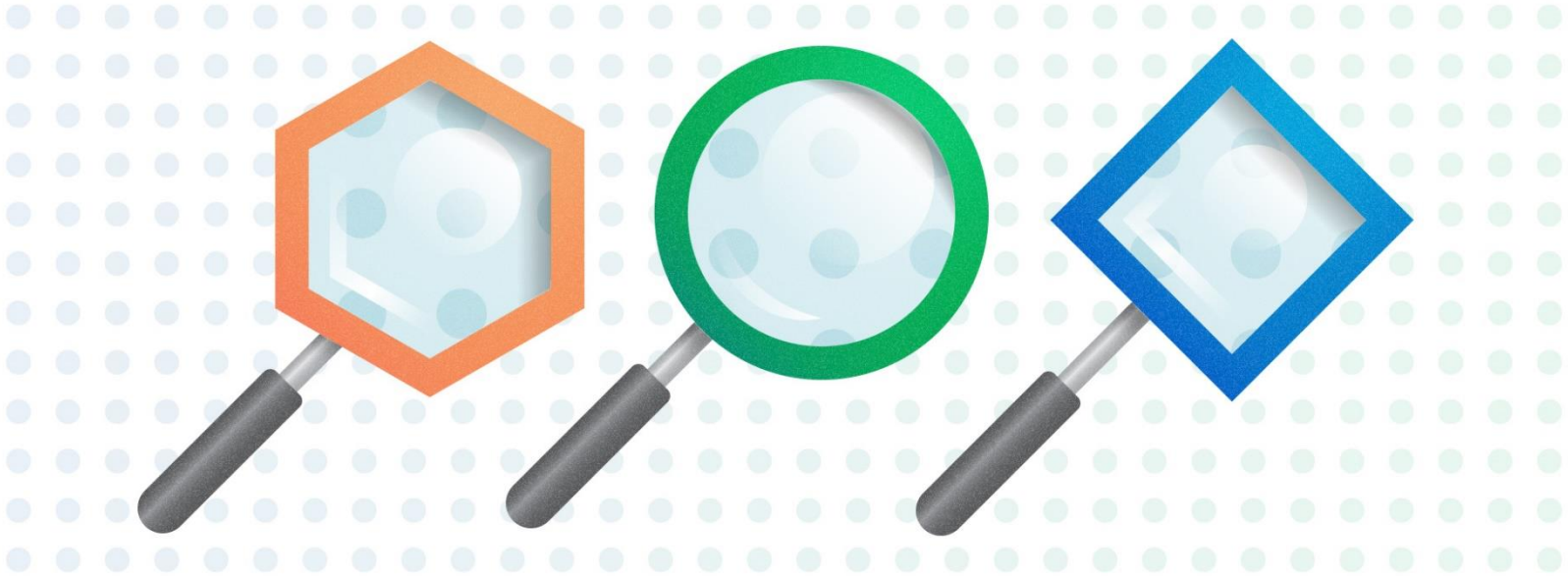

VALIDATING A NEW INSTRUMENT TO EXAMINE K-12 COMPETENCY-BASED EDUCATION IMPLEMENTATION

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Abstract

Competency-based education (CBE) reform has become a priority in many local and state education agencies in the United States. An oft-cited goal of CBE is to reduce inequities in student achievement outcomes and achievement gaps while improving the overall quality of education. The purpose of this study was to construct a reliable instrument to measure K-12 CBE implementation at the school level. This article describes our instrument development process including construct validation and reliability testing with 413 public school principals. This study employed confirmatory factor analysis and Cronbach's alpha internal consistency estimates to examine the construct validity and reliability of the pilot administration of the CBE Implementation Survey for Principals. Results suggest that the survey instrument accurately and reliably measures the essential elements of CBE, providing initial support for use in evaluating K-12 CBE implementation. Implications for research, policy, and practice are discussed.

Keywords: competency based education; administrator surveys; elementary secondary education; educational reform; factor analysis

Competency-based education (CBE) in K-12 schools is not a new concept. The K-12 CBE movement in the United States has its roots in the progressive education movement in the early 1900s (i.e., John Dewey) and also builds upon Benjamin Bloom's (1968) concept of mastery learning (Le, Wolfe, & Steinberg, 2014). An oft-cited goal of CBE is to reduce inequities in student achievement outcomes and achievement gaps while improving the overall quality of education (Lewis et al., 2014). The underlying premise is that the traditional American model of education was designed to rank, sort, and track students into college preparatory or career pathways and therefore passes students on from one grade to another, even if they have not mastered the content (Le et al., 2014). These social promotion policies leave many students with large gaps in knowledge that are oftentimes never remediated. CBE aims to address these systemic flaws by requiring students to demonstrate mastery of essential learning targets prior to moving on with their age-based cohort.

Most research related to K-12 competency-based education is from the 1970s and 1980s. Lack of conceptual clarity about defining features of CBE and piecemeal implementation limited the efficacy of CBE reforms during this time period (Block, 1978; Spady, 1977, 1978; Spady & Mitchell, 1977). Interestingly, Spady (1978) was pessimistic about the longevity of CBE reforms not because he didn't believe it could transform the educational system, but precisely because it would require "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). Indeed, Spady accurately predicted the shortened lifespan of CBE reforms, which were essentially abandoned with the heavy emphasis on accountability and related standardized testing in the 1990s and beyond.

In the last 10-15 years, CBE has once again caught the eye of education reformers looking for a way to reshape educational systems to ensure all elementary and secondary students "reach proficiency in the skills they need for college and careers" (Sturgis, Patrick, & Pittenger, 2011). This second wave competency-based education movement (~2000 to present) attempts to leverage the efficacy of a personalized and student-centered approach to education with progression in the curriculum upon demonstration of mastery in order to improve student achievement outcomes for all students (Le et al., 2014). In this way, CBE is often coupled with other reforms such as personalized learning (Bill & Melinda Gates Foundation, 2014; Pane, Steiner, Baird, & Hamilton, 2015), deeper learning (Zeiser, Taylor, Rickles, Garet, & Segeritz, 2014), and student-centered learning (Reif, Shultz, & Ellis, 2015). CBE also borrows from assessment reforms, including portfolio and performance-based assessment.

And yet there has been very little empirical research on the second-wave CBE reform movement. For example, the survey research on CBE implementation is relatively recent and appears conceptually scattered and disconnected (Students at the Center, 2016). The few survey instruments that do exist have been designed and validated for use in middle and high schools only, even though CBE is not meant to be solely a secondary school reform. Furthermore, most of the current CBE survey instruments explore only student and/or teacher perceptions of CBE implementation. While student and teacher perceptions are critical in understanding how CBE reforms are experienced in classrooms, it is also critical to explore principal perceptions about how CBE reforms are implemented at the school or building level. Principals serve as the instructional leaders of their school and often have a unique holistic perspective on the teaching and learning practices that occur in their school because they can note what is common across many classrooms and grade levels. Furthermore, as the second-wave CBE movement continues to

scale across the United States, it is important to design and validate survey instruments that can enable researchers to conduct national, large-scale educational policy research on K-12 CBE implementation within and across states. Principal surveys serve that purpose exceptionally well.

Therefore, the purpose of this study was to construct a reliable instrument to measure CBE implementation at the school level (hereafter referred to as the CBE Implementation Survey for Principals). This study was guided by the following research questions:

Research Question 1: To what extent does the CBE Implementation Survey for Principals reliably measure the essential elements of K-12 competency-based systems?

Research Question 2: What is the underlying factor structure of the CBE Implementation Survey for Principals?

This article is organized as follows. First, we explore the conceptual literature surrounding CBE in order to define the essential elements of CBE from the literature. This section provides a foundation to understand why and how the essential elements of CBE were defined and operationalized in the CBE Implementation Survey for Principals. Second, we comprehensively synthesize the existing CBE survey instruments. This synthesis provides a framework for understanding the limitations of existing survey instruments, the rationale for developing a principal survey, and the ways in which the CBE Implementation Survey for Principals builds upon and addresses the limitations within existing survey instruments. Third, the methods section explains our instrument development process including construct validation and reliability testing with 413 principals. The final two sections of the paper describe the results and discuss implications of a new survey instrument for research, policy, and practice.

Conceptual Framework

CBE Working Definition

In 2011, a group of CBE practitioners and policymakers came together to create a working definition of high-quality competency education (Sturgis et al., 2011). The five elements include: (1) students advance upon demonstrated mastery; (2) competencies include explicit, measurable, transferable learning objectives that empower students; (3) assessment is meaningful and a positive learning experience for students; (4) students receive timely, differentiated support based on their individual learning needs; and (5) learning outcomes emphasize competencies that include application and creation of knowledge, along with the development of important skills and dispositions.

Recognizing that these five CBE elements do not provide "an operational explanation of a competency-based structure" a white paper was prepared for the 2017 National Summit on K-12 CBE to more specifically define the culture, structure, and vision of teaching and learning that should be similar design features in competency-based schools (Sturgis, 2017). A key point in the final report from the 2017 National Summit was that it is a mistake to focus on only one or two aspects of CBE such as flexible pacing or competency-based grading practices and lose sight of the fact that CBE is meant to be a systems-level redesign of a school's culture, structure, and vision of teaching and learning.

Culture is defined here as the set of shared beliefs, values, goals, and practices that characterize the daily activities and interactions that take place within a school (Lopez, Patrick, & Sturgis, 2017). Some examples include beliefs about the importance of student voice and choice, active teaching methods, and the role of teacher within the learning environment. Structure is defined as the policies, practices, and processes that affect how a school operates and the

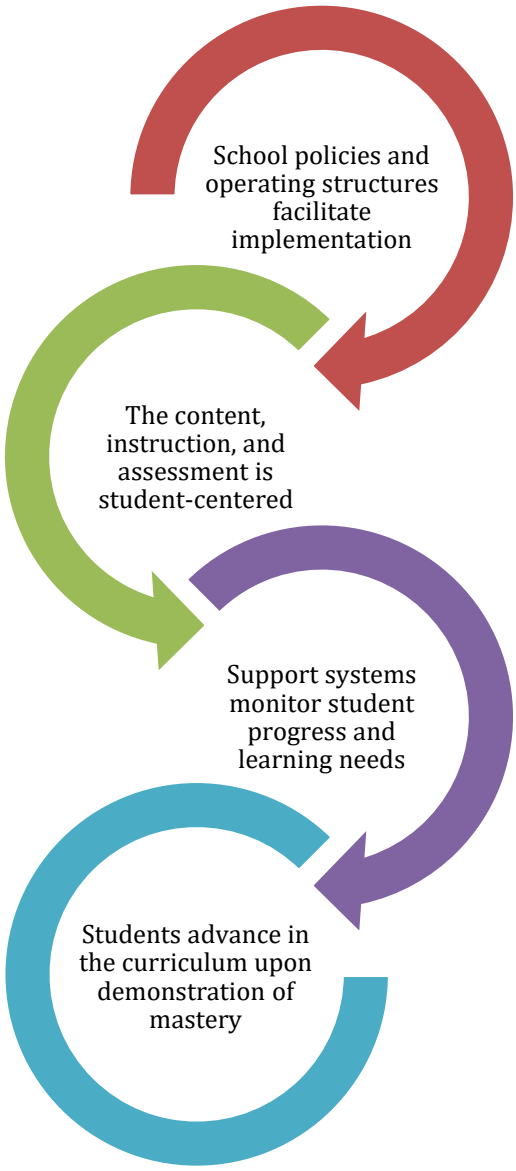
decisions that are made. For example, schools have certain ways of operating such as not allowing credit for out-of-school learning opportunities that may constrain the implementation of competency-based teaching and learning practices. The vision of teaching and learning refers to the underlying theory of how students learn and develop, which tends towards socio-cultural understandings in competency-based systems. As a result, student-centered and personalized approaches to teaching and learning are promoted in competency-based systems.

In sum, all school systems have a culture, structure, and vision of teaching and learning (whether stated or unstated). Competency-based learning advocates argue that it is the arrangement of and relationship between these elements that define and are shared amongst competency-based systems (Lopez, Patrick, & Sturgis, 2017). We used this conceptual frame to operationalize CBE, as discussed in more detail next.

Our Operationalization of CBE

We interweave culture, structure, and vision of teaching and learning in order to operationalize competency-based systems using four components: 1) students advance in the curriculum upon demonstration of mastery; 2) support systems monitor student progress and learning needs; 3) the content, instruction, and assessment of learning is student-centered; and 4) school policies and operating structures facilitate implementation of competency-based teaching and learning. Figure 1 shows how these four components are inter-related and inter-dependent, but yet distinct. This means components may share some elements, but can also be examined in isolation.

Figure 1.
Graphic illustration of the relationship among the four essential components of K-12 CBE systems



Many sources informed our operationalization of K-12 CBE. First, we drew upon the key elements as described in the 2011 working definition of CBE (Sturgis et al., 2011) and the 2017 National Summit on K-12 CBE (Lopez, Patrick, & Sturgis, 2017; Sturgis, 2017). We also relied on K-12 CBE definitions from other sources (e.g., Le et al., 2014; Lewis et al., 2014; Scheopner Torres et al., 2015; Surr & Redding, 2017), conversations with experts in the field, as well as on

the operational definitions of CBE and construct maps used to design a couple of the existing survey instruments (Haynes et al., 2016; Ryan & Cox, 2017; Steele et al., 2014). We drew upon all of these sources to operationalize K-12 CBE into four components.

First, in a competency-based system **students advance in the curriculum upon demonstration of mastery**. This is a fundamental element in all competency-based approaches because it addresses what system designers agree is perhaps the fatal flaw in the traditional model of education—namely, that students move from one grade to another with their age-based cohort without having to demonstrate mastery of the key knowledge and skills (or competencies) required in that grade level (Le et al., 2014; Lopez et al., 2017). These social promotion policies allow achievement gaps and student achievement outcome inequities to persist despite decades of equity-focused educational reform (Lewis et al., 2014). In order to facilitate the ability of students to "move on when ready" schools must allow *flexible pacing* through the curriculum. This means that instruction meets students where they are at and students can move on to new material in the curriculum when they have demonstrated that they learned the material, regardless of their classmates' progress (Steele et al., 2014). It also means that there need to be *flexible structures* built into the school system that afford students the ability and opportunity to move at their own pace. Some of these structures may include technological tools, instructional grouping approaches, multi-age classrooms, extra time, and multiple opportunities to demonstrate mastery (Scheopner Torres et al., 2015; Sturgis, 2017).

Second, in a competency-based system there are **support systems in place that monitor student progress and learning needs**. These support systems may be as simple as school- or district-defined benchmark assessments and/or the use of a learning management system to track students' progress towards proficiency on identified learning targets or competencies.

Sophisticated support structures are critical in a competency-based system because of the need to accurately identify when a student has learned the material and is ready to move on, as well as when a student has not learned the material and needs additional support. It is for this reason that *progress monitoring* is critical and must include all students regardless of how well they are doing in school (Lopez et al., 2017). There should also be *supports offered* to students that are personalized and customized to each student's learning needs. This allows students at all points in the mastery spectrum on a given competency to be appropriately supported and challenged. These support systems must work in tandem with the other components in order for information to flow through the competency-based system.

Third, in a competency-based system **the content, instruction, and assessment of learning is student-centered**. This means that students have voice and choice in what they learn and how they learn. In other words, the *content and modes of instruction are personalized* to maximize student agency, which has direct implications on student motivation and engagement (Le et al., 2014). Student-centered learning also means that there is *flexible assessment of student learning*. In competency-based systems, there is flexibility in the administration of assessments (e.g., *when* assessments are administered to students), the ability of students to re-take assessments, the use of multiple measures, and the types of assessments used to determine student mastery or proficiency (Domaleski et al., 2015; McClarty & Gaertner, 2015). Student-centered teaching, learning, and assessment facilitates the ability of students to demonstrate mastery in their own timeframe and utilizes the information from support systems to target identified learning needs.

And, finally, in a competency-based system there are **school policies and operating structures in place that facilitate the implementation of competency-based teaching and**

learning. For example, in the traditional model of education, student progress is typically reported to parents using traditional letter grades (A-F). These letter grades often combine effort, participation, and/or behavior with a student's course grade, which can easily distort evaluation of pure content mastery. However, in a competency-based system, a school should have different policies and procedures in place regarding how student progress is reported to parents and what type of information is included in those grades because of shared beliefs about what constitutes student learning (Sturgis, 2014). This is just one example of how *competency-based grading practices* enable competency-based teaching and learning. Another critical school policy and operation procedure relates to when and where student learning for credit can take place. This is sometimes referred to in the CBE literature as *anytime/anywhere learning* (or extended learning opportunities) and is usually only an option in middle and high schools (Wolfe & Steinberg, 2013). For example, does the school's policies place restrictions on when and where students can earn credit for participating in internships, apprenticeships, extended learning opportunities, or other out-of-school learning experiences? The last critical school operating structure relates to opportunities available to teachers within the school day to analyze student work, come to shared understandings of student proficiency, and discuss how to support students' individual academic growth. The professional conversations often take place in *professional learning communities* and school schedules must often be creatively adjusted in order to facilitate these professional opportunities within the school day (Patrick & Sturgis, 2015).

In sum, competency-based education represents a systems-level overhaul of the traditional model of education. Based upon our review of the literature, this means that competency-based education can be defined with four essential components. The next section reviews the existing CBE survey instruments and ends with implications for the development of a principal survey.

Synthesis of Existing K-12 Competency-Based Education Survey Instruments

Table 1 provides an overview of the existing K-12 CBE survey instruments used to examine the extent to which some or all of the key CBE practices described above have been implemented in different schools. The table includes the survey target population, grade span(s), focal concept, survey item constructs, as well as how the survey instrument's reliability and construct validity was examined. Findings from the use of the survey instruments are not included in the table because they do not pertain to the validation of the survey instruments.

There are a few key observations when synthesizing across the existing K-12 CBE survey instruments. These observations include that the existing survey instruments (1) focus on middle and high schools only; (2) focus on mainly student and teacher perceptions; and (3) are relatively recent and may seem conceptually disconnected. Each of these observations, as well as a rationale for developing a K-12 CBE principal survey is explained in more detail below.

Observation #1: Existing survey instruments focus on middle and high schools only

First, all of the K-12 CBE implementation research to date has focused on middle and high schools. None of the existing survey instruments were designed for use with elementary students, teachers, or administrators. It may be the case that CBE survey research to date focuses on secondary schools because state policies around CBE typically focus on changing graduation requirements. For example, the state may alter requirements that students complete a minimum number of credit hours with passing marks in order to graduate. These policies are often changed so that students must demonstrate proficiency in state content standards or competencies in order to graduate from high school. And yet, as mentioned earlier, CBE is not meant to be solely a

Table 1
Overview of Existing K-12 CBE Survey Instruments

Citation	**Survey Population**	**Grade Span(s)**	**Focal Concept**	**Constructs (*overlap with our survey)**	**How was reliability of the survey instrument examined?**	**How was the construct validity of the survey instrument examined?**
Bill & Melinda Gates Foundation, 2014 and Pane et al., 2015	Students & Teachers	Middle and high schools	Personalized learning	(1) learner profiles* (2) personal learning path* (3) competency-based progression* (4) flexible learning environment* (5) college and career readiness	Cronbach's alpha	Unclear
Education Development Center, 2016	Students & *Teachers*	High school	Student-centered learning (SCL)	(1) *personalization** (2) *21st century knowledge and skills* (3) demonstration of proficiency* (4) student voice and choice* (5) *academic tenacity* (6) growth mindset (7) traditional models of instruction and student activity* (8) SCL scaffolding (9) *anytime/anywhere learning** (10) technology in the service of SCL* (11) academic engagement (12) social/emotional engagement (13) student leadership (14) academic persistence (15) *collaboration*	Unclear	Unclear

Haynes et al., 2016	Students, Teachers & Principals	Middle and high schools	Competency-based education	(1) learning targets* (2) instructional approaches and supports* (3) when and where learning takes place* (4) assessment strategies* (5) measurement of learning* (6) pathways and progressions*	Cronbach's alpha	Exploratory factor analysis
Ryan & Cox, 2016 and 2017	Students	High school	Competency-based education	(1) mastery-based progression* (2) personalization* (3) flexible assessment* (4) development of specific skills and dispositions	Cronbach's alpha	Confirmatory factor analysis
Reif et al., 2015	Principals	High school	Student-centered learning (SCL)	Unclear; survey is only mentioned; may be similar to the Education Development Center, 2016	Unclear	Unclear
Steele et al., 2014	Students	High school	Competency-based education	(1) instruction meets students where they are and not according to their age-based cohort (flexible pacing)* (2) students have choices to personalize learning* (3) students demonstrate proficiency and earn credit by applying knowledge and skills not on time or effort*	Unclear	Unclear

secondary school reform. CBE is meant to be a systems-level overhaul of the traditional model of education in both elementary and secondary schools. From a practical standpoint, it is also more philosophically coherent and aligned if school districts or school systems make significant changes to their elementary and secondary schools' structure, culture, and vision of teaching and learning in the same ways, even if the reform is not rolled out at all grade levels at the same time due to school size, staffing, and/or capacity issues.

Observation #2: Existing survey instruments focus mainly on student and teacher perceptions

A second observation when synthesizing across the existing CBE survey instruments is that the survey populations are mostly students and teachers. For example, out of the six survey instruments we located, five of them have a student survey and three of them have a teacher survey. There were only two principal surveys that we could find mentioned in the literature, but one was not specific to CBE (Reif et al., 2015) and the other was not yet validated for use due to insufficient sample size (Haynes et al., 2016).

Some of the authors defended their choice of a particular target population and also the limitations inherent in that choice. For example, Ryan and Cox (2017) explained their rationale for the development of a survey that collects information on students' beliefs about, exposure to, and understanding of competency-based learning. Their rationale includes the reliability of recent student perceptions surveys in the context of teacher evaluation and how student perceptions may provide useful information that can be used to improve instruction. However, the authors also note that student perceptions might not be the same as teacher perceptions and/or what is actually occurring in classrooms.

It may be the case that researchers to date have focused mainly on designing and validating student and/or teacher CBE survey instruments because some of the research has been funded by organizations interested in understanding the efficacy of their grants made to a limited number of specific schools. For example, the Bill & Melinda Gates Foundation funded around thirty personalized learning schools and twelve competency-based education pilot schools and then commissioned RAND to investigate the effects of personalized learning (Bill & Melinda Gates Foundation, 2014; Pane et al., 2015) and effects of CBE (Steele et al., 2014). Designing a principal survey may not have made sense in this context because of the limited numbers of schools involved and the difficulty generalizing from such a small sample. Instead, the researchers used other methods to explore principal perceptions in these studies such as interviews and focus groups.

One of the limitations of student and teacher surveys is the difficulty conducting large-scale policy research with these populations. Access to students, in particular, is increasingly difficult to obtain given new State laws or local school board decisions that require active versus passive consent. This means that to survey K-12 students on non-academic content, researchers need parental opt-in signatures for students under age 18 rather than sending a note home that says students will be surveyed and if they don't want their child/student to participate then they need to opt-out. Access to teachers is complicated by the fact that teacher names and contact information is not publically available from State education departments, even though it can be located sometimes on each school's website. However, collecting teacher email addresses from every school's website is a time-consuming and likely unfeasible endeavor for state or national educational policy research. This is not to diminish the importance of student and teacher perceptions for other research uses and for use by local education agencies interested in exploring

their school and district context, but it does highlight the difficulty researchers like ourselves face when choosing a target population to examine CBE implementation within and across states.

At the same time that there are known difficulties capturing student and teacher perceptions, principals have an important perspective to examine in relation to the teaching and learning practices taking place in their schools. For example, over 40 percent of principals reported having a major influence on curriculum decisions in the 2015-16 National Teacher and Principal Survey (Institute of Education Sciences, n.d.). Principals often serve as the primary instructional leader in their schools with roles related to observing and providing feedback to teachers on their lesson plans and teaching practices. Principals also have a more holistic purview of what takes place across classrooms in the school and can offer a critical perception on the implementation of school reform efforts.

Observation #3: Existing survey instruments are relatively recent and may seem conceptually disconnected

The final observation we note when synthesizing across the existing K-12 CBE survey instruments is that the research is relatively recent and appears somewhat scattered and disconnected. There have been six different survey studies related to K-12 CBE since 2010 and it is unclear without deeper investigation how the survey construct maps and items overlap with or complement one another as they use different terms and number of constructs. For example, Steele and colleagues (2014) operationalized CBE using three constructs, Hayes and colleagues (2016) using six constructs, and Ryan and Cox (2016, 2017) using four constructs. This clearly relates to different focal concepts—some surveys focus on competency-based education (Haynes et al., 2016; Ryan & Cox, 2016, 2017; Steele et al., 2014), but others focus on related concepts such as personalized learning (Bill & Melinda Gates Foundation, 2014; Pane, Steiner, Baired, &

Hamilton, 2015) or student-centered learning (Education Development Center, 2016a, 2016b; Reif et al., 2015). The apparent disjointedness also relates to the fact that many of these survey instruments were being developed at the same time, but by different research organizations and institutions.

And yet, upon further inspection, there are many overlaps in how the existing survey instruments attempt to measure CBE. For example, all of the survey instruments have a construct that focuses on how in a competency-based system students should have to demonstrate proficiency or mastery in order to advance in the curriculum. Different terms are used to describe this such as "competency-based progression" (Pane et al., 2015), "demonstration of proficiency" (Education Development Center, 2016; Steele et al., 2014), "measurement of learning" (Haynes et al., 2016), and "mastery-based progression" (Ryan & Cox, 2017). Similarly, flexible pacing of student learning is another construct that is common across survey instruments as is the personalization of the content, instruction, and assessment of student learning. For example, Pane and colleagues (2015) label these constructs as "flexible learning environments" and "personal learning path"; whereas others name the constructs "student voice and choice" (Education Development Center, 2016), "instructional approaches and supports" and "assessment strategies" (Haynes et al., 2016), and "personalization" and "flexible assessment" (Ryan & Cox, 2017). Another common theme across survey instruments is the ability of students to earn credit for participating in out-of-school learning experiences. In other words, competency-based systems should not place restrictions on "when and where learning takes place" (Haynes et al., 2016) and school policies support "anytime/anywhere learning" (Education Development Center, 2016). We note in Table 1 the constructs that overlap between over survey and the existing surveys. We

believe these common overlaps support our operationalization of CBE into four distinct, but overlapping components.

Summary and Implications for the Development of a Principal Survey

The synthesis of existing K-12 CBE survey instruments highlights the need to expand the research to elementary schools, as well as the benefits of a principal survey for conducting large-scale educational policy research on CBE implementation within and across state policy contexts. It is for these reasons that we set out to construct a reliable instrument reflective of the key components of CBE implementation in K-12 schools.

The synthesis of existing K-12 CBE survey instruments also highlights the importance of conceptually connecting what appear to be disjointed conceptualizations of CBE in the survey research to date. In our instrument development process, therefore, we were careful to build off of what we considered the most coherent and comprehensive survey instrument to date, which was also consistent with the four CBE constructs identified in our review as essential. We found that the CBE 360 principal survey (Haynes et al., 2016) served as a useful starting point because it addressed the essential theoretical constructs, but it needed to be shortened given excessive length. The next section describes our instrument development process including construct validation and reliability testing.

Instrument Development Process

We followed four steps to develop and refine our survey instrument prior to the pilot administration based upon best practices in the field (Fowler, 2014; Groves et al., 2009). First, we clearly identified the object of measurement (i.e., K-12 CBE) and the sampling frame. Second, we created a construct map that defines the relevant constructs of CBE from reviewing the related literature, existing survey instruments, and consulting with experts in the field. We used this

construct map to determine the operational definitions of the constructs to be measured. In the end, we defined and operationalized CBE using four hypothesized constructs as measured by their underlying factors (see Table 2 for the construct map). Third, we developed survey items (or questions) for each of the CBE constructs to be measured. We used our operationalization of CBE to write survey items intended to measure the underlying latent factors. Finally, we reviewed and pilot tested the survey with experts in the field to maximize the content validity of the survey instrument. Six CBE experts reviewed and provided written feedback on the draft construct map and survey items. We used their feedback to refine the construct map and item pool and produce a final version.

Table 2

CBE Implementation Survey for Principals Construct Map, Descriptive Statistics, and Reliability Estimates (N=413)

Constructs	Items	Mean	SD	Cronbach's Alpha
Students advance in the curriculum upon demonstration of mastery (ADVANCE)				
FLEXPACE: Flexible pacing (3 items) (M=2.88; SD=0.87; N=394)	13R. Students in the same class/course work on the same material at the same time.	2.56	1.13	0.66
	14. Students are able to move on to new material when they are ready, even if other students in the class/course are not ready.	3.31	1.12	
	15R. Students move on to the next topic or unit along with their classmates, regardless of whether they demonstrated that they learned the prior material.	2.76	1.14	
FLEXSTR: Flexible structures (4 items) (M=3.50; SD=0.74; N=397)	16. Students are provided access to technology that allows them to move at their own pace through the class/course.	3.55	1.23	0.58
	17. Students are placed in classes/courses based on their level of understanding rather than age/grade level (disregard students way below grade level in your response).	2.54	1.36	
	18. Students are provided more time either during class or at another time to show their teacher that they have learned the material if needed.	3.87	0.92	

	19. Students are provided more than one opportunity to show whether they have learned class/course material.	4.06	0.89	
Support systems in place that monitor student progress and learning needs (SUPPORT)				
PROGMON: Progress monitoring (4 items) (M=3.59; SD=0.83; N=392)	20. Student progress in demonstrating that they have learned the class/course material is monitored closely for students near or below the proficiency cutoff.	4.13	0.86	0.76
	21. Student progress in demonstrating that they have learned the class/course material is monitored closely, regardless of how well they are doing in school.	4.00	0.93	
	22. Students have formal meetings (individually or in small groups) with a teacher to discuss their progress in learning class/course material, regardless of how well they are doing in school.	3.41	1.18	
	23. Students have personalized learning plans, regardless of how well they are doing in school.	2.83	1.32	
SUPP: Supports offered (4 items) (M=3.93; SD=0.78; N=388)	24. Students are provided personalized and customized support when they are not able to demonstrate to their teacher that they have learned the material.	4.02	0.91	0.72
	25. Students are provided personalized and customized support, regardless of how well they are doing in school.	3.59	1.12	
	26. Students move in and out of receiving extra support based upon their progress in the curriculum.	3.99	1.02	
	27. The school schedule includes intervention/enrichment blocks where students can receive personalized and customized supports.	4.12	1.20	
The content, instruction, and assessment of learning is student-centered (STUDENT)				
PERS: Content and modes of instruction are personalized (4 items) (M=3.42; SD=0.83; N=396)	28. Students are able to pursue their own areas of interest within the curriculum.	3.28	1.081	0.78
	29. Students are provided multiple ways to learn the same material (e.g., lecture, group projects, independent research, etc.)	3.95	0.89	
	30. Students are able to apply their learning outside of the classroom (e.g., internships, apprenticeships, community projects, etc.).	3.28	1.173	
	31. Students are able to choose how they want to show what they have learned from several different options (e.g., taking a test, writing a paper, completing a project, oral exam, etc.)	3.16	1.111	

FLEXASS: Flexible Assessment of Student Learning (6 items) (M=2.94; SD=0.66; N=389)	32R. Students in the same class/course are assessed at the same time.	2.08	0.989	0.67
	33R. Students are assessed at the end of a unit or course mainly with traditional tests (e.g., multiple choice, true-false, etc.).	2.67	1.124	
	34. Students are assessed at the end of a unit or course mainly with performance-based assessments.	3.37	0.969	
	35. Students are able to take end of unit or course assessments (e.g., multiple choice/true-false tests, performance tasks, etc.) when they are ready to demonstrate their learning, even if other students in the class will not take the assessment.	2.47	1.165	
	36. Students are allowed to retake or re-do a summative assessment without points off.	3.47	1.163	
	37. Students must demonstrate their learning of class/course material more than once (i.e., on more than one assignment, assessment, or exam).	3.58	1.041	
School policies and operating procedures in place that facilitate the implementation of key CBE cultural and structural elements (POLICY)				
GRADE: Competency-based grading practices (6 items) (M=3.82; SD=1.10; N=392) *See Note for explanation	38R. Student progress is reported to parents with traditional letter grades (A-F).	3.55	1.675	0.72
	39. Student progress is reported to parents on whether the student demonstrated mastery (or not) of the class/course standards or competencies.	3.97	1.207	
	40. Student progress is reported to parents on student skills and dispositions (e.g., taking responsibility for one's work, collaboration, respect for others, etc.) either by grade level or by course.	3.94	1.188	
	*41R. Students must re-take the entire class/course if they fail.	3.53	1.358	--
	*42. If a student does not pass a class/course they only need to demonstrate that they have learned the material they did not know to move on.	2.98	1.269	--
	*43. Students must demonstrate that they have mastered class/course material to pass and earn credit.	3.61	1.27	--
ANY: Anytime/ Anywhere learning (5 items)	*44. Students can earn credit for out-of-the classroom projects.	3.32	1.317	--
	*45. Students can earn credit for out-of-the classroom internships or apprenticeships.	3.45	1.43	--
	*46. Students can earn credit for dual enrollment.	3.61	1.538	--
	*47. Students can earn credit for an online course.	3.71	1.46	--

(M=3.44; SD=0.99; N=148) *See Note for explanation	*48R. The school's policies place restrictions on when and where students can earn credit for participating in out-of-the classroom projects, internships, apprenticeships, or other learning opportunities.	3.09	1.259	--
PLC: Professional Learning Communities (3 items) (M=4.01; SD=0.93; N=394)	49. Teachers are provided time within the school day to look at student work to ensure a common understanding of proficiency.	4.04	1.018	0.89
	50. Teachers are provided time within the school day to discuss how to support students who are not yet able to demonstrate that they have learned the class/course material.	4.14	0.951	
	51. Teachers are provided time within the school day to discuss how to support students who have demonstrated that they learned the class/course material and are ready to move on to new material.	3.86	1.129	

Note. *=Items only to applicable to middle and high schools. These items were removed prior to analyses because there wasn't a large enough sample of middle and high school principals to analyze responses to these items with statistical precision (N < 200). There was a 5-point scale range for each item (1= 'strongly disagree', 2= 'somewhat disagree', 3= 'neither agree nor disagree', 4= 'somewhat agree', and 5= 'strongly agree'). R=item reflects a traditional model of education and was re-scaled using the reverse scale range (e.g., 1=5, 2=4).

Measures

The CBE Implementation Survey for Principals 2017 contained 55 items and took approximately 15-20 minutes to complete. The first 12 items collected demographic information on respondents such as position title, state, type of school, school urbanicity, grade spans, school size, and other school information (e.g., percent free-and-reduced price lunch).

After the demographic items, the online survey was designed to randomize 9 item sets (39 items total) to participants so that item sets at the end of the survey would have roughly equivalent response rates to those at the beginning and order effect bias could be minimized. These 39 items were Likert-type questions using a 5-point scale (1= 'strongly disagree', 2= 'somewhat disagree', 3= 'neither agree nor disagree', 4= 'somewhat agree', and 5= 'strongly agree').

Seven of the 39 items were written to reflect a traditional model of education in order to reduce response set (clicking the same answer without regard to question's content) and as a check on the construct validity of the survey (we expected those items to negatively relate to competency-based items and negatively load on factors). These items are labeled with an "R" after the item number on the construct map in Table 2 because they were re-scaled. For example, principals were asked about the extent to which they agreed with the statement "Students in the same class/course work on the same material at the same time" (Q13R).

The final section of the survey included 4 items: one Likert-style item that asked principals' perceptions on the importance of competency-based, proficiency-based, or mastery-based learning in preparing students for college and career, as well three open-response items that applied only to schools moving toward or currently implementing competency-based, proficiency-based, and/or mastery-based learning approaches—all other respondents were asked to skip to the end and finish. These three open-response questions asked principals for their perceptions about the barriers to implementation, resources or supports that facilitate implementation, and resources or supports needed to support implementation. These last 4 items are not included in this survey validation study.

Pilot Testing

Sample

An open recruitment email was sent to principals in a few states using State department of education listservs/email lists and state principal associations newsletters. The sample consisted of 413 public school principals who completed the CBE Implementation Survey for Principals in summer 2017. Participants reflected diversity of school contexts across grade spans (Elementary=49.2%; Middle School=16.9%; High School=16.2%; Mix of grade spans=17.4%) and school settings (Rural=35.4%; Suburban=40.2%; Urban=23.5%).

Analysis

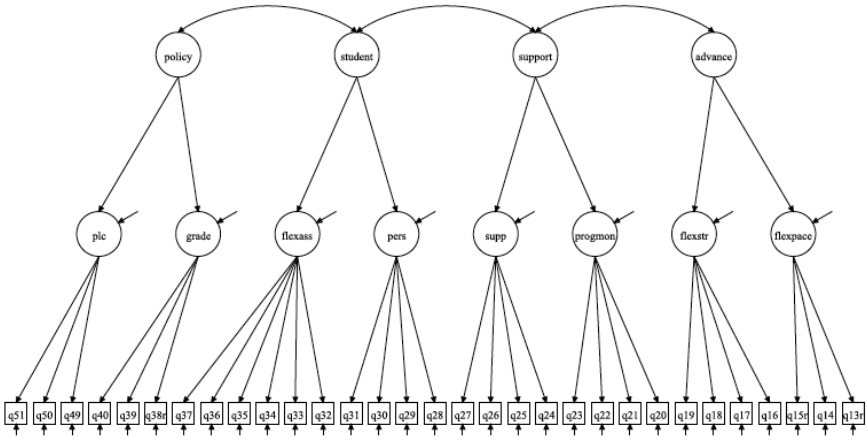
Our analysis commenced with descriptive analyses of all items and an examination of bivariate correlations between items hypothesized to measure the same underlying construct. Prior to re-scaling the seven items written to represent a traditional model of education, we examined correlations and factor loadings to see if they negatively loaded onto the hypothesized factors as would be expected for these items. Two methods were used to examine the construct validity and reliability of the CBE Implementation Survey for Principals. Cronbach's alpha coefficients were used to assess internal consistency reliability, and confirmatory factor analysis was used to explore the instrument's construct validity. These methods utilized 31 of the 39 items about CBE practices. Eight items were removed (3 items from the GRADE item set and all 5 items from the ANY item set; see items with asterisks in Table 2) prior to analyses because they focused on elements that pertain only to middle and high schools and the sample size was not large enough to conduct statistically sound separate validation procedures for middle and high school principals (i.e., $N < 200$).

Internal Consistency. To answer the first research question, "To what extent does the CBE Implementation Survey for Principals reliably measure the essential elements of K-12 competency-based systems" we used Cronbach's alpha estimates to examine the construct reliability (or internal consistency) of the item sets. We also examined whether the constructs were generalizable (or invariant) across school demographic characteristics such as school setting (rural, urban, and suburban) and grade span (elementary, middle school, high school, etc.). Typically, estimated reliability coefficients of item sets should be above 0.70 in order to be considered reliable measures.

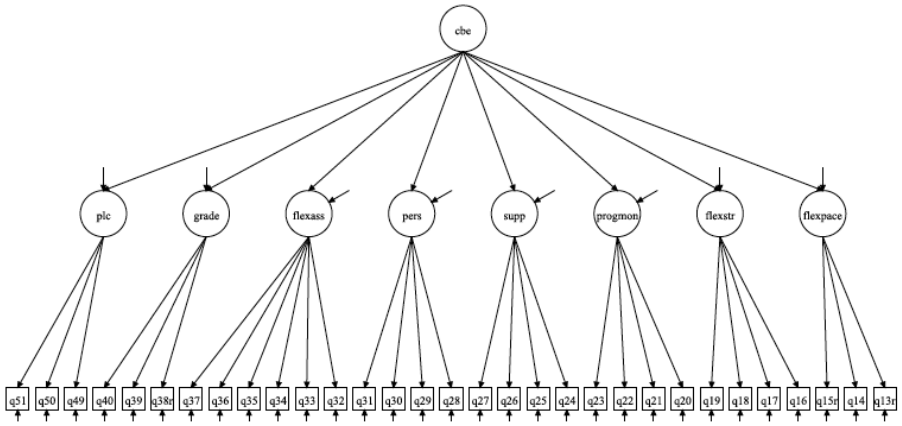
Confirmatory Factor Analysis. To answer the second research question, "What is the underlying factor structure of the CBE Implementation Survey for Principals?" we used the way the conceptual literature breaks CBE into constituent elements to determine what factor models to examine in the confirmatory factor analysis. Confirmatory factor analysis was conducted using Mplus (Muthén & Muthén, 2017) to test three hypothesized factor models visually displayed in Figure 2: four second-order factors (Model I), one second-order factor (Model II), and eight first-order factors (Model III). These factor models move from closely approximating the multi-leveled way CBE is defined and operationalized in the literature (e.g., students advance in the curriculum upon demonstration of mastery is measured by two latent factors – flexible pacing and flexible structures) to exploring the relationship among latent factors (e.g., flexible pacing, flexible structures, progress monitoring, supports offered, content and modes of instruction are personalized, flexible assessment of student learning, competency-based grading practices, anytime/anywhere learning, and professional learning communities).

Figure 2.
Three hypothesized factor models underlying the CBE Implementation Survey for Principals

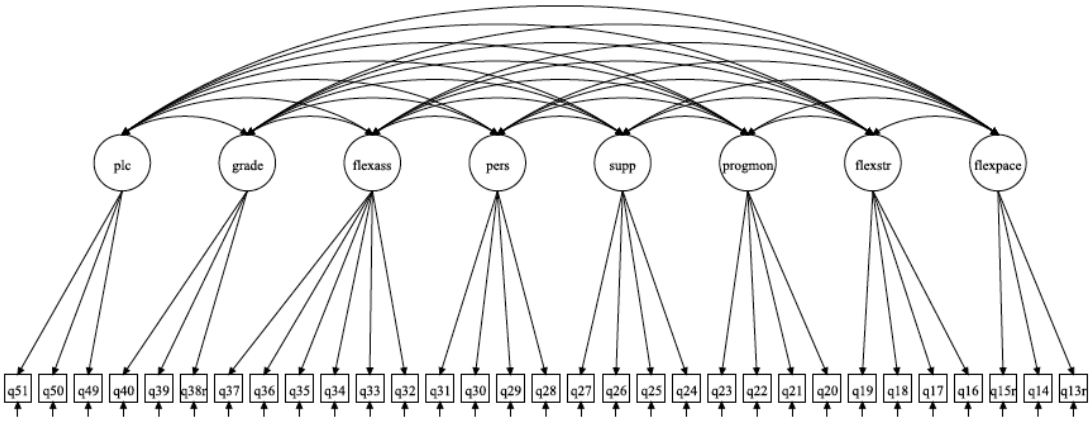
Model I: Four Second-Order Factors



Model II: One Second-Order Factor



Model III: Eight First-Order Factors



The goal of specifying these three factor models is to test theories about the constituent elements of CBE implementation and determine the extent to which the proposed models are one viable representation of the true relations underlying the sample data. The results of the confirmatory factor analysis can be used as a measure of the construct validity of the survey instruments—meaning, does the survey measure what it purports to measure?

In the first model, four second-order latent factors (ADVANCE, SUPPORT, STUDENT, and POLICY) are measured each by two first-order latent factors (see Table 2 for the construct map and item descriptions). This hypothesized model draws on the conceptual framework and theorizes that there are four distinct components of CBE reform in practice. In the second model,

there is only one second-order factor (CBE). This model examines whether there is just one construct—competency-based education—that underlies the eight first-order factors. The last model has no second-order factors and instead examines whether a factor structure with just first-order correlated factors fits the sample data best. The last two models draw on the conceptual framework as well as prior survey research where researchers questioned whether CBE implementation is more a conglomeration of curricular, instructional, and assessment practices rather than a system-level reform with four distinct elements (Ryan & Cox, 2017).

We used the magnitude of the factor loadings and model fit indices such as chi-square goodness-of-fit test, comparative fit index (CFI), root mean squared error of approximation (RMSEA), and standardized root mean squared residual (SRMR) to determine which factor structure best represents the true relations underlying the sample data. Hu and Bentler's (1999) suggested model fit cutoff criteria were followed including non-significant chi-square test, CFI ≥ 0.95, RMSEA ≤ 0.06, and SRMR ≤ 0.08. We also examined modification indices, but did not make any adjustments to our hypothesized factor models as modification indices are sample specific and atheoretical, and therefore, should be applied with caution.

Results

Internal Consistency. Descriptive statistics for each survey item and reliability estimates for each item set were examined. Table 2 provides information on the specific items forming each item set, including item means and standard deviations, as well as frequency counts and reliability estimates for each item set. Reliability estimates for the eight item sets ranged from 0.58 to 0.89. Typically, item sets with larger numbers of items have higher alpha values as long as the items are at least somewhat correlated with each other. The estimated reliabilities of three item sets fell just below the 0.70 threshold.

To understand whether the reliability of these item sets are setting specific, we examined the extent to which the reliability estimates for each item set (or construct) were invariant across school settings (i.e., rural, suburban, urban) and grade spans. The reliability estimates from the subgroup analyses are not substantively different than the overall reliability estimates generated from the item sets. The strength of the relationships between survey items within each set is relatively stable across these subgroups, suggesting that the item sets would perform equally well regardless of school characteristics.

Confirmatory Factor Analysis. Table 3 provides the model fit statistics and standardized factor loadings for each of the three hypothesized factor models. Prior to re-scaling, each of the seven items intended to measure a traditional model of education negatively loaded onto each of their factors in each factor model. These negative loadings provide evidence of discriminant or divergent validity—the extent to which concepts that are not supposed to be related are actually unrelated—supporting the survey's construct validity.

Table 3
Model fit statistics and standardized factor loadings for three hypothesized factor models underlying the CBE Implementation Survey for Principals

	Model I Four second-order factors	Model II One second-order factor	Model III Eight first-order factors
Model fit statistics			
Chi-Square (df)	1562.87 (423)	1201.16 (426)	1049.80 (406)
RMSEA [90% CI]	0.082 [0.078, 0.086]	0.067 [0.063, 0.072]	0.063 [0.058, 0.068]
CFI	0.751	0.831	0.86
SRMR	0.168	0.074	0.065
Standardized factor loadings			
FLEXPACE BY			
Q13R	0.575	0.574	0.605

Q14	0.735	0.731	0.693
Q15R	0.523	0.532	0.556
FLEXSTR BY			
Q16	0.367	0.422	0.441
Q17	0.311	0.363	0.403
Q18	0.776	0.731	0.697
Q19	0.744	0.728	0.715
PROGMON BY			
Q20	0.605	0.621	0.623
Q21	0.700	0.71	0.717
Q22	0.699	0.741	0.738
Q23	0.601	0.649	0.644
SUPP BY			
Q24	0.683	0.711	0.716
Q25	0.724	0.755	0.732
Q26	0.597	0.634	0.643
Q27	0.413	0.441	0.458
PERS BY			
Q28	0.700	0.703	0.694
Q29	0.648	0.677	0.675
Q30	0.678	0.683	0.693
Q31	0.702	0.703	0.702
FLEXASS BY			
Q32	0.459	0.468	0.515
Q33	0.468	0.49	0.513
Q34	0.349	0.355	0.323
Q35	0.737	0.705	0.705
Q36	0.513	0.519	0.492
Q37	0.465	0.498	0.475
GRADE BY			
Q38R	0.517	0.509	0.527
Q39	0.829	0.828	0.827
Q40	0.788	0.793	0.785
PLC BY			
Q49	0.844	0.841	0.841
Q50	0.878	0.875	0.877

Q51	0.840	0.846		0.845	
ADVANCE BY		CBE BY		FLEXSTR WITH	
FLEXPACE	0.813	FLEXPACE	0.850	FLEXPACE	0.618
FLEXSTR	0.706	FLEXSTR	0.812		
				PROGMON WITH	
		PROGMON	0.843		
SUPPORT BY		SUPP	0.839	FLEXPACE	0.704
PROGMON	0.857	PERS	0.791	FLEXSTR	0.588
SUPP	0.879	FLEXASS	0.823		
				SUPP WITH	
		GRADE	0.403		
STUDENT BY		PLC	0.446	FLEXPACE	0.648
PERS	0.922			FLEXSTR	0.719
FLEXASS	0.684			PROGMON	0.796
				PERS WITH	
POLICY BY					
GRADE	0.245			FLEXPACE	0.655
PLC	0.656			FLEXSTR	0.764
				PROGMON	0.696
POLICY WITH				SUPP	0.641
STUDENT	0.377				
				FLEXASS WITH	
SUPPORT WITH				FLEXPACE	0.866
ADVANCE	0.814			FLEXSTR	0.786
				PROGMON	0.611
STUDENT WITH				SUPP	0.590
SUPPORT	0.358			PERS	0.644
				GRADE WITH	
				FLEXPACE	0.508

	FLEXSTR	0.271
	PROGMON	0.372
	SUPP	0.411
	PERS	0.073
	FLEXASS	0.380
	PLC WITH	
	FLEXPACE	0.318
	FLEXSTR	0.390
	PROGMON	0.463
	SUPP	0.414
	PERS	0.325
	FLEXASS	0.258
	GRADE	0.160

Note. df = degrees of freedom; RMSEA = root mean squared error of approximation; CI = confidence interval; CFI = Comparative Fit Index; SRMR = standardized root mean residual.

Model fit statistics presented in Table 3 suggest that Model I (four second-order factors) did not fit the data well. Improvements in fit were found for the other two fitted models. Both Model II (one second-order factor) and Model III (eight first-order factors) fit the data equally well with almost identical model fit statistics. For example, both factor models had RMSEA ~ 0.06, SRMR ~ 0.07, and CFI ~ 0.8: slightly higher (RMSEA and SRMR) and lower (CFI) than the recommended values. Therefore, a χ^2 difference test of nested models was conducted to evaluate the relative performance of the one second-order and eight first-order factor models. The statistically significant finding indicated that Model III (eight first-order factors) afforded superior fit and is therefore preferred [$\chi^2(20) = 31.41, p < .001$]. All but one of the standardized item factor loadings in Model III (eight first-order factors) were moderate to strong (ranging from 0.32 to 0.88). Most of the correlations among the first-order factors were also moderate to strong, except in two cases. Both the GRADE and PLC first-order factors had weak relationships with

many of the other first-order factors (< 0.40). This suggests that how participants responded to those two item sets is only weakly associated with how participants responded to many of the other item sets.

Discussion

The purpose of this study was to construct a reliable instrument to measure K-12 CBE implementation at the school level. This survey addresses the need for a K-12 survey that coheres with the conceptual literature about the essential components of CBE and also captures elementary and secondary principals' perceptions of CBE implementation in their school. Validating this new principal survey instrument is an important first step towards the goal of examining CBE implementation across the United States.

This article describes our instrument development process including construct validation and reliability testing with 413 public school principals. Results from the internal consistency and confirmatory factor analysis provide evidence that the survey instrument accurately and reliably measures the essential components of CBE. We assert that the CBE Implementation Survey for Principals provides a new and needed instrument to support research around K-12 implementation of CBE policies and practices within and across the United States.

Implications for Research, Policy & Practice

There is widespread interest in competency-based models of education—both in previous decades (1970s and 1980s) and today. Equity considerations and the desire to help each student succeed academically are at the heart of competency-based reforms (Lopez et al., 2017). And yet, there is a dearth of research on the second-wave CBE movement (~2000 to today) and how moving to a competency-based system improves student outcomes for all students. There have been only a handful of empirically based attempts to operationalize and measure the hypothesized

elements that comprise CBE reforms. This limits the information that policymakers and practitioners have to understand, anticipate, and respond to implementation challenges, variation in implementation across settings (grade spans, urbanicity, state policies), and necessary capacity-building and professional supports to implement CBE policies and practices at scale.

Part of the difficulty in conducting research on CBE reforms is that the movement still lacks conceptual clarity—a long-standing Achilles heel of the movement (Spady, 1977). For example, the final report on the 2017 National Summit on Competency-Based Education noted concerns about the lack of a shared understanding about what constitutes CBE and recommended revising the working definition and developing a logic model (Lopez et al., 2017, p. 50).

Findings from this study may provide empirical evidence that could be used to revise the working definition and develop a logic model. For example, results from this study raise questions about the extent to which K-12 CBE implementation can be measured using a factor model that represents the underlying data as four distinct CBE elements or even one general CBE element. Instead, our findings suggest that K-12 CBE may actually be implemented as more of a mix of cultural and structural elements rather than 4-5 components as the current definition implies. This finding could encourage those revising the working definition and developing the logic model to clarify *what* are the essential elements of competency-based systems and *how* those essential elements must work together in a quality CBE system redesign. In other words, the working definition may need to be revised so it focuses more on defining elements that differentiate competency-based systems from traditional systems and how those elements cohere and align to create a competency-based system.

This new survey instrument has many potential uses. For example, future research studies could administer the CBE Implementation Survey for Principals across more states. This would

build the nascent research base and provide insight into the widening implementation of CBE policies and practices in local school systems within states and across the nation. Collecting longitudinal data may also provide insight into whether and to what extent schools begin implementing CBE policies and practices in similar ways and proceed through various stages of implementation. This information could (in turn) support more informed decision-making about the barriers schools face and the resources and supports necessary to enable the implementation of CBE. This type of information would be very useful to policymakers and practitioners who want to support the implementation of CBE reforms, but don't have any empirical information on how implementation typically proceeds within and across states.

Another potential use of this new survey instrument is the creation of an implementation metric. An implementation metric could be developed from this survey instrument for use as an explanatory variable in regression analyses as researchers attempt to disentangle effects on student achievement outcomes based on the level of exposure to CBE practices. Additionally, the relationship between school demographic characteristics and school implementation level could be examined to see whether schools serving higher percentages of underprivileged students tend to report implementing CBE policies and practices more or less than schools serving lower percentages of underprivileged students. The explanatory power of the implementation metric to predicting variation in school performance on a state achievement test over time could also be examined.

Future research could also use this survey instrument in mixed methods research. For example, the results from the survey instrument could be used to select schools of varying implementation levels for follow-up qualitative study. This information could help target schools

of varying implementation levels to gather rich descriptions and ascertain the complexities of how CBE policies and practices are implemented, adapted, and/or re-made in local policy contexts.

Conclusion

This study adds to the nascent research base about how to define and operationalize K-12 CBE in order to conduct large-scale survey research on the reform. The K-12 CBE Implementation Survey for Principals described in this study could be used by multiple constituencies and for multiple purposes. For example, local education agencies could use the survey to evaluate their local level of CBE implementation, state departments of education could use the survey to examine variation in implementation across schools in their state, and researchers could use the survey to conduct large-scale, national research on CBE implementation across states. The new principal survey instrument detailed in this study extends the prior literature as it applies to elementary schools, not just middle and high schools. The survey also builds upon the prior literature because it conceptually overlaps and coheres with the four main ways CBE has been operationalized in the literature.

As CBE reforms continue to expand nationally, it is important that empirical research follows suit and provides validated survey instruments to explore implementation within and across states. The process of validating a K-12 principal CBE implementation survey aids in that quest to provide a high-quality survey instrument that can be used to inform future steps and gain clarity on competency-based reform implementation.

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