# Chapter 6
# The Development and Assessment of Cognitive Readiness: Lessons Learned from K-12 Education

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## 6.1 Introduction

This chapter considers what lessons can be learned from the K-12 education sector's experience in defining and assessing readiness. The chapter shares examples of readiness definitions and assessment strategies at three key transition points:

- Are you ready for kindergarten?
- Are you ready for college?
- Are you ready for challenging work?

Just as the concept of cognitive readiness in the military can be conceptualized as readiness to respond to the challenges of what lies ahead—i.e., combat applications and adaptation to unpredictable circumstances (Fletcher, 2004)—so too do students and job applicants need to be ready for the demands of what lies ahead as they transition from one educational level or position to another. Treated in turn are readiness for kindergarten, readiness for college, and readiness for a demanding career. While core knowledge, skills, and dispositions needed for success are categorized differently and the specifics of terminology vary across the three contexts, the chapter uses these examples to consider common characteristics of readiness both historically and currently. These common threads include such capacities as relevant content knowledge; cognitive strategies such as problem solving and analytic reasoning; social competence, including teamwork and leadership; communication; motivation and persistence; and metacognition. The consequences of a mismatch between characteristics of readiness and measures of it also are considered. Finally, the chapter suggests the core elements of training and assessment systems to support readiness.

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## 6.2    Readiness for Kindergarten

What does it mean to be ready for kindergarten, a key, early transition for most children, as they move from home and more informal learning environments to public school and formal educational expectations? In times past, being ready for kindergarten has meant reaching age 5 by a particular month in the academic year. No more.

The idea of needing more than to simply reach a particular chronological age to be ready for kindergarten was fueled as part of the national response to *A Nation at Risk*, a prominent national commission report that documented the mediocrity of public education in the United States, the continuing achievement gaps it enabled to continue, and the disappointing performance of American students in international comparisons (National Commission on Excellence in Education, 1983). In response, the Congress established the National Education Goals Panel that was charged with assessing and reporting on state and national progress toward achieving National Education Goals to remedy this situation. First among these goals was that by the year 2000, "All Children in America will start school ready to learn." The goal was an attempt to ameliorate the major existing achievement gaps among students at school entry based on research documenting that children from economically disadvantaged communities started kindergarten with significantly smaller vocabularies and lower cognitive skills than their more advantaged peers (Farkas & Beron, 2004; Hart & Risley, 1995; Lee & Burkham, 2002). Research also supports the strong relationship between these variables and subsequent literacy development and school success (Biemiller, 2006).

*Standards and assessment*. States and a number of professional organizations responded to this goal by establishing standards for early childhood education, ostensibly bringing together the expertise of researchers and practitioners. These efforts have stimulated considerable public discussion of what it means to be ready for school and the implications of such readiness for the development of early childhood programs and the assessment of young children (see, e.g., Snow & Van Hemel, 2008). While there are various lists of expected competences for school readiness, they all basically boil down to a common set of knowledge, skills, and predispositions that largely echo, albeit in age-appropriate definitions, the categories comprising cognitive readiness that have been discussed in other chapters in this volume:

- *Physical health and well-being*: sufficient to be in school and have the fine motor, hand, and eye coordination to participate in activities, use scissors, hold a crayon, paint, paste, etc.
- *Social and emotional development*: the disposition and ability to get along with others, share, work in groups, be independent, and be able to be separated from home
- *Orientation and motivation for learning*: enthusiasm for learning some basic metacognitive skills, such as the ability to listen to and respond to instruction
- *Language development*: oral language skills and the background knowledge to associate words with things and the ability to communicate with others

- *Cognition and general knowledge*: for example, basic number and letter recognition; experience with words, objects, and natural environment; and the precursors to content knowledge

While physical health and well-being have not received much attention in other chapters, certainly physical adeptness seems a critical capacity for military readiness.

These then are the foundational skills that students need to be successful in kindergarten and to make good progress, and the establishment of these standards has encouraged important stakeholders to take note and to take action. Many parents and early childhood programs have responded by focusing on helping children develop the prerequisites they need for school success; some public agencies (e.g., state departments of education and school districts) have developed readiness tests for school entry. At the same time, however, there is general consensus, most recently observed by the National Research Council (Snow & Van Hemel, 2008), that the attention to school readiness has encouraged early childhood programs and assessment to overemphasize academic precursors and content skills at the expense of social and emotional development, motivation for learning, opportunities for self-expression, and more play-oriented approaches to learning and socio-emotional functioning.

Early childhood researchers and expert practitioners have called for a more balanced approach to program development and evaluation (Snow & Van Hemel, 2008). Recognizing that even in kindergarten, important assessments can drive and narrow practice, experts agree that effective early childhood assessments need to be comprehensive in addressing all important aspects of child development and that such assessments need to be integrated into the larger educational system that provides a strong infrastructure to support children's healthy development. I return to this point later in making recommendations for the military infrastructure needed to support the multiple dispositions and skills needed for cognitive readiness.

*California's desired results system*. For example, California has created its Desired Results System to guide the development, evaluation, and refinement of effective programs for early childhood and youth development; to identify exemplary programs and practices as well as focus programs and their attention to the assessment, screening, and support of students' learning progress (CDE, 2009). In contrast to prior evaluation models that emphasized program inputs, resources, and processes, *Desired Results* is intended to focus on programs and make them accountable for their results for children in four developmental categories and for those families in two categories:

- Children are personally and socially competent.
- Children are effective learners.
- Children show physical and motor competence.
- Children are safe and healthy.
- Families support their children's learning and development.
- Families achieve their goals.

Each of these outcome areas is defined by multiple indicators that encompass developmental themes. In turn, it is assessed through multiple measures, using standardized measurement tools that quantify and classify students' status in each area and classify their developmental levels. In addition to the tools and reporting mechanism, the system also provides for professional development to enable educators to understand and use the system. The system is available online and is used by state, regional, and local programs to evaluate quality and support progress toward successful results.

## 6.3   Readiness for College

Like readiness for kindergarten, the concept of readiness for college also is undergoing transformation. Traditional readiness indicators centered on what students needed for college admission: typically, such indicators as having a high school diploma and having taken and passed required college preparatory courses (e.g., 3–4 years of mathematics, English, foreign language, and science), grade point averages (GPAs), and scores on admissions tests such as the SAT and ACT.

However, as I discuss later, this definition has not served students well. Instead, advocates are promoting a new definition of what college readiness means and promoting its implications for K-12 education, i.e., readiness for college means not only possessing the entering requirements but more importantly having the knowledge, skills, and disposition to effectively transition to the college environment, to be ready to take credit-bearing courses, and to be successful in completing college.

*College-ready capabilities*. As with kindergarten readiness, there are many lists of what students need to be prepared for college in this sense. For example, Achieve, the Fordham Foundation, and a handful of state or university systems have laid out what they deem to be essential entering competencies (see, e.g., Achieve, 2008a, 2008b; 2009; ACT, 2005; CCC, CSU, and UC, 1982). David Conley (2007), a pioneer in promoting the alignment between K-12 and higher education and a prominent voice in the movement, has conducted research through surveys of college faculty, analysis of college course syllabi, and requirements to define the capabilities that students need to be college ready as:

- *Cognitive strategies* are intellectual behaviors and cognitive capabilities students need to engage with, understand, and master rigorous college-level content. These strategies include intellectual openness, inquisitiveness, analytic reasoning, argumentation, proof, interpretation, precision and accuracy, and problem solving.
- *Content knowledge* is the overarching academic knowledge and skills that students should develop in high school: writing, research, understanding of key principles within disciplines, and an ability to apply content knowledge in a variety of contexts.
- *Academic behaviors* are basic learning capabilities and include such capacities as metacognition, ability to reflect on and respond to one's misunderstanding,

and persistence, ability to apply a range of learning strategies to improve performance: These include, as well, a strong work ethic and ability to work collaboratively and in teams.
- *College contextual skills and awareness*. These are the knowledge and skills that enable students to function comfortably in a college context, such as the knowledge of norms, values, and conventions of college interactions; human relations skills to cope in new environments; as well as specific knowledge about requirements for college and how to apply.

While Conley explicitly calls out cognitive strategies and content knowledge as key categories, he embeds metacognition, motivation, and teamwork in the "academic behaviors" category and also includes additional dimensions of social competence within "college contextual skills and awareness." He observes that all of these capabilities and competencies should be purposively developed and practiced in high schools. For example, students can learn to intentionally apply cognitive strategies in their academic and other work, and with practice, these strategies can become a habitual way of working. As with the kindergarten readiness set of knowledge and skills (previous noted), there also are interesting similarities between the mix of general and specific capabilities that Conley identifies and those that have been associated with cognitive readiness in other chapters of this book.

## 6.4   Readiness for Challenging Work: US Secretary of State

Taking the readiness for a challenging career to an extreme, let us consider what may be required to be the US Secretary of State. In a newspaper feature (Miller, 2008), former United States' Secretaries of State provided advice to the incoming Secretary, Hillary Rodham Clinton, implicitly responding to the issue: what does it take to be ready to be Secretary of State? What does it take to be ready for a most challenging work assignment, where problems of complex, propelled by multiple factors that are difficult to assess and beyond one's control and situations and outcomes, are dynamic, uncertain, and difficult to predict? What does it mean to have the knowledge and skills to be successful in context where patterns are difficult to interpret, the connections between reaction and response tortuous, and motives, primary characters, and available options are complex and changing? Where are social relationships, partnerships, and teaming essential and ever changing? There even may be uncertainty in what success means—is it the best possible outcome, the one that optimized on the greatest variety of conflicting interests, that which suffices short- or long-term goals, etc.? Certainly the capability to achieve deals with such uncertainty and meet fuzzy outcomes is harder to define than those of kindergarten or college readiness, but former Secretaries' words of advice sound familiar themes as they offered their perspectives the principal roles of the position:

- George P. Shultz: Be a vigilant gardener. As Shultz notes, as a gardener, "You have to pull weeds when they're small and keep track of things. The same is true

in diplomacy." He goes on to emphasize the ways in which Secretaries of States need to build agendas, establish relationships, and be clear on what you like and don't—both with countries across the globe, the Congress, and the president. He also mentions the importance of recruiting and maintaining talented staff, "You may be a brilliant general, but if you don't have good troops, you're not going to get anything done."

- James Baker: Most important is "having a seamless relationship with the president" and that you have an understanding that the president will "protect your backside" and goes to note the importance of clear, not mixed signals and of being able to build national consensus on tough, contentious issues.
- Madeleine Albright: "The thing that is most difficult is setting priorities" and being attuned on rapidly changing situations and being able to respond to multiple demands simultaneously and to sift through and respond nearly instantaneously to complex, evolving information. She also underscores the importance of putting together a good team who will keep things on track.
- Colin Powell: "Leadership and management are as essential to the job of Secretary of State as are foreign policy formulation, world travel, and dealing with the crises that come your way." Powell also notes the importance of building and tending to relationships with major alliances and countries and the time he had to learn, e.g., international economic issues, relationship, products, and policy.

## 6.5 Readiness Starts with Clarity in Goals

As complex as the context, the themes raised in the Secretaries' advice echo those that were evident for kindergarten and college readiness and those that have been highlighted in other chapters of this book:

- Content knowledge and skills and ability to apply and transfer them in new situations
- Cognitive strategies, including problem solving, critical thinking, and analytic reasoning
- Social competence, including teamwork and leadership
- Communication
- Motivation/work ethic
- Ability to learn/metacognition

Surely the nature, complexity, and breadth of knowledge, skills, and underlying dispositions vary enormously from one context to the next, but the basic categories remain consistent: to be ready for college, students need to understand basic concepts and principles in academic disciplines, while a Secretary of State may need to understand the intricacies of historical context, global economies, political interests, competing values, etc., to address specific context, but both rely on content knowledge. Kindergarten social skills may focus on being able to share one's toys, while college students need to be able to work collaboratively, and a Secretary of State needs to engage in global partnerships, but collaboration, consensus building, and

teamwork are at the heart of each. Communication, abilities to learn and benefit from experience, and abilities to solve problems—these are all consistent themes in what it means to be ready for success, whatever the specific context. Situational awareness and abilities to respond quickly to new crises are apparent in Secretary of State responsibilities but have simpler counterparts on kindergarten and high school-to-college transitions.

In education, it is commonly accepted that educational effectiveness and school improvement start with being clear on expected outcomes and that expected outcomes articulate standards for student learning, (i.e., what students need to know and be able to do to be successful in the future) whether that future be the next grade, college, or other postsecondary training; the world of work; or in any other transition. Standards for student learning then are the foundation on which both programs and assessments are developed. The programs, which may be school curriculum, instruction, special interventions, or other initiatives, are developed to enable students to reach the standards, and the assessments measure how well students are doing relative to the standards and/or what progress they are making. The measures, in turn, are used to monitor, support, and hold stakeholders accountable for progress.

Taking a leaf from education, then preparing for readiness, starts with articulating standards for readiness and developing programs and measures to address the standards. While a simple model to articulate—specify goals, measure progress, and take action to ameliorate any gaps—current educational practice falls short of the ideal. The match between the assessments and the standards is essential to the success of the model, but imperfectly realized.

## 6.6  Consequences of Mismatch: Readiness Expectations Versus Readiness Assessment

Given that there is some consensus on what classes of knowledge and skill are needed to help assure a smooth transition from early childhood to kindergarten, school, or the world of work, how well do our assessments match them? Let us consider what happens when they do not, specifically the case of data on the success of decisions about college admissions. As mentioned earlier, rather than taking into account the knowledge and skills needed for success, the criteria for college admissions tend to be high school completion, completion of and grades in academic coursework, and in many cases, scores on the SAT/ACT.

In terms of success, existing statistics paints a disappointing picture (see Conley, 2008):

- Surveys of faculty, whether they be research institutions, state, or community colleges, routinely report students unprepared to meet their expectations for college coursework.
- More than 40 % of entering college students need remedial coursework in English and/or mathematics.

- Less than 20 % (17 %) of students enrolled in remedial reading upon college entry complete college.
- Only 60 % poor and minority students graduate high school. Of these students:

  – Only 1/3 enter college.
  – Less than half of those entering (1/7) complete college.

- The United States ranks fifteenth of 29 countries internationally in the proportion of students who complete college.

These data provide important feedback for the K-12 system. They also demonstrate the utility of multiple indicators for measuring readiness.

Moreover, when we look at the validity of the indicators used for college admissions, the power is quite weak. For example, the results from a validity study conducted by the University of California (UC) document the relationship between UC admissions criteria and first year college grades (Geiser & Studley, 2003). The study tracked 80,000 students admitted as freshmen to a UC campus from 1996 to 1999 and clearly suffers from range restriction. That is, the UC system is highly selected and intended to serve the top 12.5 % of California's high school graduates. Average high school GPA for the study sample was 3.5 and combined verbal and math SAT scores on average were nearly 1,200 (578 SAT verbal; 611 SAT math). While range restrictions attenuate the study's observed relationships, results show that SAT scores accounted for only 12.8 % of the variation in freshman GPA. The SAT II, tests that address more specific areas of content achievement, explained 15.3 % of the variation in freshman GPA, and high school GPA explained 14.5 % of the variation. The combined indicators accounted for little more than 21 % of the variation in freshman GPA, and interestingly, SAT I scores improved the prediction rate only by a negligible 0.1 % (from 21.0 to 21.1 %), making its value added a bit questionable. Furthermore, SAT I scores proved to be more susceptible to the influence of the socioeconomic status of an applicant than either the SAT II scores or high school GPA. That is, there was a higher relationship between students' socioeconomic status and their SAT I scores than between their such status and either performance on the SAT II or high school GPA stated in terms of correlation coefficients rather than percent of variance explained; the correlations between the individual indicators (SAT, SATII, high school GPA) and freshman GPA ranged from 0.36 to 0.39.

In short, there appears to be a problem in the alignment of the educational system and between the education and assessment systems. Indicators of college preparedness relative to the need for remedial course work and completion rates, especially for students of low socioeconomic status and students of color, suggest that precollegiate education, K-12, does not well support the development of knowledge and skills that students need for college success, and neither are assessments for college entry well aligned with what is needed for success. Clearly, graduating high school with a high school diploma does not translate into being ready for college expectations. In California, approximately 60 % of new freshmen in the California State University system are judged deficient in English, mathematics, or both and thus need to be assigned to remedial, noncredit-bearing English and/or mathematics courses (Chronicle of Higher Education, 2010), and such figures are even more

severe for poor and minority students, e.g., Latino and African American. Nor do current high school proficiency tests translate into such preparation. For example, a number of studies have documented the thin relationship between expectations evident in high school exit exams and those of entry-level college courses and/or college performance (Brown & Conley, 2007; D'Agostino & Bonner, 2009). Similarly, student failure rates in Algebra I stand in stark contrast to college expectations for successful completion of Algebra II and Geometry.

Even for those who are successful in high school coursework, passing the so-called college preparatory requirements, such as the A-G course requirements for the University of California, does not add up to readiness for the rigor of being able to independently deal with the demands of college. And, in fact, we know that passing courses with the same name can mean something vastly different in terms of rigor, knowledge, and skills, depending on what school you go to (Achieve, 2008a, 2008b, ACT, 2005; U.S. Department of Education, 2007). Neither does high school generally prepare students for the social interactions and group work that are a core element of freshman coursework, according to national college surveys (Conley).

## 6.7 Moving to a More Aligned System

In K-12 we are recognizing the need to move from the current chaos to a coherent system of development and measurement, a system that is horizontally and vertically aligned with expectations for student performance and particularly that is aligned with the knowledge and skills students need to be well prepared for college and the world of work.

*Fewer, clearer, higher standards*. Step one of the planned move is agreement on core standards that define what students need to know and be able to do to be prepared for college. This new generation of standards is intended to correct the shortcoming of current standards—standards that were too vague and too many to provide a strong foundation for education and schooling. In its place is a call for "Fewer, Clearer, Higher" (FCH) standards, meaning in general that standards should be (see Common Core State Standards Initiative, 2010; Herman, 2009):

- *Fewer*: Represent a powerful and coherent set of *essential competencies* that all students can be expected to develop over the course of their K-12 education to be college and/or work ready, reasonable, yet still cognitively demanding in scope such that all students can be expected to acquire them to graduate high school.
- *Clearer:* Be sufficiently clear to guide the development of assessments to support accountability and improvement for students, educators, administrators, and the system as a whole; be sufficiently clear to guide the design and provision of rigorous coursework to enable students to achieve such competencies; and explicitly define expected levels of content and cognitive demand.
- *Higher*: Represent the knowledge, skills, and competencies that students need to be prepared for success in college and the workplace; incorporate deep conceptual understanding and high levels of cognitive demand, including abilities to apply

and transfer knowledge, reason, conduct inquiry, and communicate; and be bench-marked to the international standards.

- *Defensible*: Meet criteria for fairness, credibility, and accuracy.

Common Core State Standards have been developed nationally for English language arts and mathematics. The first set of documents defined high school graduation expectations that would prepare students for success in college and work. Following vetting of that specification, grade-level expectations were articulated for each grade, K-12, to progressively build to the knowledge and skills required for high school graduation and subsequent success. The standards development assumes that the same knowledge and skills are needed regardless of whether students plan to enter and complete college or to enter the workforce more directly, in that livable wage jobs require postsecondary technical training and that success with such requires similar mathematics and English language arts capability to college readiness.

In any event, Common Core State Standards are intended to provide a strong, sound foundation for systems that support accountability and the improvement of learning. A prominent national commission described such systems as needing to be comprehensive, addressing all the important learning goals; coherent across levels of the educational system and across grade levels; and continuous, providing ongoing information on how students were doing (Pellegrino, Chudowsky, & Glaser, 2001).

System coherence is a hallmark, in contrast to current practice where ongoing classroom assessment and large-scale assessment tend to be disjointed and, as noted, K-12 and college expectations are frequently out of sync (Conley, 2007; Herman, 2010). Instead, standards and assessment must be *horizontally coherent*, meaning a system where curriculum, instruction, and assessment are aligned, so that assessment results can be used to judge progress and learning effectiveness as well as to guide instruction. *Vertical coherence* brings into line all levels of the educational system—classroom, school, district, and state, so that all share the same understanding of the goals for student learning and how it is expected to develop over time so that all system resources—funding, leadership, mentoring, professional development, special programs, technical assistance, curriculum, instruction, and assessment, support a unified effort to building students' capacity.

Finally, *developmentally coherent* means that the system reflects a continuous view of learning and how it is expected to develop over time, for example, from the beginning to the end of the year and across years, grades, and levels of schooling. *Developmental coherence* means that subject area standards for student learning—mathematics, for example—progressively build from one grade level to the next to articulate a logical progression of the knowledge and skills students need to develop in each grade to be able to graduate high school and be prepared for success in college and work. In a developmentally coherent system, expectations for each grade level progressively build from the prior to the next level to directly map to ultimate goals.

A coherent, standards-based system communicates a consistent set of targets for all stakeholders in the system—e.g., students, teachers, administrators, and policymakers; aligns standards, curriculum, and assessment to assure that students have the opportunity to learn what is expected, that which is required for future success;

and systematically builds and supports students' continuous progress toward immediate and ultimate goals. Assessment serves as a critical lynchpin in such a system: whether large-scale accountability, summative, or classroom assessments, assessment communicates to students what is important to know and be able to do and what is valued knowledge; it also provides evidence through which to judge the status and/or progress of learning and on which to base subsequent action, for example, to strengthen programs, identify students who need help, and to suggest next steps to facilitate progress (Herman, 2008). While large-scale accountability assessments have traditionally had the lion's share of attention in research and policy, research suggests that the most powerful use of assessment to improve learning comes not from large-scale state assessments, but from the ongoing formative use of assessment guide immediate teaching and learning (Black & Wiliam, 1998, 2004; OECD, 2005; Phelan, Choi, Vendlinski, Baker, & Herman, 2009). That is, assessment during the course of instruction or training, when it diagnoses students' learning needs and is used to inform the next steps for teaching and learning, shows strong, positive effects on learning, particularly for low ability students.

## 6.8   Systems for Developing Cognitive Readiness

These same issues apply to attempts to develop cognitive readiness for the military. Based on current work in the K-12 sector, reasonable solutions may lie in:

*Clarifying and clearly communicating expectations for preparation and readiness.* Research on standards and assessments in K-12 education demonstrates that standards and assessments make a difference; committed stakeholders listen to the signal they send and take action. Consider, for example, the unveiling of school readiness indicators and the explosion of games of "I spy" to encourage young children to recognize and use words and develop language as well as massive movement in preschool and afterschool programs to develop academic skills.

*Systematically integrating opportunities for readiness development.* Being clear on readiness expectations facilitates attention to their development. K-12 research clearly shows that educators respond to high visibility standards and assessment by focusing their curriculum and teaching on what is assessed and that curriculum developers, publishers, and other service providers respond by adapting their existing materials to address new goals and/or by creating new materials and services that address them (Herman, 2007).

Here is an area where the military could build from historic shortcomings in K-12 practice, where the process of articulating new goals and standards has tended to be additive rather than integrative. That is, standards are developed separately by subject—reading, mathematics, and science—and each set is the subject of intense and separate materials development, professional development, and implementation efforts. The result can be more standards, instructional materials, and assessments than there is available time to implement them and an overwhelming number of

things for teachers—particularly elementary school teachers who teach multiple subjects—to instructionally implement, manage, and/or monitor. Alternatively, some recent initiatives have shown the value of a more integrative approach. For example, the Lawrence Hall of Science's *Seeds of Science/Roots of Reading Program* integrates the development of literacy and science knowledge within a common curriculum. Students use science as a context for learning to read and write and develop inquiry skills across both subjects. Not only does the program get science back into the curriculum (strong accountability requirements for schools' reading and mathematics performance have reduced attention to science), but program results show clear advantage for both literacy and science learning (Cervetti, Bravo, Hiebert, Pearson, & Jaynes, 2009).

Similarly, for military applications aimed at developing cognitive readiness, it does not seem wise to treat those goals separate from the content and mission skills in which they are naturally embedded. Cognitive readiness needs to be developed in the context of developing specific mission knowledge and skills. While cognitive readiness implies a set of common intellectual processes that individuals use to deal with unexpected conditions, the concept of cognitive readiness should be overlaid on the development of capability to deal with expected conditions in particular domains and be purposely designed to provide opportunities for near and far transfer.

A parallel in education is building students' problem-solving capacity, which research shows cannot be separated from the development or assessment of content understanding—i.e., be able to address novel, complex problems requires prior knowledge and deep understanding of the concepts, principles, procedures, etc., that need to be brought to bear and combined to solve the problem (see Mayer, this volume). Rather, content knowledge and problem-solving transfer need to be developed in tandem, and training needs to incorporate research-based principles for fostering transfer, such as providing practice over a range of contexts, use of analogical reasoning, developing and invoking explicit problem-solving strategies, e.g., recognizing and representing the problem, and identifying possible solution strategies (Chi, Glaser, & Farr, 1988; Holyoak, 2005; Koedinger & Corbett, 2005).

*Define and test developmental trajectories for cognitive readiness*. While research on problem solving suggests that some aspects of cognitive readiness cannot exist independent of content knowledge or of the domain for which it is to be exercised, it seems reasonable that it may be possible to develop domain-independent models of these specific skills that then can be instantiated within specific domains and learned repeatedly and can transfer to new domains of learning (Baker, 2007a, 2007b)—e.g., communicating clearly requires knowledge of what one is communicating about and knowledge of the conventions of communication in that domain, but learning to well communicate in one domain may generalize to learning to communicate in a second domain, given appropriate content knowledge in the second domain, and/or make subsequent learning faster and more efficient, similarly with problem solving, metacognition, and other components of cognitive readiness. Given such domain-independent models, it would be valuable to hypothesize and verify the trajectories through which such skills develop and then consistently embed them within and across training contexts. Systematically attending to

problem solving within a training domain could both strengthen capability within that domain and support transfer of problem solving across training domains, i.e., problem-solving capability developed in one domain could be transferred to benefit both content and problem-solving learning in subsequent domains.

*Attention to transfer*. Transfer is inherent in any definition of cognitive readiness: that is, officers and/or enlisted men must be able to draw on their knowledge and skills to meet novel circumstances and respond to unpredictable challenges. Theory and research in educational psychology suggest that transfer is enhanced when there is explicit attention to it in instructional sequences; training, for example, should provide students the opportunity to apply their knowledge across a wide range of contexts and to see the connections between new and prior problem contexts (Chi et al., 1988; Holyoak, Gentner, & Kokinov, 2001; Koedinger & Corbett, 2005). There is an inherent tension here between the breadth and depth of knowledge and skills that can be developed during finite period of instruction, for example, a broad survey of a topic (e.g., western civilization) may give scant opportunity for students to apply and transfer their knowledge in specific areas (e.g., capitalism). The movement in K-12 to FCH mentioned previously, at least in part, is an attempt to remedy this tension by being clear on the concepts and principles that are most important for students to be able to apply *and* that can be feasibly developed within the time available for coursework. The intent is both to make learning expectations clear and to enable teachers and schools to concentrate on deeper development of fundamental knowledge and skills that will prepare students for future success. In contrast, today's panoply of standards and learning objectives has produced a curriculum that is a mile wide and an inch deep (Schmidt, Houang, & Cogan, 2002), which is counterproductive to the deep learning needed for transfer.

The lack of transfer also is evident in comparisons between students' scores on high visibility, state accountability tests, and those on other measures of the same subject at the same grade levels. That is, if meaningful learning has occurred, one would expect scores on one test to generalize to those on another, similar test of the domain. Instead, in the K-12 world, Koretz (2008) shows that students' scores on Kentucky's state assessment showed steep improvement over the 1990s in reading and mathematics, yet the National Assessment of Educational Progress showed little, if any, gains in learning and raises the specter of score inflation.

Those scores do not generally point to problems in both instruction and assessment, neither is sufficiently attentive to transfer. Research shows that teachers teach to the test and teach like the test – i.e., engage students in exercises that model test formats and are limited to test content—not to students' ability to understand and apply what they learn across multiple contexts (see, e.g., Hamilton, Stecher, Russell, Marsh, and Miles, 2008; Herman, 2004). More explicit attention to transfer in both the development and assessment to training could help to alleviate these shortcomings.

*Coherent systems of readiness assessment*. The military should consider the development of a coherent system for the development and assessment of cognitive readiness grounded in an explicit definition of the cognitive readiness construct and how

it may develop in the context of mission-oriented knowledge and skills. Such a system would be based on multiple indicators of relevant domains and yield the formative and summative information needed to monitor, improve, and certify performance as well as to support continuous development and the alignment of current training to subsequent expectations. California's Early Assessment Program (CSU, 2009), a joint assessment initiative of the State Board of Education, the California Department of Education, and the California State University (CSU) system provide one example of such a multipurpose system. Coming together to examine the alignment between K-12 standards and college expectations, the partners augmented the California Standards Tests (CST) of English and mathematics given to all 11th graders as part of the state accountability system to create a supplement that, combined with selected CST items, provides a reliable estimate of student performance relative to CSU's readiness expectations. The intent is to give students early feedback on their readiness to take credit-bearing—rather than remedial—courses upon college entry and to provide a strong signal to teachers and schools about what they need to do to better prepare students for college success. Participation in the supplementary testing is voluntary for students; those who participate get feedback on whether they have met CSU expectations, and thus are exempt from further placement exams at college entry; those who score "not ready" are informed that they need additional preparation for college-level work. Such preparation presumably is to occur during students' senior year in high school, also serving the purpose of combating the "senior slump," that is, the tendency for students to tune out of school after their college applications and grade submissions. Students whose scores show the need for additional preparation can take a variety of diagnostic tests to determine individual strengths and weaknesses to support their subsequent development and can access resources and modules to support their development on the state website. Grade 12 coursework also was redesigned and standard sequences, professional development, and instructional resources provided to support teacher implementation. In addition, CSU expectations, data on the strengths and weaknesses of student performance, and strategies for dealing with them also were incorporated into CSU teacher preparation programs. Expectations for student preparation thus provide a touchstone for more closely aligning K-12 education and college entry expectations for constructing a complementary system of assessments to provide accountability; formative and diagnostic assessment data for students and high school educators; placement data for CSU; and feedback for strengthening the pre- and in-service preparation of high school teachers to develop their students' college readiness skills in English language arts and mathematics. Not only a coordinated system of *assessments*, the system also includes model courses and instructional packages for diagnosing and responding to students' strengths and weakness relative to college preparation.

The senior year of high school may not provide sufficient time to remediate the shortcomings of the prior 11 years, and in fact, as mentioned previously, the K-12 community is currently in the process of reconfiguring its expectations of K-12 so schools will help students, grade by grade, to develop systematically the knowledge and skills students need to be prepared for college success. Nonetheless, the Early

Assessment Program demonstrates some of the many linkages through which a comprehensive assessment system can support learning and the many actors and venues through which change must occur.

Similarly, if the military wants to build the cognitive readiness of its forces, it would do well to make its expectations clear and incorporate the development and assessment of specific, relevant requisite knowledge, skills, and dispositions into all training programs. By regularly assessing individual status with regard to cognitive readiness, the military could signal the importance of these capacities to trainers and trainees alike and support accountability and provide important feedback on whether these capacities are being sufficiently developed. The feedback could be used to improve readiness within and across required training as well as to enable individuals to take responsibility for alleviating observed shortcomings. Diagnostic batteries and effective instructional resources linked to desired capacities would help to complete the system.

## 6.9   Summary and Conclusions

The K-12 public education sector offers a number of lessons that may transfer to the military's mandate to develop the cognitive readiness of its officers and enlisted personnel. A first issue is definitional: what does "cognitive readiness" mean and how does it develop? Conceptions of kindergarten readiness, college readiness, and the capacities needed for complex careers suggest many parallels to the conceptions of cognitive readiness articulated by other chapters in this volume. Being clear on expected capacities is a clear first step to assuring that such cognitive readiness capacities are systematically developed throughout education and training experiences.

Coursework must provide trainees adequate opportunities to develop the knowledge, skills, predispositions, and transfer capabilities that define cognitive readiness. Just as with problem solving in the K-12 sector, it is unlikely that cognitive readiness can be developed independent of domain knowledge, that is, independent of mission-oriented content. Rather, opportunities to develop and apply cognitive readiness skills and dispositions must be embedded systematically within and across courses addressing the development of mission-oriented domain knowledge and skills. Coursework instruction and assessment should address trainees' ability to apply and transfer their knowledge to new contexts and dynamic circumstances.

Experience in K-12 also demonstrates important advances in creating aligned systems for developing and assessing readiness knowledge and skills. Such systems take a developmental perspective of how competencies develop and align instruction and assessments to significant benchmarks along the way. A variety of coordinated assessments support student development: accountability or summative assessments which are targeted on expected course outcomes, formative assessments that address the subsidiary knowledge and skills which help to fuel the outcomes, and diagnostic assessments which may identify specific strengths and weaknesses with regard to specific knowledge and skills: they mutually focus

teachers and students on a coherent set of goals and sequence of learning and provide suitable data for the range of decisions that support quality in teaching and learning. That the assessment system is closely coordinated with expected instructional sequences provides ongoing information to guide instructional decision making, diagnose and respond to individual needs, and to support reflection and improvement of teaching.

Assessment and the improvement of cognitive readiness: yes, the military can learn valuable lessons from K-12, but K-12 should also benefit from the military efforts to reach its goals.

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