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COMPETENCY EDUCATION RESEARCH SERIES

EQUITY IN COMPETENCY EDUCATION:

REALIZING THE POTENTIAL, OVERCOMING THE OBSTACLES

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RAND Education and Jobs for the Future, November 2014

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ACKNOWLEDGEMENTS

This report sought to review a wide set of research findings and integrate insights relevant to potential equity issues that could arise as competency education evolves and begins to be implemented more broadly. Covering these many research domains is simply not possible by a single person, and this work benefited from a number of members of a larger set of contributors. Foremost, the authors wish to acknowledge and sincerely thank Eric Toshalis and Chris Dede, who provided detailed comments and feedback on an earlier draft. The authors feel a great debt to these reviewers for their attention to detail, breadth of expertise and knowledge of literatures, and willingness to help both strengthen the quality of the content as well as assure that the tone of this work appropriately communicates results in sensitive areas. Seldom do research teams find such high-quality support from reviewers.

This work was also greatly improved by very thoughtful discussions with and comments and critiques from Rebecca E. Wolfe and Adria Steinberg of Jobs for the Future and Beth Miller from the Nellie Mae Education Foundation. Our original discussions on the issues of equity in competency education helped to develop the arguments and provide foci for the work. Their willingness to provide general and specific guidance on later drafts and the writing and editorial skills of Carol Gerwin significantly improved the quality of the findings and how they are communicated.

Finally, Donna White provided consistently strong support to the production of this report throughout the writing process.

This report was funded by the Nellie Mae Education Foundation.

Suggested citation: Lewis, Matthew W., Rick Eden, Chandra Garber, Mollie Rudnick, Lucrecia Santibañez, & Tiffany Tsai. 2014. *Equity in Competency Education: Realizing the Potential, Overcoming the Obstacles*. Students at the Center: Competency Education Research Series. Boston, MA: Jobs for the Future.

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INTRODUCTION

A growing number of schools and states are turning to competency education for its potential to raise student achievement and prepare young people from all backgrounds to succeed in college and careers. Although competency education is an evolving field and implementation varies from site to site, competency-based models share an approach that is fundamentally different than the traditional time-based structure of the American school system. Rather than requiring all learners to spend the same amount of "seat time" in class and allowing them to advance by earning any passing grade, students progress at different rates and only by demonstrating mastery of learning objectives, or "competencies," aligned with state standards. All students are held to the same high expectations, but instruction is individualized to meet each person's strengths and challenges.

Equity is a central goal of competency education. The hope is to develop a system that will help students from all socioeconomic, racial, ethnic, and linguistic backgrounds, including those with disabilities, to reach essential academic standards that will prepare them for a productive life beyond graduation. In most U.S. public schools today, students are never required to demonstrate the competencies that they will need to succeed in future education, training, and careers. That is not to say their abilities are never assessed. Tests and other forms of assessment are a given. But ultimately, students move from one grade level to the next with a wide range of grades that can indicate anything from mastery of the material to large gaps in their knowledge and skills. As a result, many students fall farther behind each year.

Competency-based approaches are designed to prevent this problem. Students and teachers stick with each topic or skill until each individual learner can demonstrate mastery. While some learners advance more quickly than others, struggling students receive the support and time they need to make meaningful progress. Ideally, a mature and well-functioning competency education system would not leave any learners behind.[1]

In practice, however, there are less optimistic possible outcomes, depending heavily on how competency education is implemented. Proponents and policymakers share the concern that poorly implemented competency-based programs could inadvertently increase inequity—in opportunities and in outcomes. There is little research literature on the competency education models in place today, in part because they are so new; most have been established over the past few years. But the potential for problems is clear. In a system where students have to demonstrate skills and knowledge to move forward, there might well be a "rich get richer" and "poor get poorer" effect: those whose backgrounds afford them a richer array of learning environments and who begin school already having acquired more skills may keep increasing the distance between themselves and their less fortunate peers.

Equity concerns are gaining attention as competency-based schools grow in number across the country.[2] A recent report from Achieve, a leading nonpartisan, nonprofit education reform organization that works with states to raise academic standards and graduation requirements, summarized the stakes:

> Without attention paid to risks of equity, [competency education] could have negligible effects on persistent disparities in performance among students by race/ethnicity, income, special education and [English language learner] status. Far worse, it also could open up new achievement gaps—ones not based on different levels of performance but on the time it takes to reach standards, if different groups are moving at disproportionally slower paces through the content (Achieve 2014, p. 9).

Recent research by the authors of this paper found that educators on the ground in competency-based schools share these concerns. Interviews and conversations with teachers at sites implementing elements of competency education (visited as part of a study for the Bill & Melinda Gates Foundation) uncovered a theme of unease.

Teachers said the system as implemented works for "higher achieving" learners who have been taught to be independently engaged and to persevere despite setbacks while learning new content or skills. However, teachers expressed serious concerns about the effectiveness of their approach for learners who have become disengaged in school or have not yet learned perseverance skills (Steele et al. 2014). While some teachers noted that several hallmarks of competency education—including flexible pacing and competency-based assessment—benefited high-achieving students, who advanced quickly through learning units, they saw slow progress among students who tended to struggle academically. Higher-achieving students also took advantage of online summer learning opportunities, which allowed continued progress between school years, while other students did not.

This paper examines equity concerns in competency education through the lens of family income.[3] There is no shortage of evidence of present and past disparities in educational achievement—ranging from standardized test scores to high school graduation rates—between students from lower-income and higher-income backgrounds. Specifically, we highlight three areas in which students from lower-income families may experience disadvantages compared to higher-income families that competency education could exacerbate, potentially leading to inequitable learning opportunities as well as outcomes. The areas of potential concern, which align with important elements of competency-based approaches, are:

- The skills, strategies, attitudes, and behaviors of individual learners that are crucial to successful academic performance
- Access to, and use of, digital technologies that can contribute to personalization and customization of learning and assessment
- Access to structured and assessed learning experiences outside of the traditional school day and year

We look at each area of potential concern in light of research on these topics. We conclude with suggestions for mitigations that deserve serious consideration as competency education continues to gain interest and investment.

DEFINITIONS

There is no universally shared definition of competency education, but it is generally agreed to have three core elements, as characterized by Le, Wolfe, and Steinberg (2014) in the companion paper *The Past and The Promise: Today's Competency Education Movement*:

1. **Mastery**—Students advance to the next level, course, or grade based on demonstration of skills and content knowledge as outlined in clear, measurable learning objectives[5] that hold all students to the same high standards.
2. **Pacing**—Students progress at different rates in different areas, rather than on a teacher-driven, class-wide schedule. Students who do not demonstrate mastery of a competency on the first attempt continue learning and have multiple opportunities to try again.
3. **Instruction**—Students receive customized supports to match their individual learning needs in each subject, to keep them learning increasingly challenging material in a developmentally appropriate and motivating manner—and to ensure that those struggling in any area will be able to reach proficiency.

A Note on Our Construction of Equity

In this paper, we use family income as a proxy for a number of variables that describe different groups of American families for issues of equity. This paper focuses on differences in groups of learners from high- versus low-income families. Income is an important element of a broader category used by social sciences called "Socioeconomic Status,"[4] which includes education, income, and occupation of families. Income levels correlate strongly with parent education levels, occupation attainment and race/ethnicity.

Other groupings such as those based on race, ethnicity, and gender may be important, but the available research base using these constructions is not sufficiently nuanced for our purposes. Still other groupings that may be important include students with disabilities and English Language Learners (Achieve 2014). By limiting our equity lens in this way, we gain access to a rich research base that, although not specific to competency education, includes a number of elements of competency-based systems.

In addition to these core elements, competency-based models often include "personalization," which involves the active participation of each student in the design of their learning, and typically connects learning with the interests, talents, experiences, and aspirations of each student. High degrees of personalization "foster engagement, motivation, and responsibility for one's own learning" (Le, Wolfe, & Steinberg 2014). Personalized approaches to competency education frequently include the following: multiple measures of mastery, opportunities for "anytime, anywhere" learning outside of school buildings and beyond traditional school hours,[6] and use of technological tools to enhance engaging instruction and ease implementation challenges (Thigpen 2014).

METHODOLOGY

Though the studies cited in this paper were not conducted in settings using competency-based approaches, they may hold lessons for educators who seek to implement competency education. Such inferences are possible because, despite the fact that competency education is a distinct set of innovations, it incorporates elements that have been studied previously in other contexts.

We augment the existing literature with findings from RAND's study on competency education for the Bill & Melinda Gates Foundation (Steele et al. 2014). These include the results of structured interviews with 27 national thought leaders, such as local implementers of competency education, state and federal education leaders, software developers, academics, and foundation officials.[7] These findings also include observations and interviews that followed structured protocols from site visits to six high schools across the United States (including large, small, urban, and suburban schools) implementing elements of competency education. RAND researchers interviewed principals, teachers, and administrators at each site. We also use findings from analyses of U.S. data on socioeconomic status and aspects of learning from the Programme for International Student Assessment (PISA).

We acknowledge that this paper raises questions that we are not yet able to answer. However, we believe that it can help structure and begin to inform the conversations taking place in the educational community regarding competency education. The goal is to look over the horizon of the evolution and scaling of competency education innovations. By doing so, we can begin to enumerate areas where research suggests there may be reason for concern and also begin to articulate methods to mitigate future challenges to equity.

» There is no universally shared definition of competency education, but it is generally agreed to have three core elements: mastery, pacing, and instruction.

LEARNING STRATEGIES AND ACADEMIC PERSEVERANCE

In order to succeed in a competency-based program, as defined in the introduction, students require certain skills, strategies, attitudes, and behaviors. These range far beyond logical-mathematical reasoning abilities; they also involve self-perceptions, internal regulation, emotional states, drives, motives, and the ability to make meaning out of a variety of social situations in classrooms and schools.[8]

Farrington et al. (2012) identify five factors that cover the variety of skills, attitudes, and behaviors required for academic success: academic behaviors, academic mindsets, learning strategies, academic perseverance, and social skills. While each of these areas is important generally for academic success, we focus on two categories that may be of significant relevance to success in competency education:

- The learning strategies identified as "metacognitive strategies" and "self-regulated learning," which students need in order to acquire complex knowledge and skills, especially in classrooms that rely less than traditional classrooms on direct instruction by the teacher
- Academic perseverance, which students need in order to maintain focus and drive in the face of challenges; academic perseverance includes tenacity, "grit," delayed gratification, self-discipline, and self-control

We chose to analyze and synthesize these two areas because they enable more effective social as well as independent learning opportunities—qualities closely related to success in competency-based settings—and have a substantial research base behind them. There is also significant evidence that these areas of learner behavior are malleable and capable of undergoing profound reorganization and invigoration depending on available resources, support, opportunities, and scaffolding.

The analysis also relies on the importance of developing a "growth mindset" (Dweck 1999; Mangels et al. 2006). Individuals with a growth mindset believe that intelligence is a function of effort, not an innate ability fixed at birth. Students with a growth mindset believe they can become "smarter" with effort, and are therefore more likely to persevere in the face of learning challenges and setbacks. Again, the extent to which perseverance is supported in the learning environment is particularly relevant in a competency-based setting in which multiple revisions and opportunities toward reaching mastery are the norm.

In the following sections, we focus on the research in the areas of learning strategies and academic perseverance as they relate to socioeconomic status, the potential to teach these skills,[9] and our findings regarding implications for taking competency education to scale.

Learning Strategies

Learning strategies include study skills, metacognitive strategies, self-regulated learning, and goal setting (Farrington et al. 2012). All of these are relevant to competency education, as they affect each individual's ability to attain new skills and content knowledge, progress at their own pace, and benefit from customized supports. They are especially relevant to personalized versions of competency education that emphasize the importance of student agency and "voice," the opportunity to exercise choice and direct one's own learning, and anytime, anywhere learning (Toshalis & Nakkula 2012). We focus on metacognitive strategies and self-regulated learning because they have stronger research bases than the others.

Metacognitive strategies

Metacognition refers to a learner's knowledge and beliefs about the way people, tasks, and strategies interact to affect their intellectual enterprises (Flavell 1979). In other words, metacognition is awareness of one's own thinking processes and the abilities to understand, control, and

manipulate these processes (Garafalo & Lester 1985; Shrager & Siegler 1998). Research has established that metacognition is both malleable and teachable (Kuhn & Dean 2004; Paris & Paris 2001).

Many studies have linked student academic success to the ability to apply metacognitive strategies to comprehend specific content. These findings have implications for equity in competency-based settings, which rely more than traditional classrooms on individual responsibility for guiding one's own learning. The abilities of students to efficiently and effectively construct new knowledge and skills—and to understand and explain what they do and do not know—is more important in competency-based classrooms.

A meta-analysis of studies that looked at various interventions to improve student learning and study skills found that interventions that foster high levels of metacognitive awareness were more likely to be successful than those that did not seek to enhance metacognition (Hattie, Biggs, & Purdie 1996). Several studies suggest that students with a more-developed ability to utilize self-explanations are also capable of learning material with greater understanding than those with a less-developed ability to self-explain (Chi et al. 1994; Chi et al. 1989; Reimann & Neubert 2000; Ainsworth & Th Loizou 2003). Furthermore, studies have found that mathematics instruction that promotes metacognitive thinking improves student performance in general (Chalmers 2009; Hoffman & Spatariu 2008; Kramarski 2004) and specifically for low-achieving students (Teong 2003; Cardelle-Elawar 1995). Similarly, one meta-analysis of studies found that the use of metacognitive prompts in "writing to learn" interventions showed the most promise for improved learning (Bangert-Drowns, Hurley, & Wilkinson 2004). Another meta-analysis of studies found that metacognitive strategies in reading were an effective way to improve reading comprehension (Haller, Child, & Walberg 1988).

Research examining the relationship between family income and metacognitive skills has found a positive correlation. Evidence is provided by studies of language competency, which have been found to differ according to family income levels. Language competency, as indicated by vocabulary, has been shown to predict the level of metacognitive skills. Hart and Risley (1995) found that middle-income children tend to perform better in language competency than do lower-income children. Pappas, Ginsburg, and Jiang (2003) speculated that weak language skills may affect mathematical performance by detracting from students' metacognitive abilities to describe their thinking processes. Weak language competency might also interfere with comprehension of various academic problems that require such skills. The explicit teaching of metacognitive skills offers hope that these income-based disparities may be overcome.

Pappas and colleagues (2003) attributed their findings to prior research that indicates higher-income parents tend to engage in more extensive questioning and discussion of psychological processes with their children, suggesting that such differences could be mitigated: the more parents and teachers target the development of metacognition and self-regulation in lower-income students, the more those students will be able to capitalize on learning opportunities so that income-based achievement gaps can be eliminated.

Additional evidence regarding income and learning strategies (metacognitive strategies and self-regulated learning) comes from 2012 PISA data on "openness to problem solving" by U.S. students (OECD 2013). "Openness to problem solving" is a PISA construct using student responses to questions relative to their abilities to handle large amounts of information, to understand new content quickly, to actively seek explanations, and to easily link facts together, as well as to what extent they like to solve complex problems. This construct shows that students from higher-ESCS (economic, social, and cultural status) households report higher levels of "openness to problem solving" than those from lower-ESCS households, suggesting that some low-income children are at a disadvantage in terms of learning strategies.

The available research, summarized in Table 1, suggests that there are differences between lower- and higher-income learner groups in attaining metacognitive skills, which ultimately affect student achievement.

The question is: can schools address this gap in preparation? Research specifically exploring the relationship between students' income and their metacognitive skills (Wang 1993; Pappas, Ginsburg, & Jiang 2003) and research showing that metacognitive skills have the potential to impact student achievement and are teachable (Mayer 1998; Pintrich 2002) suggest that differences in such skills by income can be addressed by schools.

Table 1. Summary of Literatures on Learner Metacognitive Skills/Dispositions	
Differential Effects	**Competency Education Implications**
Three papers indicated differences in attainment of metacognitive skills between low-income and high-income children (Pappas, Ginsburg, & Jiang 2003; Wang 1993; Hart & Risley 1995).	Without, or prior to, metacognitive skill building, competency education may benefit children *differently*, depending on socioeconomic status.

Self-regulated learning

Effective learning also requires the ability to self-regulate thoughts, feelings, and actions related to the learning processes (Meece 1994; Schunk 1991; Zimmerman 1990). Zimmerman describes self-regulation as "self-generated thoughts, feelings, and behaviors that are oriented to attaining goals" (2002). Students who are self-regulated can initiate focus during academic activity, manage distractions, and set goals to sustain attention and achievement.

Findings regarding the importance of self-regulation raise concerns about the implementation of competency education. The ability to self-regulate is critical to the ability of students to work effectively at their own pace and stay on track to meet their goals. Self-regulation is also important given the flexible uses of time that characterize many personalized competency-based models, encouraging learning experiences outside of the traditional school day and year and in a variety of formal and informal settings.

In a system that includes anytime, anywhere learning, students would have myriad opportunities to learn outside the classroom—for example, at museums, parks, local businesses, community centers, and historic sites. Students who are able to effectively self-manage their attention outside of traditional school environments will be at an advantage. For example, students who are better able to ignore distractions around them and who know when it is appropriate to actively seek a quiet, non-distracting location to learn (if one is available and time is afforded to use it) will more likely be able to focus on learning and effectively build new skills and knowledge. Those with less developed self-regulation abilities will need additional supports, modeling, guided practice, and regular experiences of incremental success to help acquire these skills.

There has emerged a consensus among researchers that the self-regulation skills of children differ by income. While some earlier studies had found no differences in many of these skills between children from different income groups (Stipek & Ryan 1997), more recent studies have found the

Table 2. Summary of Literatures on Learner Self-Regulation Skills	
Differential Effects	**Competency Education Implications**
Seven papers found self-regulation/attention to be different across income levels (Howse et al. 2003; Stevens et al. 2009; D'Anigiulli et al. 2008; Evans & Rosenbaum 2008; Posner & Rothbart 2000).	Without, or prior to, self-regulation/attention skill building, differences across income levels may result in *different* individual effects in a competency education system.

opposite. Indeed, seven recent studies, as shown in Table 2, found significant differences in self-regulation when comparing lower- and higher-income students (Howse et al. 2003; Stevens, Lauinger, & Neville 2009; D'Angiulli et al. 2008; Evans & Rosenbaum 2008; Posner & Rothbart 2000). These findings are based on a variety of methods, but include experimental tasks, such as attending to one set of computer-generated tones and not being distracted by other tones, or pressing a computer key in response to one visual stimulus and not being distracted by another.

Overall, the research suggests that lower-income learners consistently experience negative outcomes in academic tasks that call for attentional regulation. Furthermore, children from lower-income groups may lack the skills needed to filter distracting stimuli, affecting attentional control (Stevens et al. 2009). Findings from other studies suggest that environmental factors contribute to deficits in the development of self-regulation skills (Stevens et al. 2009). To the extent that environmental factors contribute to such deficits, interventions geared toward increasing schools' and educators' capacities to teach self-regulation skills may lessen such differences (Vassallo 2011).

Learners who struggle to self-regulate or form metacognitive awareness can be well served by competency education, provided the competency-based approaches are well implemented. To effectively lead in a competency-based learning setting, teachers must be skilled at differentiating instruction and providing customized supports for students who struggle to progress, as well as helping them to develop the metacognitive and self-regulation skills that will enable them to progress. Absent personalized attention to income-linked differences in these learning strategies—and concerted efforts to mitigate them—competency education risks becoming yet another way in which students are labeled and tracked into different life trajectories already skewed by class disparities.

Academic Perseverance

Over the last decade, there has been a growing acknowledgement of the importance of non-academic aspects of learning such as perseverance—including grit, tenacity, and self-control (Farrington et al. 2012)—as key pieces of an individual's educational success. "Gritty" individuals are often characterized by their propensity to maintain a high level of perseverance throughout a process despite failures and obstacles they encounter (Dweck 1999; Duckworth et al. 2007). Most research suggests that individual differences in perseverance account for significant variances in achievement beyond that explained by IQ tests or other measures of intelligence (Duckworth et al. 2007). "Intelligence" itself, formerly understood as a fixed entity, is now largely understood as a malleable, and therefore teachable, quality of a learner.[10]

Academic perseverance may be especially important in competency education environments for many of the same reasons that metacognition and self-regulation are critical in these settings. While students receive customized instructional supports to match their individual learning needs, they progress at individual rates and are expected to play a significant role in guiding their own learning and supporting collaborative learning with others. Part of the often-cited argument for infusing high degrees of personalization into competency-based approaches is that it fosters engagement, motivation, and responsibility for one's own learning. Students who have been adequately engaged feel a sense of agency, or confidence in their ability to shape and benefit from their learning experiences, and are more likely to seek learning challenges and to persevere in the face of discouragement and failure (Christenson, Reschly, & Wylie 2012; Klem & Connel 2004; NRC & IOM 2003).

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In our research for the Gates Foundation, several people interviewed at competency-based schools and other settings noted that, while students make choices in competency education, they still must persevere through activities they do not like. Educational contexts can be structured in ways that support perseverance. This is managed at some competency-based sites by separating the discussion of desirable dispositions like perseverance from the grading of academic progress. Some schools have standards for behavior, often referred to as "habits of mind," that include qualities such as perseverance, professionalism, collaboration, and cultural respect (Kallick & Costa 2009). Teachers can use these standards to engage in explicit discussion with students about the behaviors and beliefs that lead to success or frustration, and specific strategies for increasing persistence.

There is limited research and mixed results with respect to differences between students from high- and low-income backgrounds as related to perseverance, as summarized in Table 3. Howse et al. (2003) and Stipek and Ryan (1997) found that motivation levels were comparable among economically disadvantaged and advantaged preschool and kindergarten children. Similarly, Bernard et al. (1996) observed no differences in diligence among students in grades 3 to 8 based on socioeconomic levels. However, the 2012 PISA data suggest that U.S. middle school mathematics students from groups of higher economic, social, and cultural status exhibit higher levels of perseverance than students from lower economic, social, and cultural groups.

Academic perseverance appears to be important for success in competency education. Academic perseverance may be diminished by learners' stereotypes of themselves as, for example, being part of a group that is "not good at math" or "high achieving." This "stereotype threat," which is an added pressure to perform well in order to discredit adverse (especially race, class, and gender) stereotypes, often results in negative outcomes (Steele 1997; Steele & Aronson 1995). Steele cites African-American females in a math class as an excellent example of a group potentially impacted by stereotype threats. Because African-Americans and females are two groups stereotyped as doing poorly in math, they may feel pressure to counter these beliefs by performing well. This pressure often creates anxiety and diverts attentional resources from the learning task at hand. Steele surmises that, as a result of this additional stressor, students experiencing stereotype threats are less likely to perform well even if they do persevere. In a mature competency education system where there is more personalization, more anytime, anywhere learning, and less directly guided, large group instruction by teachers, there may be fewer opportunities to actively counter stereotype threats by supportive peers and instructors. These could disproportionately affect learning and performance in students from marginalized populations.

In sum, competency education may provide benefits to children differently, based on the development of their learning strategies (metacognitive strategies and self-regulated learning skills), and there is evidence that the development of these learning strategies is varied by income. Of important note is that there is good evidence that these learning strategies are teachable. However, there is a lack of clear evidence of differences in perseverance levels in learners by income. In the next section, we look at concerns about differential "digital access and use" that cross the individual, family, community, school, and district spheres.

Table 3. Summary of Literatures on Learner Academic Perseverance

Differential Effects	Competency Education Implications
One paper found diligence to be similar across socioeconomic levels (Bernard et al. 1996). Two papers found motivation and perseverance levels to be similar across income brackets (Stipek & Ryan 1997; Howse et al. 2003).	Competency education may benefit children *similarly* across income brackets due to lack of clear evidence of differences in perseverance levels by socioeconomic status.

DIGITAL ACCESS AND USE

The rapid development of information and communication technology continues to affect the K-12 educational system generally, and competency-based approaches specifically. First, new types of learning management software that can track demonstrations of competency and other digital innovations can ease the critical challenges to implementing competency education at any large scale. Second, personalized competency-based schools use technological tools in service of flexible and engaging instruction. Digital access to a wide variety of learning content and experiences, both during and beyond the traditional school day and year, is valuable. Web-based resources and collaboration tools can help provide learning experiences, but require the often costly acquisition of bandwidth, devices, and skills to use them. As such, there is growing concern about whether differential access to technology will mitigate or exacerbate existing inequalities in learning achievement between low- and high-income students.

Access to and use of technology has the potential to provide students a greater reach to larger and broader information networks and to increase learning. For example, for underserved students, the effective use of technology has shown the ability to improve student outcomes, both in and beyond the traditional school environment (Thigpen 2014). However, there are reasons to believe that unequal access to technology—often called the "digital divide"—whether at home, at school, or in the community, will increase educational and social stratification (Bolt & Crawford 2000). It is important to note that the nature of the digital divide is changing: the gap in Internet access between low- and high-income youth continues to narrow, but important differences remain in uses of the Internet (Purcell et al. 2013).

This section surveys literature regarding student access to, and use of, technology at all income levels in order to determine whether inequities would interfere with student achievement in competency-based models. We investigate literature on the "digital divide" related to competency education in three areas: access and use in schools and communities, access and use by teachers and parents (as facilitators of learning), and access and use by individual students.

Digital Access and Use in Schools and the Community

At the institutional level, a digital divide may exist in schools and communities that affects access to, and use of, hardware, software, Internet, and technological support. Equitable access to technology and technological infrastructure, either hardware or software, within schools is often a starting point for research on this topic (Daugherty et al. 2014; Warschauer & Matuchniak 2010). In earlier years of the transition to widespread use of educational technology, lower-income schools were clearly at a disadvantage compared to higher-income schools. Although inequities still exist with regard to the quantity and quality of computers and software in schools, views about the impact of technology—whether it narrows or widens the achievement gap—are mixed (Mancilla 2014). In many low-income (Title 1) urban schools, there is evidence of good access to technology (Gray et al. 2010), even though it may not be used to full advantage by teachers and administrators.

As part of the Pew Research Center's Internet & American Life Project, researchers found that teachers in higher-income schools are more likely to report that their students use tablet computers and e-readers as part of their learning process (Purcell et al. 2013). Fifty-six percent of teachers

of higher-income students said tablet computers are used for classroom learning, while only 37 percent of teachers of the lowest-income students reported this. The study also found that teachers of the lowest-income students report that pressures to focus instruction on material that appears on state standardized tests, a lack of financial resources among students, and a lack of technical support all contribute to challenges incorporating digital tools in their classrooms. Furthermore, when asked whether the digital divide is narrowing or widening the achievement gap between the most and least academically successful students, 44 percent of teachers of the lowest-income students said that technology is narrowing the achievement gap, while 56 percent said it is widening the gap. This has important implications for schools and districts that have moved to BYOD (bring your own device) models of instruction due to the fact that many students do not possess smartphones or tablets that are needed to support their learning in the classroom.

A more significant concern may be that high-income schools have greater access to a wider variety of state-of-the-art digital tools, such as videoconferencing and learning management systems, when compared to the technology available at low-income schools (Barron et al. 2010; Thigpen 2014). Furthermore, the manner in which technology is used in schools differs based on economic factors. For instance, technology is significantly more likely to be used to promote higher-order thinking skills (e.g., through teaching analysis using spreadsheets) in high-income schools than in low-income schools (Reinhart, Thomas, & Toriskie 2011).

Another recent report by the Pew Research Center's Internet & American Life Project (Zickuhr & Smith 2013) found that between the availability of broadband access at home and smartphones, there is virtually no difference in Internet access by race. Another study found that there is a gap in Internet access across income levels, but that divide is greatly diminished when considering avenues for Internet access beyond home (e.g., at schools, libraries, and on smartphones) (Jansen 2010). On the other hand, a study by the Kaiser Foundation found that while almost all students, regardless of race or parent education, had access to a computer, a digital divide existed in terms of Internet access at home. Moreover, the divide was even larger for access to high-speed or wireless services (Rideout, Foehr, & Roberts 2010).

A larger percentage of teachers in higher-income areas than in lower-income areas also report that their schools do a "good job" of providing resources and support for incorporating digital tools into classrooms (Purcell et al. 2013). Teachers from higher-income areas also report receiving more formal training in use of digital tools in the classroom than teachers from lower-income areas.

Competency education, at scale, will benefit greatly from the appropriate use of high quality learning management software to track competency and from access to digital learning tools, collaboration tools, and content that supports personalization of learning experiences both during and beyond the traditional school day and year. Table 4 summarizes the literatures on access to such technologies in the school and community to support competency education implementation.

Table 4. Summary of Literatures on Digital Access and Use in Schools and Community

Differential Effects	Competency Education Implications
High-income schools not only have greater access to state-of-the-art digital tools when compared to low-income schools, they are also more likely to promote higher-order thinking skills with these technologies, such as teaching analysis using spreadsheets (Purcell et al. 2013; Barron et al. 2010; Reinhart et al. 2011).	Access to and use of technology at the school may benefit children *differently*, depending on income level.

» With the importance of digital access and use in supporting competency education, students coming from homes that encourage the use of technology will be at an advantage simply because those students do not need to acquire these skills in school.

Digital Access and Use in the Home

A digital divide also exists between richer and poorer families. According to a report by the U.S. Department of Commerce, National Telecommunications and Information Administration, and Economics and Statistics Administration (2013), households with income under $25,000 had lower Internet use, computer ownership, and broadband adoption. For example, 43 percent of households with income less than $25,000 adopted broadband, compared with 93 percent of all households earning $100,000 or more. In addition, slow broadband connection rates are concentrated among households making less than $50,000 a year (Thigpen 2014).

A study by Warschauer and Matuchniak (2010) found low-income parents who are not sophisticated users of the Internet may perceive the educational value of technology to be low and therefore may be less likely to encourage and provide direction for Internet use. Finally, compared to teachers of high-income students, more teachers of low-income students report that their students are not effective in using digital tools in the learning process (Warschauer & Matuchniak 2010). With the importance of digital access and use in supporting competency education, students coming from homes and schools that encourage the use of technology and development of technological skills will be at an advantage simply because those students do not need to acquire these skills in school.

Like the importance to competency learning of digital access and use in schools and the community, such access and use is also important in the home: students with fast Internet access and who have developed the skills to use digital tools and resources at home will be at an advantage. They will have easier access to richer content (e.g., videos) and will also have the opportunities to master use of tools like spreadsheets and become expert at skills such as searching for and evaluating the quality of Internet content. The results of these literatures are summarized in Table 5.

Table 5. Summary of Literatures on Digital Access and Use in the Home

Differential Effects	Competency Education Implications
Internet use, computer ownership, and broadband adoption at home vary by income level (U.S. Department of Commerce, NTIA, & ESA 2013; Thigpen 2014). Low-income homes more often lack parental involvement when using technology (Warschauer & Matuchniak 2010).	Access to and use of technology at the home may benefit children *differently*, depending on income level, under competency education.

Digital Access and Use By K-12 Learners

Now we examine a third digital divide, the socioeconomic differences in technology use by individual. Generally, the gap in Internet use between low- and high-income youth continues to narrow: Findings from the Pew Research Center indicate a large increase in Internet use via smartphones, raising important questions about the functionality of different platforms to support complex learning, as opposed to other tasks (Madden et al. 2013).

> In overall internet use, youth ages 12-17 who are living in lower-income and lower-education households are still somewhat less likely to use the internet in any capacity—mobile or wired. However, those who fall into lower socioeconomic groups are just as likely and in some cases more likely than those living in higher-income and more highly educated households to use their cell phone as a primary point of access (p. 2).

There are open questions regarding which aspects of competency education will and will not work effectively on smartphones and tablets. But there remains a difference between what higher- and lower-income children do when using the Internet. High-income children were found to be more likely than low-income children to use word processing, email, multimedia, and spreadsheets or databases (DeBell & Chapman 2006). There is evidence that children from low-income households use information and communication technologies more for entertainment and social networking (Rideout, Foehr, & Roberts 2010). Conversely, there is evidence that children from high-income households are more likely to have depth and breadth of experience in using digital media (Barron et al. 2010).

The literature reviews and data analyses cited here suggest legitimate concerns regarding digital access issues exacerbating inequalities in learning achievement between low- and high-income students in competency education environments. Many interpret the anytime, anywhere aspects of competency education to mean schooling is implemented in such a way that students are required to use technology outside of school to complete work. A risk to be monitored is the potential "rich-get-richer" effects on educational outcomes of BYOD approaches. The data indicate this implementation of competency models will exacerbate the "digital divide" between high-income and low-income students and increase inequitable outcomes. Thus, school leaders implementing competency-based approaches should carefully consider how to mitigate those effects. These results are summarized in Table 6.

Table 6. Summary of Literatures on Digital Access and Use by K-12 Learners

Differential Effects	Competency Education Implications
Research suggests that low-income students are more likely to use technology for entertainment and social purposes than educational ones (Rideout et al. 2010; DeBell & Chapman 2006; Barron et al. 2010).	Individual students' use and time getting familiar with technology may benefit children *differently*, depending on income level, under competency education.

ACCESS TO LEARNING CONTENT AND EXPERIENCES

Our final focus is on the quality of learning content and experiences to which different groups of learners have access, with an emphasis on access outside of the school day and school year. The anytime, anywhere and differential pacing aspects of competency education provide the promise of opportunities to acquire skills and knowledge, demonstrate competency, and earn recognized credit outside of traditional school schedules and buildings.

There continues to be varied access to learning content and learning experiences for K-12 learners, based on differential public funding of public schools, the distribution of teaching talent (Darling-Hammond et al. 2005; Howard 2003), access to advanced courses (e.g., Advanced Placement, GATE/TAG or Gifted and Talented Education or Talented and Gifted, International Baccalaureate), and the quality of the learning infrastructure (buildings, furniture, bathrooms, lab equipment, technology, etc.), as well as based on the differential ability of individual families to pay privately to supplement what public schools provide. This includes access to:

- Textbooks and workbooks, either hardcopy or online
- Private instruction, including individual tutoring or small-group instruction
- "Informal" learning (sometimes called "non-formal"),[11] including learning-themed workshops and camps offered by art and science museums, colleges and universities, private companies, school districts themselves, and other organizations

Each of these types of learning content and experiences has the potential to increase and deepen the learning of those with access during the traditional school year. Furthermore, they could also be valuable to counter the "summer slide," or learning losses during the summer for learners without summer educational opportunities that more greatly affect low-income learners (Alexander, Entwisle, & Olson 2007).

A key difference between how these resources are used in a traditional education system and a mature, well-functioning competency education system is in assessment and credit. In future competency education systems, there is the possibility of learners fulfilling school requirements by earning those credits, recognized by the school district, via third parties. Much like higher education will selectively accept credit for certain levels of performance on Advanced Placement tests offered by Educational Testing Service, K-12 districts could evolve to accepting credit from assessment organizations (such as the Educational Testing Service) or providers of instruction and assessment. Some districts now accept credit for certain web-based courses, such as health education, but such credit acceptance could broaden to include accredited museum courses and college summer camps. In such a system, appropriately accredited learning and assessments of competency from a variety of third parties could translate into school credit for this learning, and those who could afford the instruction and assessments could progress more rapidly and learn deeper competencies.

Textbooks and Workbooks, Either Hardcopy or Online

The traditional forms of independent learning via out-of-pocket-payment for textbooks and workbooks are now competing with the rapid growth in availability of online resources that support K-12 learning. There are providers such as Khan Academy, CK-12 Foundation, and massive open online courses (MOOCs) that are producing and providing web-based learning content and learning management tools for individuals at no cost. However, there are also providers of learning content that require payment, such as the homeschooling site K12.com (Mallon 2013; Yuan, Powell, & Cetis 2013).

Our interviews with experts found varying opinions regarding where the future would move with respect to access to web-based learning content in support of competency education. Opinions ranged from the extreme view that all learning content will be free in the future to the more plausible view that web-based learning content will vary in price and quality. If access to better quality learning content and experiences provides higher levels of learning, and there will be higher-quality content accessible to those who can afford to pay, then there will be the potential for inequities in learning, as has been true with all forms of learning materials.

Private Instruction

One result of competency education's emphasis on anytime, anywhere learning could be that students with access to private instruction will be able to learn faster and, potentially, more deeply than those without access. The ability to afford individualized afterschool, in-person tutoring, or attendance at for-profit, afterschool learning centers, will differentially benefit those who participate. Part of the reason is simply spending more time in structured learning environments. However, part is also due to the increased access to the same elements of teaching advantage of competency education: small-group instruction and individual, human-delivered tutoring that can provide tailored instruction and very fast, personalized responses to perceived challenges (VanLehn 2011). While well-implemented competency education could bring such advantages to low-income students during the school day, they will lack the access of their more advantaged peers in the non-school hours.

Web-based, automated tutoring has the potential to alleviate some of the equity concerns raised by in-person private instruction, as it provides broader access and, typically, lower costs than human-based instruction. There is evidence that artificial intelligence (AI)-based tutoring provides nearly the same learning improvements as human one-on-one tutoring in the domains of science, technology, engineering, and mathematics (STEM) (VanLehn 2011). Recent findings even suggest that classroom-based algebra instruction that was effectively complemented by AI-based tutoring of problem solving provides learning improvements over traditional algebra curriculum and classroom instruction (Pane et al. 2014). However, while web-based access to current and future AI-based tutoring content has the potential to provide learning advantages at a large scale at a fraction of the costs of human-delivered tutoring, students will still need access to technology resources in order to take advantage of these opportunities.

Non-formal and Informal Learning: Learning-themed Workshops and Camps

Non-formal and informal learning offerings are staples of art and science museums, colleges and universities, private providers, school districts themselves, and other organizations. Utilizing such learning experiences requires knowledge of the opportunities, being able to afford the tuition or fees, and having access to transportation to get to and from the events, as well as unoccupied time to schedule such events. Differential abilities to pay for any fees and transportation, whether across town to the local university or an airplane ticket across the country, are important determinants for which learners will participate and the benefits they receive. Differences in access and opportunities between high- and low-income learners are quite stark in this area of learning.

» Web-based, automated tutoring has the potential to alleviate some of the equity concerns raised by in-person private instruction, as it provides broader access and, typically, lower costs than human-based instruction.

Providers of such events are aware of the potential for inequities in access to their offering and in some cases will provide discounts or "scholarships" to learners who have financial need. There are also nonprofit providers who specifically work to address the needs of low-income families, such as Horizons National (horizonsnational.org), and who develop and provide free afterschool and summer educational enrichment programs to low-income public school students.

Table 7 summarizes the findings of analyses and literature reviews regarding possible differential effects of various types of access to different categories of learning content and experiences and competency education implications.

There is reason to believe that differential access to learning experiences and learning content could produce differential levels of learning. Differences in income could have significant impacts on the financial resources available to provide access to supplemental learning content and experiences, as well as adult caregiver time to identify opportunities and provide transportation.

Table 7. Possible Differential Effects of Access to Learning Content and Experiences on Learning Outcome and Competency Education Implications

Topic	Differential Effects	Competency Education Implications
Access to textbooks, workbooks, and online learning materials	Access to higher-quality learning materials should provide higher-quality learning outcomes when all other variables held constant. If higher-quality materials are available only for pay, then there will be differential effects based on ability to pay. If bandwidth is a limiting access factor to free content, especially video-based content, then there will also be technology-limited inequities in learning.	High-quality materials will provide improvements in learning if there is access, and access could be dependent on resources.
Access to private instruction	Studies of individual human tutoring and AI-based tutoring systems show improved learning over traditional classroom instruction alone (VanLehn, 2011; Pane et al., 2014). There is potential for differential effects if there is unequal access.	Small-group and individual tutoring could provide improvements in learning if there is access, and access could be dependent on resources.
Non-formal and informal learning experiences	Potential for differential attendance is based on knowledge of opportunities, ability to pay fees/tuition, and provision of transportation.	Non-formal and informal learning experiences could provide improvements in learning if there is access, and access could be dependent on resources.

MITIGATIONS TO ADDRESS EQUITY CONCERNS

Emerging concerns about the potential for competency education to exacerbate existing educational inequities or create new ones have been met with discussions of how to mitigate such challenges. Possibilities include explicit instruction of skills that will help students increase the pace and enhance the mastery of their learning, address potential disparities in access to learning content and experiences, and ensure appropriate student pacing (Achieve 2014). This final section discusses possible mitigations, continuing concerns, and the need for ongoing monitoring and research about these important issues. First, we address in more detail the mitigations, grouped by those targeted at differences in learner skills, digital access issues, and access to learning content and experiences. For the most part, these mitigations are aimed at reducing or eliminating the factors that create inequities in learning outcomes; however, some of them may be used remedially, to reduce the consequences of inequitable learning outcomes.

Mitigations to Reduce Differences in Learner Strategies and Academic Perseverance

One potential mitigation to address differences in metacognitive strategies and academic perseverance among different groups of learners would be to provide support for building the critical strategies and skills across all groups. Indeed, some competency-based programs even include learning objectives focused on these areas, because of their clear importance to student success.

There is ample evidence that metacognitive skills for complex learning can be taught (Donovan, Bransford, & Pellegrino 1999). More specifically, studies report significant improvements by prompting students to provide "self-explanations" while reviewing textual material and worked examples (Chi et al. 1994; Bielaczyc, Pirolli, & Brown 1995; Crippen & Earl 2007; Rittle-Johnson 2006).

A similar mitigation could be used to offset disparities in student self-regulation and perseverance. A meta-analysis of self-regulation training found that such interventions produced a large effect on academic performance (Dignath, Buettner, & Langfeldt 2008). Diagnosing the need for such skill and regulation development and explicitly providing tutorial support for that development could help to close the gap in groups of learners. We also acknowledge that it is challenging to measure many of these learning strategies and skills (Soland, Hamilton, & Stecher 2013).

Another mitigation to potentially assist students with managing their learning, as well as to provide them with a more personalized learning experience (and hence increasing their engagement and motivation), is explicit, individualized support during learning experiences. The promise of such customized supports is central to current arguments for competency-based models, where students work independently or in small groups and teachers have the time to pull out individuals or small groups and provide short tutorials. There is arguably no better support to a learner, especially to a struggling learner, than the support that can be provided by teachers who have a positive relationship with the student, are familiar with their individual learning skills, and have a rich assortment of cognitive tutoring skills, emotional and motivational support methods, and learning contexts and examples. Acquiring the skills to be an effective individual tutor or small-group learning facilitator will potentially require more emphasis in these areas by teacher education programs and in-service professional development.

Diagnostic expertise to help support formative assessment of student learning is also critically important to the

success of competency education (Clark 2012; Athanases & Achinstein 2003). Automated tracking and analyses of rich data generated by digital learning activities can be available to students and their teachers. Such computer-generated information could provide teachers and learners with options regarding upcoming learning goals and personally tailored learning experiences to reach those goals. Such systems could not only recommend learning and assessment options directly to the learner, but they could also potentially provide recommendations to teachers/instructors regarding groupings of learners with similar interests for project-based work or other collaborative activities. However, if such formative assessment tools are limited to high-income learners, then these "rich" would get "richer" (Dede & Richards 2012).

Mitigations to Reduce Differences in Digital Access and Use

Inequities across schools in access to Internet bandwidth and technology platforms continue to raise alarms about the effects of a digital divide (Consortium for School Networking 2013; State Educational Technology Directors Association 2008). Competency education could mitigate such inequities if access is closely monitored by researchers and policymakers and efforts are made, across districts and states, to ensure that schools have minimum levels of access that are defined and funded. Teachers must be provided appropriate levels of professional development and access to communities of practice to support adapting their practices to competency education. They should also be supported with tools and techniques to provide students with learning activities that require the use of learning resources (including use of digital media) for supporting higher-order thinking skills.

As part of our study of competency-based schools for the Gates Foundation, we observed the way one particular school is mitigating technological inequities. Math teachers had "flipped" their classrooms to increase personalization of learning, by creating and posting online videos of their lessons for students to view during school and non-school hours. Students could watch and take notes on their teachers' video-based lessons or do the same using comparable lessons provided by Khan Academy. QR codes were provided for both resources for each lesson. For students who could not or did not want to bring smartphones, personal laptops, or tablets to school, the district and teachers found a solution: The district had received a grant to compensate teachers for creating video-based lessons by providing the teachers small, hand-held devices (iPods) for classroom video-viewing use by students. Teachers handed out iPods when a student needed to study a lesson, or when the teacher felt a specific "refresher" video-based lesson would be helpful to a student. The devices were collected at the end of each period and redistributed again as needed. In order to avoid stigmatizing students who could not afford personal computers/tablets/smartphones, these devices were available for use by all students.

Free and low-cost plans for Internet access are important for mitigating the digital divide between high- and low-income homes. Even as there is evidence of bandwidth and device gaps closing among younger Americans, efforts continue to provide high-bandwidth access and devices into the homes of people in lower-income communities. Competency education programs should find nonprofit organizations that partner with commercial cable companies and hardware providers to offer affordable Internet access and devices to eligible customers. For example, EveryoneOn.org has a Connect2Compete program specifically aimed at families with students in K-12 education.

We acknowledge there are social policy approaches to these issues that could provide more permanent solutions. However, these are beyond the scope of this paper.

» There is arguably no better support to a learner, especially to a struggling learner, than the support that can be provided by teachers who have a positive relationship with the student, are familiar with their individual learning skills, and have a rich assortment of cognitive tutoring skills, emotional and motivational support methods, and learning contexts and examples.

Mitigations to Reduce Differences in Access to Learning Content and Learning Experiences

We first acknowledge the important general differences in school funding, teacher talent, rigorous coursework, and infrastructure between schools in high- and low-income neighborhoods, the effects these have on learning outcomes, and the importance of addressing these systemic inequities. Similar inequities and effects on learning outcomes could emerge as the markets for web-based learning experiences and assessments evolve. Policymakers could seek to subsidize the development of high-quality learning content for free or low-cost distribution. There is also the possibility of increasing access to private instruction (human and automated) and non-formal/informal learning experiences outside of school hours via subsidies for underserved populations and grant programs.

But these mitigations address only the financial costs of access. There is also the need to provide more information and to communicate effectively with parents regarding the importance of access to learning content and experiences, especially during the summer. For low-income families, there can be special attention to sharing opportunities that are free or low-cost offerings. However, these mitigations need to be addressed in the broader context of possible environmental barriers to accessing learning content and experiences: there might be increased needs in low-income families for older children to work or provide child care after school or during summers. The viability of all the mitigations we have discussed needs to be assessed within the larger social challenges to equity.

Table 8 provides a summary of potential areas of concern for equity in competency education systems and possible mitigations.

Table 8. Potential Learning Inequities in Competency Education and Possible Mitigations

Topic	Competency Education Implications
Metacognitive learning strategies	› Via individual tutorials, teachers/tutors seek to diagnose gaps in individuals' metacognitive learning strategies and explicitly teach such skills, within the context of the material the student is learning. › Students in collaborative, heterogeneous, small-group settings help peers by providing examples of such skills, and prompt fellow learners to apply these skills. » *Example:* Teachers/tutors teach "self-explanation" skills to develop complex problem-solving skills based on worked-out examples in textbooks during group problem-solving sessions.
Self-regulation and perseverance	› Teachers explicitly teach self-regulation skills in the context in which the skills are applied: emphasize "habits of mind" early in school experience and reinforce throughout K-12 experiences. › Schools and districts stress to teachers, parents, and students the development of Dweck's "growth mindset" (1999) to encourage perseverance. » *Example:* Schools and districts implement curricula that include elements that teach learners skills like "Managing impulsivity: take your time! Thinking before acting: remaining calm, thoughtful and deliberative." › Teachers, schools, and districts include explicit efforts to counter "stereotype threat" throughout education (Tomasetto & Appoloni 2013).
Technological access and use in schools	› States and districts ensure equitable distribution of bandwidth and platforms across schools. › Teacher education programs, states, and districts support teachers/instructors in shifting to "facilitator" role by: » Adapting initial teacher education » Providing professional development and classroom release time to observe and model new skills that include individual and small group instruction and diagnostic/prescriptive methods › Districts closely monitor distribution of competency education-related teaching expertise across schools.

Table 8. Potential Learning Inequities in Competency Education and Possible Mitigations (continued)

Topic	Competency Education Implications
Technological access and use in homes	› Federal and state education leaders support programs that provide low-cost access to bandwidth and platforms in low-income neighborhoods, and help to communicate these via public outreach. › Districts provide workshops and written materials to help guide parents and students on effective monitoring and management techniques/tools for use of web-based resources. › Districts and teachers reform homework practices and expectations that exacerbate differences in families' capacities to support their learners' ability to complete work.
Technological use by individuals	› Districts and teachers provide learners with early and continued access to technologies and experiences that enable use of higher-level cognitive skills. › States, counties, districts, for-profits, and nonprofits make available affordable, high-quality afterschool programs and clubs, as well as summer learning opportunities.
Access to learning content and learning experiences	› States, counties, districts, for-profits, and nonprofits stress to parents the importance of access to learning content and experiences, especially during the summer. › Districts and schools actively communicate opportunities to parents, especially free or low-cost offerings in low-income areas. › Nonprofits and for-profits subsidize access to learning experiences for underserved populations.

THE WAY AHEAD

Many in the competency education community believe that, over time, the approach will decrease existing achievement gaps by closely following student progress, supporting personalization of learning to increase engagement, and helping teachers provide rapid, targeted support to help keep students engaged and progressing. However, there are also those who are concerned that competency education systems may differentially affect higher-income students versus lower-income students, giving rise to new or unexpected gaps. Though not limited to competency-based approaches, there is particular need to consider these challenges in light of competency education's core enabling elements, such as access to digital resources and out-of-school learning experiences.

This paper has established that concerns about inequitable learning outcomes for lower-income students in a competency education setting are supported by research on several factors affecting academic performance and achievement. These factors include both individual characteristics, such as metacognitive strategies, self-regulated learning, and academic perseverance, as well as contextual or environmental factors such as access to and use of digital technologies in schools and homes. For at least some lower-income students, without mitigations, a poorly implemented competency education environment may increase the effects of their comparative disadvantages in these areas.

These findings should not be interpreted to imply that competency education is an inappropriate model for schools with substantial lower-income student populations. On the contrary, they emphasize the need for program designers, administrators, teachers, and policymakers to pay concerted attention to ensure that all students receive the customized supports that competency education promises in order to ensure that they will benefit as much as higher-income students.

We have identified potential mitigations and key stakeholders to reduce or eliminate the factors that were identified as potentially creating a comparative disadvantage, summarized in Table 8. It is important for educators considering competency education, or who are engaged in its implementation, to be aware both of the risks to lower-income students and of effective approaches to mitigating those risks. The sooner that the risks can be assessed, the sooner the mitigations can be put in place: We, as a community, should seek to get out in front of possible inequities and reduce the chances of negative effects.

» Effectively addressing equity challenges will likely necessitate bringing together expertise on disparate topics, including metacognitive skills; self-regulation; perseverance and motivation; Internet access, usage, and skills issues; and access to differentially effective learning experiences.

When considering both risk factors and mitigations, we have necessarily relied on educational research that looks at core elements often found in competency education but was not focused on competency education specifically. The development of best practices for competency education will require systematic research on competency education effectiveness. A recent study of implementers of competency education around the United States (Steele et al. 2014) has shown mixed results, with some sites showing an "implementation dip" that is not unexpected when implementing innovations (Fullen 2001), and others showing possible evidence of outperforming comparison schools on standardized tests (Steele et al. 2014). However, establishing causal links between competency education and student achievement will require further research.

Data will also specifically be needed on potential differential effects on various groups, so that implementers and practitioners can track and respond to early signals of inequity. Given the enabling elements required for students to succeed in a competency education environment, effectively addressing equity challenges will likely necessitate bringing together expertise on disparate topics, including metacognitive skills; self-regulation; perseverance and motivation; Internet access, usage, and skills issues; and access to differentially effective learning experiences.

Finally, as efforts to develop, implement, and understand the impact of competency education grow, it may be an opportune time to convene interested stakeholders—within communities and more broadly—to raise awareness about equity concerns. Implementers, state and federal policymakers, foundations and public funders, researchers, and software developers should come together to address these challenges. These stakeholders can pursue a robust research agenda and a commitment to ensure that competency education upholds its potential to help all students learn, achieve, and succeed in high school and beyond.

ENDNOTES

[1] We note that successful implementations of competency education require appropriate changes in teachers' beliefs and expectations regarding both students' capacities and acceptable outcomes. For example, a report by Achieve (2014) noted the risk to competency education being that teachers of traditionally underperforming students may intentionally or unintentionally lower standards. The important role of teacher expectations (Rist 2000) and how they could affect learners in competency education systems is outside the scope of this paper, which focuses on student learning skills, digital access and use, and rich learning experiences.

[2] Many states are moving toward changes in rules and requirements that support elements of competency education. For example, 40 states now allow districts to define credit more flexibly than the "seat time" standard. In 2008, New Hampshire eliminated seat time or the Carnegie Unit from education regulation regulations, instead awarding credit for demonstrated mastery of content. Maine is also a leader in experimentation and change. For a recent summary, see the "State Policies on Seat Time and Course Credits" box in Le, Wolfe, and Steinberg (2014).

[3] Income disparities are not the only factor that could lead to inequity in competency-based systems. Other frequently cited concerns include limited English language proficiency and disabilities.

[4] The American Psychological Association's fact sheet on education and socioeconomic status includes: "Socioeconomic status (SES) is often measured as a combination of education, income, and occupation. It is commonly conceptualized as the social standing or class of an individual or group. When viewed through a social class lens, privilege, power, and control are emphasized. Furthermore, an examination of SES as a gradient or continuous variable reveals inequities in access to and distribution of resources. SES is relevant to all realms of behavioral and social science, including research, practice, education, and advocacy" (APA 2014).

[5] The Common Core State Standards currently cover K-12 Mathematics and English Language Arts, and the Next Generation Science Standards were released in 2013. A district implementing competency education has developed structured series of standards, or "learning targets" in mathematics, literacy, science, social studies, technology, visual arts, performing arts, physical education, world language, and personal/social skills. See the Adams 50 Wiki: http://wiki.adams50.org/mediawiki/index.php/SBS:Physical_Education_v3

[6] Le, Wolfe, and Steinberg (2014) view personalized competency education as including personalization of some or all of six elements: competencies, assessment, time, agency, technology, and culture.

[6] See the CompetencyWorks wiki page "Examples of Competency-Based Schools and Districts" for case studies, videos, school models and more additional links: http://competencyworks.pbworks.com/w/page/67552887/Examples%20of%20Competency-based%20Schools%20and%20Districts

[7] Questions that made up the structured interviews included definitions of competency education, potential benefits, barriers to implementation, and a final question regarding possible equity concerns.

[8] The way these characteristics of learners are categorized in this paper is informed by the framework developed by Farrington et al. (2012) from the University of Chicago Consortium for Chicago School Research.

[9] For a more thorough summary of the research on the general effectiveness of each of these areas, see Farrington et al. (2012).

[10] There are important cultural elements that affect perceptions of intelligence in educational settings and these perceptions on the parts of teachers and administrators may affect student achievement (Duckworth 2006; Dweck 2010).

[11] Merriam, Caffarella, and Baumgartner (2007) define the term "formal" education as "highly institutionalized, bureaucratic, curriculum driven, and formally recognized with grades, diplomas, or certificates," and define "non-formal" education as "used most often to describe organized learning outside of the formal education system."

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