



# Aligning Education Policy with the Science of Learning and Development

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WRITTEN BY:  
Natalie Truong



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OCTOBER 2019

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Natalie Truong

PRODUCED BY:

iNACOL

## Acknowledgments

This report draws upon the expertise and collaboration of many individuals. A special thank you to participants of the Technical Advisory Group on *Aligning Education Policy with the Science of Learning and Development*. We deeply appreciate the knowledge and committed leadership from the following individuals:

Laureen Avery

Courtney Belolan

Pamela Cantor

Cyrus Driver

Jamie Fasteau

Helayne Jones

Richard Lerner

Eliot Levine

Susan Patrick

Jennifer Poon

Tony Monfiletto

Natalie Slocum

Eric Toshalis

Maria Worthen

Derek Wenmoth

Bob Wise

We want to take this opportunity to appreciate the generosity and leadership of our funders. The support and partnership of the Barr Foundation, the Bush Foundation, the Carnegie Corporation of New York, and the Chan Zuckerberg Initiative have been invaluable. The findings and conclusions contained within are those of the author and do not necessarily reflect the positions or policies of our funders.



## About iNACOL

The mission of iNACOL is to drive the transformation of education systems and accelerate the advancement of breakthrough policies and practices to ensure high-quality learning for all.



Please refer to this paper as Truong, N. (2019). *Aligning education policy with the science of learning and development*. Vienna, VA: iNACOL.

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# Definitions

In this paper we use the following definitions:

**Competency-based education:** The term “competency-based education” refers to a systems model in which teaching and learning are designed to ensure students become proficient by advancing on demonstrated mastery. Schools are organized to provide timely and differentiated support to ensure equity. A competency-based structure enables personalized learning to provide flexibility and supports to ensure mastery of the highest standards possible. With clear and calibrated understanding of proficiency, learning can be tailored to each student’s strengths, needs, and interests, and it enables student voice and choice in what, how, when, and where they learn.<sup>1</sup>

In 2011, 100 innovators in competency-based education came together for the first time. At that meeting, participants fine-tuned a working definition of high-quality competency-based education:

- Students advance upon demonstrated mastery.<sup>2</sup>
- Competencies include explicit, measurable, transferable learning objectives that empower students.
- Assessment is a meaningful and a positive learning experience for students.
- Students receive timely, differentiated support based on their individual learning needs.
- Learning outcomes emphasize competencies that include application and creation of knowledge, along with the development of important skills and dispositions.

**Personalized learning** is tailoring learning for each student’s strengths, needs, and interests—including enabling student voice and choice in what, how, when and where they learn—to provide flexibility and supports to ensure mastery of the highest standards possible. Personalized learning informs the pedagogical principles embraced by districts, schools, and teachers. This term is used to describe an approach to teaching and learning, not the use of technology. Online learning or adaptive software may be used within a personalized learning approach. In those cases, the term online learning would be used.

**Learning sciences:** An interdisciplinary field that works to further scientific, humanistic, and critical understanding of learning, as well as to engage in the design and implementation of learning innovations and the improvement of instructional methodologies. Research in the learning sciences traditionally focuses on brain science, cognitive-psychological, social-psychological, cultural-psychological, and critical theoretical foundations of human learning, as well as on the design of learning environments.<sup>3</sup>

Put another way, the learning sciences can be defined as the study of how people learn and how different kinds of environments, circumstances, mindsets, and approaches impact learning experiences."<sup>4</sup>

Throughout this paper, we will refer to the learning sciences in three interrelated areas: the sociocultural context in which learning occurs; the cognitive, which will refer to internal psychological and neurological factors; and the operational, or the activities, pedagogies, and assessments we use to inspire and measure learning.

**Whole child:** Educational psychologists have proposed that holistic education is aimed at helping students be the most that they can be, or what Abraham Maslow referred to as "self-actualization."<sup>4</sup> Public education with a holistic perspective is concerned with the development of every person's intellectual, emotional, social, critical, multicultural, ethical, and creative potentials. It seeks to engage students in the teaching/learning process and encourages personal and collective responsibility on the part of professionals charged with students' development.<sup>6</sup>

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# Introduction

A strong public education system is essential for democracy and civil society to thrive. It is time to build a system on the core principle that all students can succeed and be ready for the next steps in their learning, the workforce, citizenship, as well as for lifelong health and prosperity.

The education system is a major contributor to each student's preparedness to participate and contribute to society. It is an important factor in every student's well-being, as well as their economic prosperity and growth. Successful long-term outcomes include every child achieving educational success with the skills and knowledge needed for life. We intend to provide advice and analysis for policymakers so that they can improve decision-making and supports to dramatically raise achievement for each and every student. Achieving these important 21st-century learning outcomes for all students requires strengthening research-based policy and practices.

With these goals end in mind, this report aims to summarize the learning sciences and evaluate the alignment of research-based best practices with K-12 education policy across the United States.

We hope to answer the question: To what extent does education policy support and align with what research says about student learning and development? Although there are policies that support the findings of the learning sciences, this alignment is the exception and not the norm.

There is an opportunity to transform education systems with what we now know about how students learn. We aim to provide policymakers, K-12 education policy organizations, and funders with a clearer picture of how policy can best support and align with the learning sciences.<sup>7</sup>

We conducted an analysis of research on the learning sciences to compare and contrast with existing federal and state education policy. From this, we offer recommendations to better support K-12 education models designed for how students learn best. We hope to help readers deepen their understanding of the learning sciences research and knowledge of policy barriers that inhibit educators from practicing within the best conditions for student learning and development.

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## Background

### WHAT ARE THE LEARNING SCIENCES?

The terms "science of learning," "the science of learning and development (SoLD)," and the "learning sciences" refer to a multidisciplinary field of research that incorporates child neuroscience, psychology, sociology, behavioral development, and cognitive learning. The learning sciences provide insights into how

students learn, grow, and develop into whole individuals. This valuable knowledge can drive educators, education leaders, and policymakers to incorporate best practices and research-based evidence for designing schools and instruction to create the optimal conditions for student learning.

There are many funds of knowledge and disciplines to consider related to the science of learning,<sup>8</sup> but for the purposes of this report, we will focus on three interrelated categories of learning sciences. The first is the socio-cultural context in which learning occurs; the second is the cognitive or the internal psychological and neurological factors; and third, the operational, meaning the activities, pedagogies, and assessments we use to inspire and measure learning.<sup>9</sup>

Research from the past few decades is shedding light on how students learn and develop, providing teachers, researchers, and policymakers with more information than ever before. With advancements in neuroscience, psychology, brain science, and other disciplines, there is more evidence of how dynamic learning is.

A focus on educating the whole child is necessary to maximize learning opportunities to ensure every student has mastered the knowledge and skills they will need to thrive and succeed. We believe the learning sciences research to be a key driver of the design of a transformed K-12 education system, providing deep, personalized student-learning experiences to develop and support the whole child. This paper is about moving the research to wide-scale implementation; to do so will require aligned, supportive policy frameworks.

**Learning Sciences Definition:**

*The study of how people learn, and how different kinds of environments, circumstances, mindsets, and approaches impact learning experiences.*

## **DOES EDUCATION POLICY SUPPORT AND ALIGN WITH HOW STUDENTS LEARN BEST?**

Unfortunately, the traditional K-12 education policy environment is often predicated on outdated models of teaching and learning that were designed for the industrial age. The factory model, one-size-fits-all education system design is built for efficient sorting of students, reduces the student experience across K-12 education down to a GPA at graduation and focuses on content by course subject.

According to [The National Research Council of the National Academies of Sciences, Engineering and Medicine](#), students must gain critical thinking and problem-solving skills, interpersonal skills, and self-directional skills.<sup>10</sup> Actively learning how to learn, persist, problem-solve, and take on creative approaches to ownership of their learning is central to contemporary pedagogical models.<sup>11</sup> The learning environment and structures of schooling today have not changed much in 50 years. The old education model does not support what we know in the learning sciences from motivation theory, brain research, or whole child development.

In the following section, we provide a summary of the literature on the science of learning and development, providing insight into how students learn and grow.

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# Literature Review of the Science of Learning and Development

The resources listed in this literature review incorporate a range of perspectives on student learning and development. They represent a sample of the findings in the field rather than an exhaustive list. Some of the reports included are also in and of themselves reviews of the literature on the learning sciences. From this, we were able to look for meta-analyses to identify areas of consensus, as well as rely on individual studies that collectively make up this research base for the learning sciences.

This section also provides a cross-field analysis between the trends from the literature review of where the learning and development sciences explain the social, emotional, and cognitive domains intertwined in the learning process and how the K-12 education system can better support student learning and development.

The following are nine valuable resources from the literature on the learning sciences.

## RESOURCE 1

### ***Considerations for Equity in the Science of Learning and Development***

In *Looking at SoLD through an Equity Lens: Will the Science of Learning and Development Be Used to Advance Critical Pedagogy or Will It Be Used to Maintain Inequity by Design?* Zaretta Hammond (2019) argues that the application of the learning sciences research won't solve education problems if it isn't approached from the perspective of improving systemic educational equity.<sup>12</sup> Hammond asserts that equity needs to be at the forefront of education systems redesign. She posits: "How will we understand and apply the science of learning and development within the current socio-political context of education systems that are still inherently inequitable?" Hammond states that the "science of learning" in history has been used to create a more efficient process of inequity and examines the ways in which schooling in the United States has a history driven by the use of systematic methods to ensure racialized outcomes. This has been referred to as the "pedagogy of poverty."<sup>13</sup>

Hammond contends that we cannot effectively talk about the science of learning in "color-blind" terms and offers three ways to approach the science of learning in designing for equity.

- » Design supportive environmental conditions. Environments must be "intellectually safe" for students of color. One recommendation would be to provide training for educators in micro-aggressions toward students of color.
- » Provide support for the development of social, emotional, and cognitive skills; habits; and mindsets. There is a need to ensure that social-emotional learning is not being used to "check" student emotions, especially for diverse students who express and manage emotions that are not congruent with the dominant culture.
- » Provide "productive instructional strategies" that can help students of color engage in productive struggle for learning and expressing themselves.<sup>14</sup>

## RESOURCE 2

### ***Principles of How Students Learn in OECD's [The Nature of Learning: Using Research to Inspire Practice](#)***

In 2010, the Organisation for Economic Co-operation and Development (OECD) Innovative Learning Environments project published [The Nature of Learning: Using Research to Inspire Practice](#). This resource provides a summary of research on how students learn, as well as recommendations for embedding research into policy and practice. Written by leading education researchers and practitioners from across OECD countries, *The Nature of Learning* is a compilation of global best practices.

One of the critical tenets that emerged from *The Nature of Learning* is that a learner has to actively engage in constructing new knowledge and skills. This aligns with the psychologist Lev Vygotsky's [theory](#) of active student learning and engagement. Michael Schneider and Elsbeth Stern (2010) highlight the cognitive perspective on learning and present 10 cornerstone findings. Schneider and Stern assert that the current cognitive perspective on learning is based on the assumption that knowledge acquisition lies at the heart of learning.<sup>15</sup> For example, once a child acquires new information in a particular environment, they will need to be able to use that knowledge in completely different situations later in life. This is only possible if they have understood it correctly and stored it in a well-organized manner in their long-term memory. However, a paradigm shift in modern-day cognitive science recognizes that the quality of knowledge is at least as important as the quantity because knowledge is multi-faceted. The way knowledge is structured and organized is important in helping learners connect and construct concepts. Jane Gllbert's work in *Catching the Knowledge Wave? The Knowledge Society and the Future of Education* describes the challenge of moving from knowledge acquisition in students (the noun) to the processes for developing and building knowledge (the verb).<sup>16</sup>

Schneider and Stern developed 10 points to highlight how learners can build up well-organized knowledge structures:<sup>17</sup>

- 1.** *Learning is an activity carried out by the learner.* Learners have to create new knowledge structures by themselves; consequently, teachers need not only good pedagogical knowledge about teaching methods, good content knowledge about the topics they teach, but they also need pedagogical content knowledge which is an awareness of how students construct content knowledge.
- 2.** *Optimal learning takes prior knowledge into account.* What students know substantially influences their subsequent learning process, and teachers can only help students when they know the students' prior knowledge during the teaching.
- 3.** *Learning requires the integration of knowledge structures.* Teaching and learning should help students make sense of and connect several different pieces of knowledge the student may hold.
- 4.** *Optimally, learning balances the acquisition of concepts, skills, and meta-cognitive competence.* An important aspect of integrating students' knowledge structures is helping them link their concepts and their procedures.
- 5.** *Learning optimally builds upon complex knowledge structures by organizing more basic pieces of knowledge in a hierarchical way.* Students learn connections and problem-solving through structuring

and building on knowledge. However, there is no one structure of change for all people. Learning and changing knowledge is part of a constructive web.

6. *Optimally, learning can utilize structures in the external world for organizing knowledge structures in the mind.* Educators can provide optimal learning opportunities to help students organize information in their minds by preparing well-structured learning environments. For example, conditions can be designed to support positive developmental relationships, such as self-regulation and executive functioning skills, growth mindset, and agency.
7. *Learning is constrained by capacity limitations of the human information-processing architecture.* Students have working memory where information is actively processed and long-term memory where information is stored. The former has limited capacity and information stored in working memory is quickly lost when it is not updated regularly. The more meaningful, more important, more frequently recurring the information, the more likely it is to be transferred from working memory to long-term memory. Teachers can make information more meaningful and more important to students by linking it to their prior knowledge and by using appealing examples that demonstrate the usefulness for solving real-life problems.<sup>18</sup>
8. *Learning results from a dynamic interplay of emotion, motivation, and cognition.* Motivation and emotion are important determinants of thinking and learning. Students' learning goals and goals in life, their thoughts about their own competence, and their attributions of academic success or failure on various potential causes and their interests and hobbies all contribute to the complex interplay of cognition and motivation.
9. *Optimal learning builds up transferable knowledge structures.* The more connections a learner sees between the educational world of learning environments and the outside world through real-life problem-solving, the easier transferring knowledge will be.
10. *Learning requires time and effort.* It is time and effort over long periods of time, invested in practicing problem-solving and extending one's knowledge base, that are the most important factors influencing the success of learning.

### RESOURCE 3

#### ***Learning Development for the Whole Child from the Learning Policy Institute and American Institutes for Research***

A 2018 summary report from the Learning Policy Institute and the American Institutes for Research, [Implications for Educational Practice of the Science of Learning and Development](#), breaks down how interacting factors, such as families, relationships, and curriculum influence children's learning and development.<sup>19</sup> The report suggests that schools address the whole child and personalize learning in ways that take these factors into account to support each student's success and achieve greater equity. The report discusses three areas to support teaching and learning:<sup>20</sup>

1. *Positive adult relationships are foundational to healthy learning and development.* The report highlights the science behind creating a safe, healthy learning environment for students in order for them to learn and take risks.

2. *Curriculum and instruction support academic capacity, motivation, and metacognition.* Students actively map incoming information into their existing knowledge to create mental models and to proactively shape their own learning.
3. *Education should support the development of social, emotional, and academic skill; mindsets; and habits.* The report emphasizes that whole-child development requires cognitive, social and emotional processes and suggested that classrooms be organized to enable collaboration.

Among the many implications and recommendations from the report are suggestions that educators work within students' zone of proximal development, educators build on students' prior knowledge, and teaching should help develop students' metacognitive thinking, agency, and self-efficacy.<sup>21</sup> Additionally, there is a need to reach beyond the classroom to provide both academic and social support, including personalized supports that respond to students' needs and address the effects of adversity.

## RESOURCE 4

### *Implications of the Learning Sciences on Educator Practice in Deans for Impact's The Science of Learning*

In 2015, Deans for Impact created a practice guide, [The Science of Learning](#), on best practices for instruction based on the learning sciences. Some of the science of learning highlighted in the guide include the following research findings:

1. *Students learn through constructing new information with their prior knowledge.*<sup>22</sup> According to the guide, students must transfer information from working memory to long-term memory. The guide recommends that educators use a variety of instructional tools to help students access and apply their prior knowledge and ensure through carefully paced explanation and modeling that students are not overwhelmed.
2. *Cognitive development does not progress through a fixed sequence of age-related stages.* The guide suggests that educators need to be able to gauge where students are in their learning and states that education systems can detach age from performance-level expectations. Deans for Impact state that: "Content should not be kept from students because it is "developmentally inappropriate." The term implies there is a biologically inevitable course of development, and that this course is predictable by age. To answer the question "is the student ready?" it's best to consider "has the student mastered the prerequisites?"<sup>24</sup>

One criticism of this conclusion is that the concept of "developmentally inappropriate" or not is understood as an age-grade phenomenon. This conception reflects exclusive reference to development that is represented by averages. Developmentally inappropriate may also be used as a concept relevant to idiographic facets of change. Here, the idea would be that if content is outside of a specific child's ZPD, then it would not be useful to impose this content on the child. Problems would arise because of the probability that student-teacher coactions would not enable successful scaffolding toward the ZPD.<sup>25</sup>

3. To learn, students must transfer information from working memory (where it is consciously processed) to long-term memory (where it can be stored and later retrieved).<sup>26</sup> [Here, the guide highlights the work of University of Virginia cognitive scientist Daniel Willingham.](#) This research suggests that students have limited working memory capacities that can be overwhelmed by tasks that are too cognitively demanding. Thus, understanding new ideas can be impeded if students are confronted with too much information at once.
4. *Educator and student beliefs about intelligence are important predictors of student behavior in school.* The research finds that students are more motivated if they believe that intelligence and ability can be improved through hard work. This concept is referred to as growth mindset.<sup>27</sup> Educators play a key role in encouraging and motivating students to help them develop this mindset.

The paper recommends that educators become familiar with instructional strategies at multiple performance levels, and that they should be able to recognize common misconceptions of cognitive science that relate to teaching and learning.

## RESOURCE 5

### ***Optimizing Student Motivation and Engagement in The Brain Science of Motivation in Jobs for the Future's Motivation, Engagement and Student Voice***

[Motivation, Engagement, and Student Voice](#) was published by Jobs for the Future in 2012. The paper and related resources can be found on the Students at the Center Hub website, which is a project of KnowledgeWorks. The report summarizes research on student internal and external motivation. The paper asserts that young people are likely to be motivated and engaged in an activity when they feel they have a voice in how it is conducted and can affect how it concludes.<sup>28</sup> Thus, opportunities for choice, control, and collaboration are potent strategies for increasing academic achievement. The authors discuss research that shows that both intelligence and motivation are malleable and that helping students understand that they can acquire new skills and improve existing skills through effort, regardless of past achievement, increases their motivation to try. On the other hand, tracking students based on perceived intelligence or motivation can be harmful and likely to exacerbate poor motivational dispositions and perceived intellectual capacities. Thus, educators should focus on each child's own development and motivations.

## RESOURCE 6

### ***Social Emotional Learning and Academic Development for the Whole Child in the National Commission on Social-Emotional Learning's The Evidence Base for How We Learn***

In 2017, The Aspen Institute's National Commission on Social, Emotional, and Academic Learning brought together researchers from the fields of education, psychology, and child development to produce [The Evidence Base for How We Learn: Supporting Students' Social, Emotional, and Academic Development](#), articulating the scientific consensus regarding how people learn. In the report, the scientists and researchers affirm the interconnectedness of social, emotional, and academic development as central to the learning process.

According to the report, well-implemented programs designed to foster social-emotional learning (SEL)<sup>29</sup> are associated with positive outcomes, ranging from better test scores and higher graduation rates to improved social behavior.<sup>30</sup> The report discusses how social-emotional skills and competencies<sup>31</sup> are intertwined with academic development to help students toward success:

- » Classroom instruction and academic activities that connect rigorous cognitive challenges with social interaction or that spark students' emotions result in deeper, longer-term learning.<sup>32</sup>

A key understanding of social-emotional learning and academic development from the report is that these skills and competencies are malleable over long periods of a child's development. It follows then that educators, schools, and the wider community including parents and peers, have an important role in helping to foster healthy dispositions and mindsets throughout children's growth and learning. According to the report, children who develop positive relationships with teachers are more likely to "grapple with challenging material and persist at difficult learning tasks."<sup>33</sup> The report contends that schools can have a significant influence in shaping student growth in social, emotional, and cognitive competencies, to foster academic excellence, collaboration, communication, civic engagement, and other skills and dispositions needed for success in the 21st century.

## RESOURCE 7

### ***What the Learning Says about Social-Emotional Learning, Academic Development, and Student-Centered Learning Approaches in the National Commission on Social, Emotional and Academic Development's From a Nation at Risk to a Nation at Hope.***

The National Commission on Social, Emotional, and Academic Development also published, [\*From a Nation at Risk to a Nation at Hope: Recommendations from the National Commission on Social, Emotional, & Academic Development\*](#), with a focus on educating the whole child in safe, supportive and flexible learning environments. The authors conclude from teacher surveys, research on the effects of social-emotional learning, and convening experts, such as the Council of Distinguished Scientists, that educating the whole student is necessary as social-emotional learning and academic learning are inextricably linked to learning in every moment. The report states, "supporting students' social, emotional, and cognitive development relates positively to the traditional measures we care about: attendance, grades, test scores, graduation rates, success in college and careers, more engaged citizenship and better overall well-being."<sup>34</sup> The Commission recommends creating student-centered, developmentally appropriate, personalized learning environments that are aligned across the K-12 education system and reflect the interconnection of the social, emotional, and academic dimensions of learning.

## RESOURCE 8

### ***Individuality, Adversity and Social Context in Student Learning***

In the 2018 journal article, *Malleability, Plasticity, and Individuality: How Children Learn and Develop in Context*, the authors present findings on how humans develop, synthesizing research from multiple fields, including brain science; human variability and relationships; the science of learning; and the dynamics

of stress, adversity, and resilience, among other disciplines. The article also examines how cognitive development and social and cultural contexts influence student development and learning.

The authors discuss the integration of multiple disciplines of science on human learning and development in a “development systems theory” (DST). DST can be used to “explain patterns of both stability and variability in children’s performance across diverse contexts.”<sup>35</sup> According to the article, DST provides a useful, flexible framework for seeing how multiple factors act together to shape how children learn, change, and systematically grow across the developmental continuum. Furthermore, the “science of individuality” implies that there is no single “ideal” developmental pathway for every student; instead, there are multiple pathways to healthy development, learning, academic success, and resilience.<sup>36</sup> Ultimately, by shedding light on the diverse developmental pathways through which children acquire increasingly complex skills, develop motivation, identify intentionality as learners, and fully engage and perform, this integrated perspective can help to align instruction and school design with children’s individual capacities and needs. This paves the way toward facilitating developmentally oriented, culturally responsive approaches to domain mastery, the personalization of learning, and whole child development.

Key findings from the research on the science of learning and development include:<sup>37</sup>

- » “Neural plasticity and malleability enable the brain to continually adapt in response to experience, which serves as a ‘stressor’ to brain growth across development.”
- » “Each individual’s development is non-linear; has its own unique pacing and range; features multiple diverse developmental pathways; moves from simplicity to complexity over time; and includes patterns of performance that are both variable and stable.”
- » “Whole child development requires the integration and interconnectivity—both anatomically and functionally—of affective, cognitive, social, and emotional processes. Though these processes—particularly cognition and emotion—have historically been dichotomized, they are inextricably linked, co-organizing and fueling all human thought and behavior.”
- » “Adversity, through the biological process of stress, exerts profound effects on development, behavior, learning, and health.”

In a companion article, *Drivers of Human Development: How Relationships and Context Shape Learning and Development*, the same authors present research synthesizing the knowledge on the role of relationships and environmental contexts in student development. The authors assert that relationships and contexts, along with how children appraise and interpret them, can be risks and assets for healthy learning and development.<sup>38</sup>

According to the National Academies of Sciences, Engineering, and Medicine, “developmentally constitutive relationships with adults, along with supportive environments, are foundational to healthy development.”<sup>39</sup> The development of contexts matter, as the report asserts: a developmentally rich context can provide safe, secure, enriching opportunities and developmental relationships with adults; direct targeting of self-regulation; executive function; and social and behavioral skills, opportunities for practice and reinforcement

of these foundational competencies, and opportunities to take on leadership roles and participate in collaborative and productive peer interactions.

The report synthesizes numerous studies on the relationship of schools, educators and peers on student development and learning. One of the studies found that positive classroom climates support students' social and emotional development and help them be effective learners.<sup>40</sup> The report explains that structural and social features of schools that provide a developmentally rich context can enhance developmental range, buffer the effects of stress and trauma, promote resilience, and accelerate the development and integration of affective, cognitive, social, and emotional processes. In contrast, developmentally unsuitable, insufficiently supportive, and culturally incongruent contexts can exacerbate stress, hinder the reinforcement of foundational competencies, and impel maladaptive behaviors by failing to foster healthy relationships with adults, limiting enrichment and stimulating experiences, and reducing the changes of interacting with peers who are positive influences.

The authors assert that schools can be designed and organized in ways that support students by providing a web of support and fostering developmental relationships for students with their teachers and peers. For example, schools that are culturally responsive and competent help build conditions for learning and support development while reducing cognitive load and minimizing the tensions created by challenging environments.

## RESOURCE 9

### ***The Role of Noncognitive Factors in Shaping Student Learning in Teaching Adolescents to Become Learners***<sup>41</sup>

This resource summarizes the University of Chicago's Consortium on School Research's findings that what they termed as "noncognitive factors" are strongly linked to academic performance, which in turn predicts positive life outcomes. The author finds that noncognitive factors are crucial for children's learning and development at *all* ages and *all* education levels—from early childhood through high school and beyond—and are not fixed traits that students either do or don't have.

These noncognitive, or social-emotional, factors include: perseverance, mindsets, academic behaviors, and social skills and learning strategies.<sup>42</sup> The authors found that the factors are related to students' long-term academic performance. For example, students are more likely to demonstrate perseverance and strong academic behaviors when they have positive mindsets and effective learning strategies. The report suggests that test scores are limited indicators of whether students will be "academically successful;" rather, the way noncognitive skills are developed and used by students to persist, reach mastery, and accomplish their goals is a better indicator of long-term success.<sup>43</sup>

This study is valuable as it shows how student learning and development is malleable and that habits and mindsets can be taught. If we believe that students are more than recipients of information but can learn, grow, and adapt, then improving and individualizing learning strategies can be an effective way to help students achieve.

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# Trends and Analysis of the Literature Review on the Science of Student Learning and Development

By synthesizing the research and resources from the literature review, common trends emerge from the findings on how humans develop and learn. These include how children develop into whole individuals and learners and the optimal ways in which children learn, retain information, and progress in their learning. The following is a list of powerful takeaways across the body of research in the learning sciences:

- » Brain science shows that social, emotional, and academic learning is malleable and extends from childhood through adulthood.
- » Behavior, skills, dispositions, and mindsets are learned concepts and can be explicitly taught (for example, growth mindset).
- » Context, such as environments and relationships, affects and informs development.
- » Students experiencing recurring trauma can have symptoms that deter learning as trauma has been shown to affect student memory and retention of concepts.
- » According to the research led by Pamela Cantor, M.D., of [Turnaround For Children](#), providing students with safe, supportive environments can help offset some of the stress associated with trauma and help students toward healthy development and academic achievement.<sup>44</sup>
- » Student learning is diverse, varied, and does not always happen in a straight and narrow line; instead, students learn “jaggedly” through interconnecting concepts.<sup>45</sup> For example, the traditional model of K-12 education moves each student from one standard or unit to the next regardless of their mastery; however, it’s important to focus on students moving through competencies on demonstrated mastery and learning progressions.
- » We also see individuality as a facet of the science of learning. Students learn and develop along pathways as unique as their neurological make-up, genetic expression, background, and personal experiences.
- » Students are motivated when they are involved in and co-owners of their learning, and when they are learning in their zone of proximal development.
- » Students’ sophisticated cognitive functions and funds of knowledge are activated when they feel like they belong, are supported to succeed, are helped to connect meaningfully to peers and adults, and are exploring topics that matter to them.
- » Connected to memory and motivation, cognitive learning is maximized when students are accessing and building on prior knowledge.<sup>46</sup> This includes both background knowledge and culture as well as previously learned and applied concepts.<sup>47</sup>

All facets of how humans develop and how we learn are interrelated and influence our experiences in learning and in life. In each of the resources from the literature, there exists an intuitive or explicit message that for too

long, the domains of cognitive science and child development have been siloed from the application of policy and practice and have been confined to research and academia. With the increase of findings and consensus from the science of learning and development surfacing in recent years, the implications for how education systems teach and prepare every student with a lens on supporting the whole child are imperative.

## **FOCUSING ON INTEGRATIVE APPROACHES TO BUILD ACADEMIC KNOWLEDGE, SUPPORT YOUTH DEVELOPMENT, AND INCREASE SKILLS**

There is a need for a broader perspective on how students learn and develop into whole individuals and how education systems and educators can best provide a well-rounded and high-quality learning environment that meets the needs of every child.

Student learning is nonlinear, individualized and influenced by the interaction between unique aspects of the child and their family, community, and classroom contexts. As such, schools must be designed to attend to the unique needs of individual children and support them in their development. Educators must know how to differentiate instruction and supports to enable optimal growth in competence, confidence, and motivation.

Furthermore, the link between social-emotional learning and academic development needs to be understood and advocated for by education stakeholders. Although there is evidence of the correlation between explicitly teaching SEL and growth in academic achievement,<sup>48</sup> there is a lack of intentional integration of teaching SEL alongside content. Surveys<sup>49</sup> show that parents, teachers, and other stakeholders intuitively understand the importance in integrating SEL in academics, but policy is still behind on using this research.

Another challenge and reason for the gap between the demands and research of cognitive science and child development is that the learning sciences are not singular. They are comprised of research across a variety of fields including cognition, psychology, and neurological development. These subdomains are rarely integrated and, as such, it can be challenging for education stakeholders to make sense of them as a whole.

To do a better job of integrating the science of child development and cognitive research in the education system, education stakeholders will need to redefine student success with a focus on the learning and development of the whole child.

## **TAKEAWAYS FROM THE LEARNING SCIENCES RESEARCH**

Based on the trends and analysis of the learning sciences, a few key issues arise in how the current educational system, structures, and environments are designed to service students in their learning and development.

We ask: where does the current K-12 education system align to the learning sciences now, where does it fall short, and how can leaders across the system use the learning sciences to drive the design of the K-12 learning experiences?

Because the imperative for alignment is clear, our task is to determine not “if,” but “where” and “how” the research from the literature review demonstrates a need for the current education system to be redesigned based on what the learning sciences tell us is best for children and students.

The following are non-negotiables for what needs to be done to name the important core science principles. The assumptions about children and learning in the past yielded an industrial model of education that focused on efficiency and averaging student learning and achievement. What are the priorities today to move the field forward?

Overall, the learning sciences point to several core issue areas for child learning and development:

- » *Education needs to incorporate learning for the whole child.* Memory, motivation, and social-emotional learning are all connected and influence student cognitive learning. Considerations for how education systems view students as whole individuals with learning and development as interconnected pieces to support, nurture, and lift up students learning are crucial.
- » *Education stakeholders need to understand how student academic learning develops.* Education systems currently focus on a one-size-fits-all approach to schooling and learning. However, the cognitive learning sciences point to how differentiated and individualistic learning is for each student as a developmental process. Education stakeholders who make decisions influencing the pace and progress of when and what students learn need to have an understanding of how student learning develops and progresses.
  - *First, education stakeholders need an understanding that learning is individualized.* Each individual student’s learning is non-linear, has its own unique pacing and range, features multiple diverse developmental pathways, moves from simplicity to complexity over time, and includes patterns of performance.
  - *Next, educators need to “meet students where they are” and “where they are going” in their learning trajectories.* The learning sciences point to the need for students to work within their zone of proximal development.<sup>50</sup>
  - *Then, educators need to support students as they progress in their learning trajectories.* Students perform better when educators frequently check for understanding, using tools such as formative assessments, for students to demonstrate their learning and provide ongoing feedback to fill in gaps, transition students from one learning task to the next, and/or to support students in learning at a deeper level.
- » *There is a need to integrate cognitive and social-emotional learning both in research and practice.* The learning sciences point to the need for schools to pay attention to both the cognitive and social-emotional learning processes and development of students. SEL impacts how students learn and develop. Along with supporting academic capacity and competence, there needs to be explicit instruction and support in motivation and metacognition, and SEL skills and dispositions.

» *Education stakeholders and educators need to provide the conditions for learning that support student success along the developmental continuum:*

- Increase educator capacity to understand and guide students along their developmental pathways and learning trajectories (from one unit to the next and check on student learning throughout).
- Build trusting relationships with students and to have the cultural competencies to provide supportive environments and materials for students with diverse backgrounds.
- Create flexible use of spaces, pace, and time in ways that are conducive to learning. Additionally, school and district designs need to be addressed to support implementation.

The next section dives into the barriers in policy that hold K-12 education back from providing these crucial learning environments as well as the opportunities in policy for implementing best practices based on what we know from the learning sciences.

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## Implications of the Learning Sciences for K-12 Education Policy

### WHERE DOES POLICY ALIGN TO THE LEARNING SCIENCES?

There are some promising trends in federal, national, and state policy to support student learning and development.

The 2015 federal education law, the [Every Student Succeeds Act](#) (ESSA), provided states with more flexibility to advance policies that are centered around the success of the whole child. States have an opportunity to redefine student success to reflect whole child learning and to better align systems of assessments and accountability.

One example of states redefining student success is through the creation of a [Profile of a Graduate](#). Several states have engaged with stakeholders to determine the skills, knowledge, and dispositions students should have upon exiting the K-12 education system.

The learning sciences point to the importance of programs that encourage a positive school climate that fosters learning and growth. ESSA allows states to include indicators of culture and climate in school quality systems, including student and teacher engagement surveys, school discipline and climate measures. Additionally, Title IV of ESSA requires schools to look at data on “conditions for learning” that impact student learning in the areas of safety, engagement, and learning environment.<sup>52</sup>

ESSA is also promising for state policy by allowing states to move away from classifying schools for improvement based on single summative scores. [Multiple measures](#) allow schools and state policymakers to

look beyond narrow definitions of success.<sup>53</sup> ESSA allows states to use multiple measures, including student academic growth, in their data reporting and accountability systems.

At the national level, several states are providing diverse learning opportunities through multiple pathways allowing students to customize their education to meet their unique needs and interests. Diverse learning pathways can engage students in rigorous and relevant academic opportunities that connect to real world experiences. These learning opportunities can expand the ways in which students can meet learning standards, graduation requirements, and other requirements. They can also be personalized based on student interest and foster deeper connection to student learning and student engagement.

## **WHERE IS POLICY AT ODDS WITH THE LEARNING SCIENCES?**

States have the opportunity under ESSA to implement innovative and evidence-based education approaches that can support student success. Unfortunately, there are persistent trends in state policy barriers that are predicated on an outdated model of education and are at odds with the findings from the learning sciences.

These barriers can begin with a narrow definition of student success (in many states, student success goals have been limited to reaching grade-level proficiency in reading and math). Reading and math skills are extremely important, but no longer sufficient. When state accountability systems have a singular focus on reading and math, they can miss out on other factors in student success. Additionally, research evidence from the learning sciences emphasizes the importance of continuous check-ins and formative assessments to gauge student learning. End-of-year summative assessments used in many state education systems only provide a limited scope of student achievement.

Other examples of policy barriers include accountability and instruction systems built around grade-level proficiency and age-based cohorts, line-of-sight rules, seat-time requirements and single summative rating systems (e.g., A-F school grading), limiting the teaching and learning environments conducive to child development. "Line of sight" policies assume lecture is the default form of instruction. The idea that a student has to be in the line of sight of the teacher can limit the students who may learn actively and are motivated and engaged to learn anywhere (such as through community-based learning experiences).

In some states, restrictions based on seat-time limit flexibility in academic learning. Seat-time requirements focus on passing students based on time spent in a course, not mastery. Seat-time requirements award credits based on how long students are in class and not necessarily what students have learned.

Another policy barrier to implementing recommendations from the learning sciences is the systemic model of entering and exiting students based on age-based cohorts. Students enter school in age-based cohorts and advance with their age groups instead of by mastery of learning objectives. Age-based cohorts and instruction are not based on meeting students where they are in their learning. The learning sciences

reinforces teaching students in their zone of proximal development, which includes students' emotional, psychological, and cognitive processes. Age-based cohorts are a remnant of the industrial-age model when separating children by age was thought to be the most efficient way in which to transmit "age-appropriate" bodies of knowledge. This system continues to perpetuate despite growing evidence that age alone tells us very little about what any given child can do or the support they need to develop more fully.

Finally, another policy barrier worth highlighting is the use of single summative rating systems (e.g., 100-point scale, A-F grades, and performance levels) often found in school quality rating systems. Single, summative school ratings used for accountability purposes is a reductive way of measuring school quality.

We need to consider how the structure of test-based accountability, a driving reform of the past 20 years, has created incentives to move in the wrong direction, and that we would do well to decouple accountability from single summative measures.

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## Considerations for Student-Centered Learning

There needs to be a transformation in the K-12 education system to a student-centered learning system<sup>54</sup> where policy and practice are informed by and more aligned to the science of learning.

The findings from the learning sciences support the shift to student-centered learning models, such as competency-based education and personalized learning. Many of the necessary elements of designing environments based on how students learn best are embedded into student-centered learning models. For all students to succeed in K-12 education, they must be provided with multiple ways to demonstrate their knowledge, and educators must continuously monitor student pace and progress and provide interventions to keep students on track to meet their goals. This requires a shift in how we currently design teaching and learning in schools and enable supportive policies for student-centered learning.

### **OUTCOMES: NEW DEFINITIONS OF STUDENT SUCCESS AND A FOCUS ON PUTTING STUDENTS AT THE CENTER OF LEARNING**

In the current education policy environment, graduation requirements, learning outcomes, and learning measures have substantial influence in determining how schools are organized. Outcomes and measures shape how students experience learning through the selection of content, instructional strategies, and assessments. Traditional models tend to emphasize lower levels of Bloom's Taxonomy.<sup>55</sup> They expect students to prove basic recall and comprehension of content knowledge aligned to grade-level standards. Student-centered learning systems, such as competency-based education, emphasize balance between

## WHAT IS COMPETENCY-BASED EDUCATION AND HOW DOES IT DIFFER FROM THE TRADITIONAL SYSTEM OF EDUCATION?

A core element of the future state of education is competency-based education. In 2011, one hundred innovators in competency-based education came together where they fine-tuned a working definition (below in bold) of high-quality, competency-based education with the following five elements.

Competency-based education is a system where:



**Students advance upon demonstrated mastery** — By advancing upon demonstrated mastery rather than on seat time, students are more engaged and motivated and educators can direct their efforts to where students need the most help.



**Competencies include explicit, measurable, transferable learning objectives that empower students** — With clear, transparent learning objectives, students have greater ownership over their education.



**Assessment is meaningful and a positive learning experience for students** — New systems of assessments give students real-time information on their progress and provide the opportunity to show evidence of higher order skills, whenever they are ready, rather than at set points in time during the school year.



**Students receive timely, differentiated supports based on their individual learning needs** — When students struggle with a concept, they receive timely, personalized supports. Often, schools with personalized, competency-based learning environments provide flexible time during the day for students to receive additional instructional support in the area where they need it.



**Learning outcomes emphasize competencies that include application and creation of knowledge, along with the development of important skills and dispositions** — Personalized, competency-based learning models meet each student where they are to build the knowledge, skills and abilities they will need to succeed in postsecondary education, in an ever-changing workplace and in civic life.

broad content knowledge and enduring understandings of key concepts and skills; ability to apply and transfer knowledge and enduring understandings of key concepts and skills; ability to apply and transfer knowledge and skills to meaningful problems and contexts; and skills, dispositions, and habits that contribute to lifelong learning and learner agency.

As educators and leaders embrace this expanded definition of student success, they will find it necessary to make very different decisions about student experiences, instructional strategies, district policies, and the culture of learning. It is helpful to think about the role of outcomes with regard to systems design in two ways: First, outcomes can be used to engage in backward design. When we know what we want to be true for students in their adulthood, we can define graduation expectations, critical learning, and development milestones and find ways to define and assess readiness and progress. Second, outcomes can be used to frame how we think about students' experiences throughout the process of learning. We can use our understanding of student success to inform what students experience at different points in their learning and what supports they need at different stages of their development. Additionally, educators need to experience student-centered learning to be successful in leading in these learning environments.

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## Opportunities for K-12 Education Systems to Shift Toward Student-Centered Learning

Mounting evidence demonstrates that integrating social, emotional, and academic development boosts outcomes in children and youth.

State policymakers, therefore, have a unique opportunity to ensure learning systems are working off of research on how students learn best. New findings from the learning sciences can be translated into more effective practice. There are tremendous opportunities for research and development to push the field even further and to improve outcomes for young people and society at large.

There is also a need to call on educators and leaders in youth-serving organizations across the K-12 education ecosystem to embrace an integrated approach<sup>56</sup> to educating the whole child. There are many opportunities for policymakers at the state, local, and in some cases, federal levels for leadership.

This effort should not be viewed as a new initiative. Rather, it is an opportunity to better align the K-12 education ecosystem so that each and every student can develop into a lifelong learner and engaged citizen through supportive, engaging and challenging experiences both in and out of school. In pursuing this work, state and local leaders should acknowledge the expertise within state education agencies, district offices

and other key state, district, and community partners to help with implementation, staff capacity, reporting, and data collection. And they should consider opportunities to help share knowledge and resources across these groups. It is important to elevate the voices of marginalized communities to ensure efforts and decisions are inclusive of vulnerable populations. State and local agencies along with their community partners may already have significant work underway that can and should be leveraged and amplified.

At the core of these recommendations is a new vision for how state players and their local partners can operate in a more collaborative, coherent fashion to support each community's vision for teaching and learning, informed by best practice. This vision requires moving from:

- » Practices driven by policy compliance to enabling policies that support best practice;
- » Disconnected programs and supports to integrated and aligned strategies that focus on the well-being of the whole child;
- » Deficit frames for accountability<sup>57</sup> to using multiple measures and evidence for continuous improvement; and,
- » A definition of success limited to percentages of students who are grade-level proficient, to a more inclusive definition that reflects the mastery of social, emotional, and academic competencies as well as civic awareness, informed by a broad, collaborative network of partners.

In this way, we can ensure each and every child receives a quality education and comprehensive supports needed to succeed in school, in the evolving workplace, and in community and civic life.

## **CONSIDERATIONS TO ADVANCE AN EQUITY-DRIVEN EDUCATION POLICY AGENDA**

Research from Turnaround for Children shows the effects of trauma on student motivation, memory, and cognition.<sup>58</sup> It's imperative that education stakeholders understand the institutional barriers to holistic learning for underserved students and students affected by trauma and work towards implementing equity strategies so that every student has the support and opportunity necessary to acquire a quality education.

We need to recognize that every student requires and deserves learning environments that treat social, emotional and academic development as interconnected parts of a whole. At the same time, we must recognize that some students growing up with trauma and adverse childhood experiences need additional support to realize their potential. The science of learning and development is rapidly expanding the knowledge base about the interconnected nature of social, emotional, and academic development, with particularly important implications for buffering young people from the effects of stress and nurturing their healthy development in response to adversity.

Integrating social, emotional and academic development in current traditional schooling may not respond well to compliance-driven reform efforts. According to the Council of Distinguished Scientists who unanimously concluded, social and emotional learning drives increases in, among several success factors, high school graduation, entry and completion of college, together with more success in careers.<sup>59</sup> We need to

## STATE STRATEGIES FOR SUPPORTING PATHWAYS TO REALIZE THE LEARNING SCIENCES

States could consider more student-centered pathways by creating innovation zones with priorities to focus on aligning to learning sciences research and providing pathways that expand supports shown to be effective in research.

Some actionable examples of what this might look like would be to create state support for new programs such as youth participatory action research, education and career-tech employment pathways, and social and emotional support initiatives.<sup>60</sup>

First, states could create a new program for “Youth Participatory Action Research” to incent pathways to graduation that include project-based learning and capstone projects, while formalizing the role of youth in research and advocacy. A Youth Participatory Action Research program could be centered on reciprocity with community and youth development with these design elements:

1. Service-learning and internships rooted in local needs;
2. Ethnic studies classes co-designed with community partners; and
3. Community-based projects that are designed to apply learning from school to real-life problems.

Second, education and career-tech employment pathways might provide credit-bearing and paid work-based learning that happens during the school day. States could establish matching funding for students to be paid while interning or in apprenticeships, with partnerships with local employers. Paid work-based learning is essential for students that must work to help support their families.

Third, a state could consider launching new initiatives focused on Social and Emotional Support. State programs might create incentives in state policy to:

1. Support pathways for social workers and community members to become licensed teachers and administrators, especially those who have expertise in youth development and learning sciences.
2. Incentivize co-teaching/curriculum development with social workers and community organizers. Addressing real-life, relevant issues for students and families in their communities is another pathway to learning the knowledge, skills, and dispositions students need.

These ideas challenge the status quo and prior “limited” conceptions of what it means to be served as a young person (such as education strategies only occurring within school building walls). Drawing on the role of community and its local wisdom, including traditions, values, and cultures, new partnerships could provide social and emotional supports, expertise, mentorship, and other resources. All are needed if we intend to deal with the life outcomes for students rather than just narrowly focused educational outcomes. There is a much bigger group of contributors to youth that schools should be designated to engage for the whole child approach. If we are to make the learning sciences impactful in implementation, we need to engage contributors across communities connected to students and families.

*by Tony Monfiletto, Future Focused Education*

design teaching and learning to reflect and model the very skills and attitudes that we want to see embodied in schools and classrooms. Policy can enable the conditions for districts and schools to implement locally crafted approaches that support students' social, emotional, and academic development.

Additionally, we need to consider how support can be used to develop the knowledge and practice of all adults working to support the learning and development of students. This includes supporting the cognitive, social and emotional, and skills, habits, and mindsets of learners.

Moreover on equity, it is crucial to approach this work mindful of the deficit-based lens perspective on challenges students face. A perspective of racial and cultural assets needs to be oriented to focus on how to support and care for young people, especially from non-dominant and non-white cultures.

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## Recommendations to Synchronize K-12 Education Policy with the Science of Learning and Development

Students in every school need an integrated approach to the multiple dimensions of learning and development. The growing science of learning and development tells us that this integrated approach is how young people learn and how education systems can set them up for success. But adopting this approach does not mean learning and school should look the same everywhere. We need to make sure that teaching and learning are designed with an asset-based approach that seeks to unlock the great potential within each young person and affirms the dignity and value of every student's background and culture. Additionally, policy can operationalize the findings from the learning sciences by considering these recommendations and supporting initiatives to increase the connection and application between research and practice. The following are recommendations on rethinking and redesigning policy to support whole child teaching and learning.

***Redefine student success for the whole child.*** Across the K-12 education ecosystem, state and local leaders should share a clear vision for student's comprehensive development. One strategy to begin this work is through redefining student success and how we credential learning.<sup>61</sup> State and local leaders need to articulate a clear vision of what every student should know and be able to do, grounded in evidence that learning has social, emotional, and academic dimensions. Graduate profiles are one example of states driving coherence with new definitions of success. State and local agencies can partner with communities to articulate the essential knowledge, skills, and abilities of a successful high school graduate, inclusive of the social and emotional competencies demonstrated to contribute to academic progress and workforce success as well as prepare students to become productive members of their communities.

**Focus on supporting inclusive and safe learning environments.** When students feel known, valued, and supported by both adults and peers, they are able to take the risks necessary to learn and grow. Such a culture and climate are inclusive of and responsive to the diversity of interests, aptitudes, perspectives, races, ethnicities, abilities, cultures, and identities represented in the classroom. These types of learning environments give students voice, opportunities to be engaged and heard, and agency in their own learning and development. Enabling students to feel respected for their unique identities and perspectives is an essential element in creating safe, affirming, and inclusive classrooms. States and leaders should enable districts and schools to create and continually improve supportive and affirming learning environments that ensure strong relationships, personalized supports for students, and engaging, relevant learning opportunities.

**Create meaningful credentials that certify student mastery of the knowledge and skills necessary for students to succeed and thrive in college, career, and civil society.** Currently, most high school diplomas in the United States are based on transcripts that reflect credit for academic subjects based on meeting minimum seat-time requirements (or Carnegie units) and a passing grade, which may or may not signify mastery of the content. There is wide variability in grading practices and in the knowledge attained in given subjects, which is evidenced by high remediation rates in entry-level college courses. College faculty often cite the underpreparedness of high school graduates for the rigor of college courses. Today, the only thing we can know for sure about a high school graduate in most U.S. school districts is that they have put in the required seat time in the requisite courses. When schools are passing students along and graduating them with major gaps in skills and knowledge, they are doing students a disservice.

How could the high school diploma align to a more comprehensive definition of success and be more transparent about achievement? This is one area where state policymakers and communities can take action. Whether a community conversation or a state conversation, the idea of engaging communities and families in conversations around what is different in the 21st century, and around what students need to know and be able to do, is increasingly important. A more meaningful high school credential would focus on the knowledge, skills, and competencies a student has earned based on evidence of mastery.

**Provide diverse learning opportunities through multiple pathways to allow students to customize their learning pathways according to their unique needs and interests.** Multiple pathways are an important element of personalized learning environments because they create distinct, equally rigorous paths for students to pursue their interests and gain the real-world skills and experiences they need to be successful after high school.

Multiple pathways to graduation, college credit, and career credentials are a powerful way to infuse meaning and relevance into school. They provide an avenue whereby students can select the learning environment and path that best meet their needs. They increase student outcomes and better prepare students for the challenges of higher education and the workplace.

**Meet students where they are.** Meeting students where they are requires that we begin with a commitment to support learning environments where educators know and care about students in profound ways—academically, cognitively, culturally, emotionally, linguistically, physically, and behaviorally. Meeting students where they are in policy and practice allows educators and schools to begin creating learning experiences that are within each student’s zone of proximal development, as discussed previously in this report. In a competency-based education system, educators support students to master learning objectives based on their own learning progressions, unique prior knowledge, and through designing frequent check-ins and formative assessments.

According to the report, [Meeting Students Where They Are](#):

The implications for competency-based models are profound: they underscore the importance of challenging the practice of advancing students based on

- » age-based cohorts and grade-based standards and curriculum;
- » age-based design of, and access to, learning experiences; and
- » age-based benchmarks for performance (such as end-of-year exams, age-based high-stakes tests).

These are artificial constructs designed to serve efficiency and external accountability needs as ends in themselves. As a result, they run at direct cross-purposes to meeting students where they are as students work to master competencies that can be learned at many ages.

Meeting students where they are academically requires assessing, reporting, and communicating the progress of each student, along their learning progressions and in real time, resulting in greater transparency of student learning and rigor in outcomes.

Additionally, to meet students where they are in their social and developmental stages requires ensuring that discipline policies and practices are positive, asset-based, and developmentally appropriate. For example, discipline practices should focus on restorative practices over punitive ones.

**Build educator capacity and professional judgment to support whole-child learning.** State policymakers can enact enabling policies to encourage and support redesigning teacher preparation, learning, and advancement in alignment with 21st-century student learning and workforce needs and ensure that educators have the requisite skills and knowledge to lead in student-centered learning environments.

State policy governs the gateways and pathways in the educator development pipeline and could prioritize educators’ own knowledge base in learning science and child development strategies to build learning environments that support each student’s development. Districts can similarly prioritize these knowledge areas and skills in their recruitment, hiring, promotion and compensation policies and in the ongoing professional learning of educators.

State leaders could redesign the licensure requirements for school leaders and educators, as well as the approval requirements for educator preparation programs, to reflect the knowledge base and competencies required to integrate social, emotional, and academic development. State leaders can engage with stakeholders, such as accreditation agencies and teacher unions, around rethinking teacher preparation and certification system for student-centered learning.

In *Moving Toward Mastery*, Katherine Casey describes how state policymakers can play a pivotal role in creating professional learning systems and policies to support student-centered learning environments. States can be most pivotal in shifting policies and structures that will make teaching a lifelong profession. State leaders can enact policy that enables more balanced and authentic systems of assessments at the local level. State leaders, in cooperation with higher education and districts, set vision, direction, and outcomes that guide the development of new teacher pathways, the redesign of certification and credentialing and the balance of responsibility across levels of the larger system. While higher education leaders must lead the way on redesigning educator preparation, states must be at the table for this process; they help align preparation with state and local needs, as well as learner and educator competencies.<sup>63</sup>

State leaders could use micro-credentials and educator preparation programs to work collaboratively on building comprehensive preparation experiences focused on understanding and modeling integrated social, emotional, and academic development. Micro-credentials are useful to acknowledge educators' demonstrated competencies and certify that educators have mastered specific skills and competencies.<sup>64</sup>

Other strategies include recruiting diverse educators, as well as providing professional learning communities for educators to share best practices in social-emotional learning and personalized learning approaches.

Finally, building educator professional judgment is crucial in student-centered learning environments that move beyond traditional, compliance-based structures. In student-centered learning models, the role of the educator shifts from being the lecturer in front of the classroom to a facilitator, helping to guide student learning and co-creating learning environments with students. Educators must be able to exercise professional judgment and expertise in student learning progressions, assessment literacy and collaboration with peers and students alike.

***Build balanced systems of assessments that better align with student-centered learning.*** Research from the learning sciences has made clear the importance of activating prior knowledge and continuous use of formative assessments. ESSA provides flexibility for states to redesign systems of assessments to better align with student-centered learning. In ESSA, all states may use a variety of assessment types, including formative and performance-based assessments, to begin to develop statewide, balanced systems of assessments. States can also apply to the U.S. Department of Education to participate in the Innovative Assessment Demonstration Authority (ESSA Section 1204), which allows states to pilot next-generation systems of assessments in collaboration with a subset of districts prior to scaling statewide. State

policymakers can encourage the development of balanced systems of assessments that allow for more holistic measurements of student learning outcomes.

Another key component for creating balanced systems of assessments that make a difference for student learning is investing in developing assessment literacy among education leaders and educators. Assessment literacy can be considered as the knowledge and skills associated with designing, selecting, interpreting, and using multiple types of high-quality assessments to improve student learning. Beyond using assessments in their classrooms, educators should be equipped to work with a range of data from large-scale state assessments, interim assessments, local district- or school-wide assessments, and classroom-based assessments.

In addition to building educators' ability to assess student learning, there is an opportunity to build educators' ability to help students co-regulate their own learning. Student self-assessment can be included as part of their development of agency and co-regulated learning.<sup>65</sup> This ties directly into findings from learning science around student engagement and motivation, as well as formative feedback loops that are co-owned with students.

Rethink accountability systems for continuous improvement. States have an opportunity to rethink how accountability systems could be designed to ensure all educators and schools can give students the supports they need to master the knowledge and skills necessary for success and to support whole child development.

ESSA allows states flexibility to modify their ESSA plans to redesign accountability systems for continuous improvement. State leaders can begin to transform state accountability systems to better support student learning, provide greater transparency, and support districts in building the capacity to analyze and continuously improve on their practice.<sup>66</sup>

State policymakers can design next-generation accountability systems to provide transparency on multiple measures aligned with comprehensive student success outcomes. Additionally, states can consider how building reporting tools can provide greater transparency on student learning progressions in real time.

State policymakers can also use [multiple measures](#) of student learning to encourage a focus on the conditions for how children learn best as well as invest in educator professional learning in quality improvement processes. For example, states can begin by examining the inputs, supports, and resources to schools in relation to outcomes and identify actions to take for research-based, continuous improvement efforts.

There is a need for holistic outcomes and learning progressions that measure and communicate student growth over time in building skills and knowledge. From formative measures, policy needs to align, recognize, and begin to describe the development continuum of student growth that is not only academic but includes progress on what OECD describes as "critically important competencies," such as thinking, learning how

to learn, relating to others, managing self, using language, texts, and numbers, as well as participating and contributing.<sup>67</sup>

**Support innovative student-centered learning environments.** Policymakers can support networks of districts and schools working collaboratively to build high-quality learning environments. States can provide policy flexibility to enable student-centered learning environments that support whole-child learning and development based on the learning sciences.

As highlighted in the [2019 iNACOL State and Federal Policy Priorities](#), here are a few ways policymakers at the state and federal level can begin to transform K-12 education systems to address the issue areas and recommendations in this report and better align to learning sciences research.<sup>68</sup>

At the state level, state policymakers and leaders can:

- » Provide multi-tiered systems of support to address students' social, emotional, and academic development. These systems provide a framework of evidence-based academic and behavioral practices that are matched to student needs.
- » Build leadership capacity for creating and sustaining change for personalized and competency-based education through preparation, professional development, and culturally responsive teaching, learning and leading throughout the K-12 education system. School leaders need preparation, support, vision, and skills to transform K-12 education systems to next-generation learning. To do this, state policymakers can build system and school leadership capacity for change through personalized and competency-based preparation and professional development systems rooted in the learning sciences.
- » Establish enabling state policies to create and launch innovative new learning designs and multiple pathways in schools and systems through innovation zones, pilots, credit flexibility, mastery-based diplomas, and mastery-based transcripts. State policies and mechanisms that create space for innovation are essential to transforming education systems.

At the federal level, federal policymakers and leaders can:

- » Provide opportunities such as in the Innovative Assessment Demonstration Authority to allow states to pilot innovative new systems of assessments with a subset of districts before going to scale state-wide. Congress should amend Section 1204 of ESSA, to remove barriers to state participation in the IADA, with implementation of high-quality performance assessments to support competency-based pathways.
- » Launch a pilot program in the reauthorization of the Higher Education Act to train educators in culturally responsive teaching, in social-emotional learning, and in personalized learning approaches. There is an opportunity in the Higher Education Act to launch an innovation pilot for teacher preparation that can equip teachers with the skills to teach and lead in future-focused, competency-based learning environments. The pilots would be designed to be innovative, competency-based models with personalized pathways for educators.

- » Provide direction to align lifelong pathways across the K-12 education, higher education, and career and technical credentials. States can also use federal programs like ESSA, the 2018 reauthorization of the Carl D. Perkins Act (Perkins V) and the Workforce Investment and Opportunity Act to coordinate approaches on aligning competency-based, high-quality career and technical pathways across secondary to postsecondary education systems.

Finally, at both the federal and state level, there is a need to support bridging the domains of policy, practice, and research through leveraging local research–practice partnerships or investing in initiatives to increase the connection and application between research and practice.

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## Conclusion

The science of learning and development provides evidence and insights into how students learn and develop. This knowledge base can be used by education leaders across the K-12 education system to guide a vision and framework for how to best support student learning and development. Findings from the learning sciences can, in particular, illuminate the areas where our current education system is misaligned with how children learn and grow. The learning sciences indicate the importance of rethinking schools and social institutions designed a century ago based on factory-model conceptions to prepare students for an industrialized and standardized workforce. We need to shift to more student-centered, personalized learning approaches that prioritizes holistic, developmentally supportive teaching and learning.

Policy plays a supportive role in framing the expectations for teaching and learning in each state, providing resources and creating the conditions that enable districts and communities to co-create and align around a common vision grounded in how learning and development happen. K-12 education leaders at every level have a part to play in building the capacity needed at the state, district, and community levels to implement evidence-based strategies from the learning sciences that advance the transformation to personalized, competency-based education systems.

Wellbeing, cultural responsiveness, equity, localized curriculum, inclusive education, lifelong learning, and community and parent engagement are all important factors in building an education ecosystem. Without the strong alignment between and among these policies and the learning sciences, schools will continue to operate outside the lived experience of their learners. Through providing learning environments that affirm, support, and individualize learning, students can benefit from their learning environments to develop as learners and whole individuals to attain successful and prosperous futures.

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# Glossary

## **Assessment Literacy**

Assessment literacy is the collection of knowledge and skills associated with appropriate assessment design, implementation, interpretation, and, most importantly, use. A critical aspect of assessment literacy is that educators and leaders know to create and/or select a variety of assessments to serve different purposes such as improving learning and teaching, grading, program evaluation, and accountability. However, the most important component of assessment literacy is the degree to which educators and others are able to appropriately interpret the data coming from assessments and then take defensible instructional or other actions.

## **Bloom's Taxonomy**

Bloom's Taxonomy is a framework categorizing the hierarchy of student learning and demonstration of learning, from simple to complex. It was named after Benjamin Bloom and is used widely in educator practice to set objectives and measure student demonstration of the learning tasks.

## **Competency-Based Education**

Competency education, also known as mastery-based, proficiency-based, or performance-based, is a school- or district-wide structure that replaces the traditional structure to create a system that is designed for students to be successful (as compared to sorted) and leads to continuous improvement.

## **Culturally Responsive Teaching**

First coined by Gloria Ladson-Billings in 1994, culturally responsive teaching is the pedagogical practice of recognizing, exploring, and responding to students' cultural contexts, references, and experiences. Cultural responsiveness builds upon eight principles:

- » Communication of High Expectations
- » Active Teaching Methods
- » Practitioner as Facilitator
- » Inclusion of Culturally and Linguistically Diverse Students
- » Cultural Sensitivity
- » Reshaping the Curriculum or Delivery of Services
- » Student-Controlled Discourse
- » Small-Group Instruction

The New York City Mastery Collaborative highlights that a competency-based approach can promote cultural responsiveness in the following ways:

- » Transparency: path to success is clear and learning outcomes are relevant to students' lives and interests. Shared criteria reduce opportunity for implicit bias.

- » Facilitation shifts: refocus the roles of students and teachers to include flexible pacing, inquiry-based, collaborative approach to learning. Students drive their own learning, and teachers coach them.
- » Positive learning identity: growth mindset and active learning build agency and affirm students' identities as learners (academics, race, ethnicity, gender, sexual orientation, etc.).

### **Educational Equity**

There are many definitions of equity in education. iNACOL will use the definition from the National Equity Project: Education equity means that each child receives what he or she needs to develop to his or her full academic and social potential. Working towards equity involves:

1. Ensuring equally high outcomes for all participants in our educational system; removing the predictability for success or failures that currently correlates with any social or cultural factor;
2. Interrupting inequitable practices, examining biases, and creating inclusive multicultural school environments for adults and children; and
3. Discovering and cultivating the unique gifts, talents, and interests that every human possesses.

### **Fixed Mindset (See Growth Mindset)**

Carol Dweck's research suggests that students who have adopted a fixed mindset — the belief that they are either "smart" or "dumb" and there is no way to change this — may learn less than they could or learn at a slower rate, while also shying away from challenges (since poor performance might either confirm they can't learn, if they believe they are "dumb," or indicate that they are less intelligent than they think, if they believe they are "smart"). Dweck's findings also suggest that when students with fixed mindsets fail at something, as they inevitably will, they tend to tell themselves they can't or won't be able to do it ("I just can't learn Algebra"), or they make excuses to rationalize the failure ("I would have passed the test if I had had more time to study"). The traditional system of education was developed based upon a fixed mindset and resulted in a belief that part of the K-12 system's function was to sort students. (Adapted from the Glossary of Education Reform [edglossary.org](http://edglossary.org).)

### **Growth Mindset (See Fixed Mindset)**

The concept of a growth mindset was developed by psychologist Carol Dweck and popularized in her book, *Mindset: The New Psychology of Success*. Students who embrace growth mindsets — the belief that they can learn more or become smarter if they work hard and persevere — may learn more, learn it more quickly, and view challenges and failures as opportunities to improve their learning and skills. Dweck's work has also shown that a "growth mindset" can be intentionally taught to students. (Adapted from the Glossary of Education Reform [edglossary.org](http://edglossary.org).) Competency education is grounded in the idea that all students can succeed with the right supports, including learning how to have a growth mindset.

### **Habits of Success**

Habits of Success (also called habits of work and habits of mind) are directly related to the ability of students to take ownership of their learning and become self-directed learners. There are a variety of Habits of Work (specific practices or behaviors) and Habits of Mind (skills, perspectives, and orientation) that help students

succeed in school or the workplace. Schools tend to focus on a few of the habits of work and mind to help students learn the skills they need to take ownership of their learning. See *Learning and Leading with Habits of Mind*.

### **Learning Progression**

Learning progressions are research-based approaches and maps how students learn key concepts and skills as described in Achieve’s briefing *The Role of Learning Progressions in Competency-Based Pathways*.

### **Learning Sciences**

An interdisciplinary field that works to further scientific, humanistic and critical theoretical understanding of learning as well as to engage in the design and implementation of learning innovations, and the improvement of instructional methodologies. Research in the learning sciences traditionally focuses on brain science, cognitive-psychological, social-psychological, cultural-psychological and critical theoretical foundations of human learning, as well as on the design of learning environments.

We also referenced the definition from the Chan-Zuckerberg Initiative:

The learning sciences can be defined as the study of how people learn, and how different kinds of environments, circumstances, mindsets, and approaches impact learning experiences.

Lastly, we wanted to share the definition that was provided in previous *CompetencyWorks* publication *Levers and Logic Models* and iNACOL’s *Moving Toward Mastery*:

The learning sciences are concerned with “the interdisciplinary empirical investigation of learning as it exists in real-world settings.” Core components of learning sciences research include:

- » Research on thinking: including how the mind works to process, store, retrieve, and perceive information;
- » Research on learning processes: including how people use “constellations of memories, skills, perceptions, and ideas” to think and solve problems, and the role that different types of literacies play in learning; and
- » Research on learning environments: including how people learn in different contexts other than a direct instruction environment with a core principle of creating learner-centered learning environments.

### **Personalized Learning**

[Personalized learning](#) is tailoring learning for each student’s strengths, needs and interests—including enabling student voice and choice in what, how, when and where they learn—to provide flexibility and supports to ensure mastery of the highest standards possible (iNACOL). Personalized learning informs the pedagogical principles embraced by districts, schools and teachers. Again, this term is used to describe an approach to teaching and learning, not the use of technology. Online learning or adaptive software may be used within a

personalized learning approach. In those cases, the term online learning would be used.

### **Social and Emotional Learning**

According to CASEL, “social and emotional learning (SEL) is the process through which children and adults understand and manage emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships, and make responsible decisions.”

### **Student Agency**

Student agency or student ownership of their education refers to the skills and the level of autonomy that a student has to shape their learning experiences. Schools that want to develop student agency will need strategies to coach students in the lifelong learning skills (growth mindset, meta-cognition, social and emotional learning, and habits of work and learning) and to establish practices that allow students to have choice, voice, opportunity for co-design and the ability to shape their learning trajectories.

### **Student Learning Trajectories**

CompetencyWorks refers to trajectories as the unique personalized path each student travels to achieve learning goals on the way to graduation. Educators apply what is known about learning progressions toward helping students make progress on their trajectory.

### **Universal Design for Learning (UDL)**

CAST defines Universal Design for Learning as “a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn.” UDL guides the design of instructional goals, assessments, methods, and materials that can be customized and adjusted to meet individual needs.

### **Whole Child / Whole Child Learning**

Educational psychologists have proposed that holistic education is aimed at helping students be the most that they can be, or what Abraham Maslow referred to as “self-actualization.”<sup>69</sup> Public education with a holistic perspective is concerned with the development of every person’s intellectual, emotional, social, critical, multicultural, ethical, and creative potentials. It seeks to engage students in the teaching/learning process and encourages personal and collective responsibility on the part of professionals charged with students’ development.

### **Zone of Proximal Development (ZPD)**

A term developed by psychologist Lev Vygotsky to refer to the moment(s) during the learning process that lives between what one can do on one’s own and what one cannot do at all. It is the zone in which guidance and support is needed in order to become independently competent. A personalized approach to learning provides students with access to learning experiences attuned to students’ individual ZPD — which sometimes overlaps with others’, but frequently may not.

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# Endnotes

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- 21 The Zone of Proximal Development (ZPD) is part of the Social Development Theory created by Russian psychologist Lev Vygotsky. ZPD refers to the distance between a student's ability to perform a task under adult guidance or with peer collaboration and the student's ability to solve the problem independently. According to Vygotsky, learning occurred in this zone. (Vygotsky, L.S. (1978). The interaction between learning and development. In M. Cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds.), *Mind and society: The development of higher psychological processes* (pp. 79-91). Cambridge, MA: Harvard University Press.
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- 26 Richard Lerner, personal communication, September 2019.
- 27 "Growth mindset" is a term coined by psychologist and researcher Carol Dweck ([\*Mindset: The New Psychology of Success\*](#)). According to Dweck, students with a "fixed mindset" believe that they either are good at something or they are not. In contrast, students with a "growth mindset" believe that their basic abilities can be developed through dedication and hard work. Students who embrace growth mindsets may learn more, learn more quickly, and view challenges as opportunities for improvement.
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- 42 A note on the terminology: we want to recognize a concern that the use of "noncognitive factors" could be implied by some that these skills are less cognitively rigorous. We want to use language that represents the research of the literature while also acknowledging that since the publication of this

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- 46 Additionally, we can determine if students’ prior knowledge was incorrect and that a new formulation for knowledge is needed. For example, the “Grand Synthesis” proposed by Ernst Mayr in the 1930s/1940s involved the integration of Darwinian conceptions of evolution with Mendel’s genetic work. It framed “knowledge” about human evolution for more than 70 years. However, it was wrong. The work of Noble, Jablonka, Lamb, Gissis, and others, though, has resulted in a revised conception of evolution, one that constituted a paradigm shift. (R. Lerner, personal communication, September 2019.)
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- 50 ZPD can be used as a way to focus on students’ strengths and understanding more deeply their unique learning trajectories.
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1934 Old Gallows Road, Suite 350  
Vienna, VA 22182

888.95.NACOL (888.956.2265)  
**ph.** 703.752.6216 / **fx.** 703.752.6201  
[info@inacol.org](mailto:info@inacol.org)