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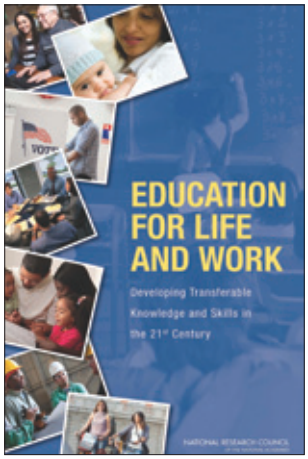
BOARD ON SCIENCE EDUCATION • BOARD ON TESTING AND ASSESSMENT

Education for Life and Work
Developing Transferable Knowledge and Skills in the 21st Century



Business, political, and educational leaders are increasingly calling on schools to teach students the wide range of skills they will need to navigate a rapidly changing world — skills such as problem solving, critical thinking, and collaboration. Such skills are often referred to as "21st century skills," "soft skills," or "deeper learning."

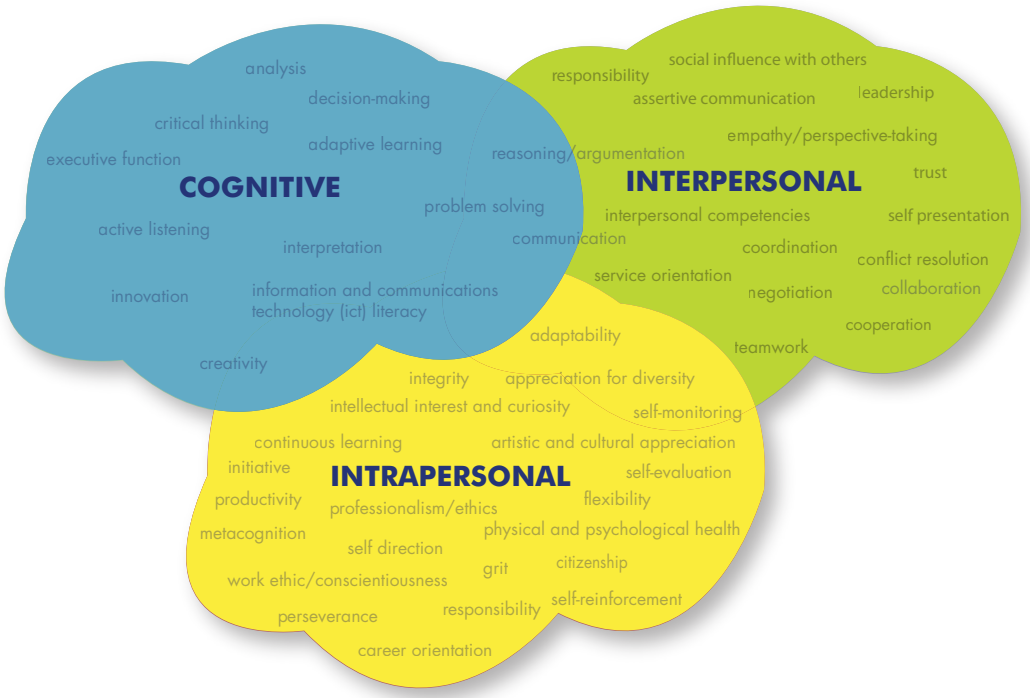
These skills are best developed within the teaching and learning of academic subjects — and in fact are key to helping students master academic subject matter, says a report from the National Research Council, *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*. By engaging in deeper learning, students go beyond rote learning of facts and procedures to understand underlying principles. They know when and how to transfer their knowledge and skills to solve new problems and navigate new situations.

This type of learning will be needed to meet the goals set by the new state standards for English language arts, mathematics, and science. And as technology reduces workplace needs for routine skills, success in coming years will demand people who can apply their knowledge and skills effectively to changing situations rather than rely solely on routine procedures.

But creating school environments that support deeper learning and the transferable knowledge and skills that result — known as "21st century competencies" — will require changes in teaching methods, curricula, and assessments. State and federal policymakers should support this shift, establishing policies and programs to help students develop transferable knowledge and skills.

DEEPER LEARNING AND 21ST CENTURY COMPETENCIES

Deeper learning, as defined in the report, 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. They don't simply learn isolated procedures or pieces of knowledge; they also learn when and why to use their knowledge and skills. They recognize when new problems or situations are related to what they have previously learned, and they can apply their knowledge and skills to solve them.



"21st century skills" grouped into three broad domains

For example, suppose a student experienced deeper learning about means, medians, and modes in mathematics. The student would not only know how to define and calculate these values, but also understand how and when each is best used. If the student later worked at a store that tracked average daily sales each month, he or she would likely recognize that a special sale on the first day of a particular month would skew the average and that an alternative measure like the median might better represent daily sales for that month. In contrast, a student who had only memorized the formulas for calculating means, medians, and modes would be less likely to understand which measure to use and why.

Through the process of deeper learning, students develop **21st century competencies** — knowledge and skills that can be transferred to new situations or problems within the discipline or subject area. Instead of the commonly used "21st century skills," the committee uses the broader term "competencies" to include both knowledge and skills.

Many foundations and organizations have developed lists of competencies that they believe to be important. The competencies vary widely — ranging from critical thinking and argumentation to flexibility and "grit" — but the committee found that they can be organized into three overarching domains:

- **the cognitive domain**, which includes thinking, reasoning, problem-solving, 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, and collaborating with others.

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.

So far, research on links between 21st century competencies and positive outcomes in education, work, and other areas of life has been limited. Cognitive competencies show consistent, positive correlations of modest size with desirable outcomes in education, the workplace, and health. Among intrapersonal competencies, conscientiousness — being organized, responsible, and hardworking — shows the strongest correlation with desirable outcomes. Anti-social behavior, which has both intrapersonal and interpersonal aspects, is negatively correlated with desirable outcomes. More research is needed to increase our understanding of the relationships between particular 21st century competencies and positive adult outcomes.

TEACHING FOR DEEPER LEARNING

Research has identified features of instruction that aid deeper learning and the development of transferable knowledge and skills. For example, instruction should help learners understand the general principles underlying the specific examples they

are taught. In addition, teaching should emphasize not only content knowledge, but also how, when, and why to apply this knowledge. As students gain understanding of how to use their content knowledge to solve problems and address challenges—both inside and outside the classroom—they will become more motivated to engage seriously in deeper learning.

Instruction should follow these research-based teaching methods:

- **Start with clear learning goals and a model of how learning is expected to develop**, a step that will help coordinate instruction and assessment.
- **Use multiple and varied representations of concepts**, such as diagrams, numerical and mathematical representations, and simulations, along with support to help students interpret them.
- **Encourage elaboration, questioning, and explanation** — for example, 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 to grades or scores.
- **Use "formative" assessment**, which continuously monitors students' progress and provides feedback to teachers and students for use in adjusting their teaching and learning strategies.

Although these methods were identified through research on cognitive knowledge and skills, they could also reasonably be applied to support the development of transferable interpersonal and intrapersonal competencies.

DEEPER LEARNING IN STANDARDS DOCUMENTS

The study committee found that goals for deeper learning and 21st century competencies converge with goals in 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. And all three documents support cognitive competencies such as critical thinking, problem-solving, and evidence-based argumentation. For example, the Common Core standards for English language arts emphasize that by the end of high school, students should be able to evaluate the reasoning in a text, assessing whether the evidence presented is sufficient to support its claims.

Coverage of other competencies — especially those in the interpersonal and intrapersonal domains — is uneven. Developing the full range of 21st century competencies within the disciplines will require systematic instruction and sustained practice, a change in approach that will require additional instructional time and resources.

NEXT STEPS FOR POLICY

Developing 21st century competencies will require significant shifts from current educational practice. States and the federal government should establish policies and programs to support students' development of transferable knowledge and skills.

Specific areas that need policymakers' attention include:

Curriculum. Funding agencies should support the development of curricula and instructional programs that include research-based teaching methods, such as those outlined above, to help students develop transferable knowledge and skills. In addition, policymakers should support the development and use of curricula that foster instructional techniques that focus on the process of thinking rather than only the products.

Assessments. The extent to which teachers will focus on helping students develop 21st century competencies will be strongly influenced by the degree to which these competencies are included in district, state, and national assessments. Currently, educational policies and accountability systems rely on assessments that emphasize recall of facts and

procedures, posing a challenge to wider teaching and learning of 21st century competencies.

However, recent policy developments offer an opportunity to address this challenge. With the support of the U.S. Department of Education, two large consortia of states are developing new assessments aligned with the Common Core State Standards. Through these consortia, states should work to ensure that these assessments — as well as those eventually developed based on new science standards — include tasks that call upon facets of 21st century competencies as applied in each of the major content areas.

Accountability. When reauthorizing the Elementary and Secondary Education Act, Congress should support the systemic development, implementation, and evaluation of educational interventions to facilitate deeper learning and the development of 21st century competencies.

Teacher education. New approaches to teacher preparation and professional development will be needed to help current and prospective teachers understand how to teach for deeper learning, as well as the role of deeper learning and 21st century competencies in helping students master core academic content. Currently, the instructional practices described above are rarely reflected in the knowledge and practices of teachers and school administrators.

RESEARCH NEEDS

Foundations and federal research agencies should support studies to fill research gaps on teaching and learning for transfer. In particular, research is needed to:

- increase our understanding of the relationships between 21st century competencies and adult outcomes;
- shed light on how to design instruction to help students develop transferable knowledge and skills in the interpersonal and intrapersonal domains; and
- determine whether and to what extent knowledge and skills developed in one discipline or subject area can transfer to another.

COMMITTEE ON DEFINING DEEPER LEARNING AND 21ST CENTURY SKILLS

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