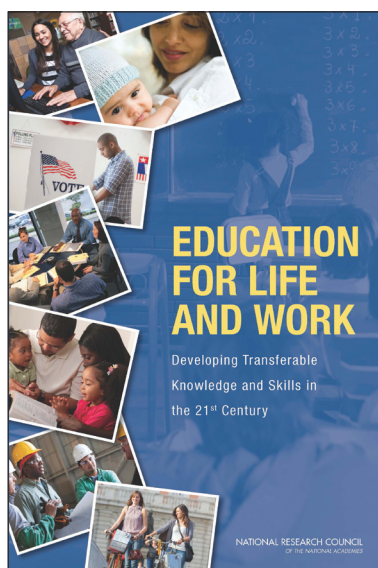


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BOARD ON TESTING AND ASSESSMENT • BOARD ON SCIENCE EDUCATION

EDUCATION FOR LIFE AND WORK

DEVELOPING TRANSFERABLE KNOWLEDGE AND SKILLS IN THE 21ST CENTURY



Business, political, and educational leaders are increasingly asking schools to integrate development of skills such as problem solving, critical thinking, and collaboration into the teaching and learning of academic subjects. These skills are often referred to as “21st century skills” or “deeper learning.”

At the request of several foundations, the National Research Council appointed a committee of experts in education, psychology, and economics to more clearly define “deeper learning” and “21st century skills,” consider these skills’ importance for positive outcomes in education, work, and other areas of life, address how to teach them, and examine related issues.

The committee’s findings and recommendations are detailed in its report *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*.

FIRST STEPS TOWARD CLARIFYING TERMS

Deeper learning is the process through which a person becomes capable of taking what was learned in one situation and applying it to new situations – in other words, learning for “transfer.” Through deeper learning, students develop expertise in a particular discipline or subject area.

Suppose a student learns about means, medians and modes in mathematics. Deeper learning would mean that the student would learn not only how to calculate these values, but also understand how and when each is best used. For example, if the student later worked at a store that tracked average daily sales each month, he or she would recognize that a special sale on the first day of a particular month could skew the mean and that an alternative measure like the median might be more representative of daily sales for that month.

Through the process of deeper learning, students develop **21st century competencies** – transferable knowledge and skills. In contrast to a view of “21st century skills” as general

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"21st century skills" grouped into three broad domains

skills that can be applied to a range of different tasks in various civic, workplace, or family contexts, the committee views these competencies as aspects of expertise that are specific to – and intertwined with – knowledge of a particular discipline or subject area. The committee uses the broader term "competencies" rather than "skills" to include both knowledge and skills.

Precise definitions of the many terms used for "21st century skills" are not possible at this time, in part because there is little research to support such definitions. However, as a preliminary way to organize the skills, the committee first identified three broad domains of competence:

- **the cognitive domain**, which includes thinking, reasoning, and related skills;
- **the intrapersonal domain**, which involves self-management, including the ability to regulate one's behavior and emotions to reach goals; and
- **the interpersonal domain**, which involves expressing information to others, as well as interpreting others' messages and responding appropriately.

The committee then took several existing lists of "21st century skills" and, based on a content analysis, grouped them within these three domains.

The figure above links similar competencies together, groupings that provide a starting point for further research on the competencies' meaning and value.

THE IMPORTANCE OF 21ST CENTURY COMPETENCIES

The committee examined evidence on the importance of 21st century competencies within the three domains for positive outcomes in education, work, health, and other areas. They reached the following conclusions:

- The available research is limited and primarily correlational in nature. To date, only a few studies have demonstrated a causal relationship between one or more 21st century competencies and adult outcomes.
- Cognitive competencies, which have been more extensively studied than interpersonal and intrapersonal competencies, show consistent, positive correlations of modest size with desirable outcomes in education, the workplace, and health.
- Among intrapersonal and interpersonal competencies, conscientiousness – being organized, responsible, and hardworking – shows the strongest correlation with desirable work and educational outcomes. Anti-social behavior, which has both intrapersonal and interpersonal aspects, is negatively correlated with these outcomes.
- Educational attainment – the total number of years a person spends in school – strongly predicts adult earnings, as well as health and civic engagement. It may be that schooling builds some mix of cognitive, interpersonal, and intrapersonal skills that are valued by the labor market.

If so, making it possible for students to get more education may itself be a useful complementary way to develop 21st century competencies.

More research is needed to increase our understanding of the relationships between particular twenty-first century competencies and desired adult outcomes.

Over a century of research on transfer has yielded little evidence that teaching can develop general cognitive competencies that are transferable to any new discipline, problem or context, in or out of school. Much of the research has been carried out in the cognitive domain and it shows that transfer does occur but is limited in scope. Studies of interventions to teach social and emotional skills suggest that these also support transfer beyond the immediate context in which they were acquired, affecting students' behavior throughout the school day. More research is needed to illuminate whether, and to what extent, competencies learned in one discipline or context of application can generalize and transfer to other disciplines or contexts.

The committee found not only that deeper learning develops 21st century competencies, but also that the relationship flows both ways: 21st century competencies can aid the process of deeper learning in a discipline or subject area. For example, deeper learning to develop expertise in a discipline or subject area requires months of sustained, deliberate practice – a process supported by the intrapersonal competency of conscientiousness.

TEACHING FOR DEEPER LEARNING

Emerging evidence indicates that cognitive, intrapersonal, and interpersonal competencies can be taught and learned in ways that support transfer. Research in the cognitive domain has also identified features of instruction that are likely to support transfer within a given subject area. For example, transfer is supported when instruction helps learners understand the general principles underlying the specific examples included in their original learning. Teaching that emphasizes not only content knowledge, but also how, when, and why to apply this knowledge is essential to transfer. Instruction should follow these research-based teaching methods:

- **Use multiple and varied representations of concepts and tasks**, such as diagrams, numerical and mathematical representations, and simulations, along with support to help students interpret them.

- **Encourage elaboration, questioning, and explanation** – for example, by prompting students who are reading a history text to explain the material aloud to themselves or others as they read.
- **Engage learners in challenging tasks**, while also supporting them with guidance, feedback, and encouragement to reflect on their own learning processes.
- **Teach with examples and cases**, such as modeling step-by-step how students can carry out a procedure to solve a problem while explaining the reason for each step.
- **Prime student motivation** by connecting topics to students' personal lives and interests, engaging students in problem solving, and drawing attention to the knowledge and skills students are developing and their relevance, rather than grades or scores.
- **Use “formative” assessments**, which continuously monitor students' progress and provide feedback to teachers and students for use in adjusting their teaching and learning strategies.

DEEPER LEARNING IN STANDARDS DOCUMENTS

The committee found important areas where goals for deeper learning and 21st century competencies overlap with the new Common Core State Standards in English language arts and mathematics and the NRC Framework for K-12 Science Education. All three documents highlight the importance of helping students understand the general principles underlying specific content, a hallmark of deeper learning. A cluster of cognitive competencies—including critical thinking, nonroutine problem solving, and constructing and evaluating evidence-based arguments—is included in all three disciplines. Coverage of other competencies—especially those in the intrapersonal and interpersonal domains—is uneven. Developing the full range of 21st century competencies within the disciplines will require systematic instruction and sustained practice, a change from current practice that will require additional instructional time and resources.

MOVING FORWARD

Because 21st century competencies support deeper learning of school subjects, their widespread acquisition could potentially reduce disparities in educational attainment, preparing a broader swathe of

young people for successful adult outcomes in work and other areas of life.

However, important challenges remain in two major areas. First, research and development is needed to create and evaluate new curricula based on the research-based instructional methods described above, and to find valid ways to assess cognitive, intrapersonal, and interpersonal skills. Second, at the level of education systems and policies, new approaches to teacher preparation and professional development will be needed to help instructors acquire a deep understanding of the role of 21st century competencies in learning core academic content and create environments that support students' learning of these competencies.

To help address these systemic issues, the states and the federal government should establish policies and programs – in the areas of assessment, accountability, curriculum and materials, and teacher education – to support students' acquisition of transferable knowledge and skills.

RESEARCH NEEDS

Far more research is needed to fill gaps in the evidence base on deeper learning and 21st century competencies. Foundations and federal agencies should support research aimed at:

- Establishing agreed-upon definitions of 21st century competencies and ways to measure and assess them.
- Better illuminating the relationships – particularly any causal relationships – between 21st century competencies and desired outcomes.
- Gaining a better understanding of whether, and to what extent, teaching for transfer within an academic discipline (such as mathematics) can facilitate the transfer of competencies across disciplines (for example, from mathematics to history).

COMMITTEE ON DEFINING DEEPER LEARNING AND 21ST CENTURY SKILLS

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