

The 21st-Century Skills Movement  
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We need a citizenry that is able to communicate, solve problems, master computers, think critically, innovate, and adapt. The movement to teach these 21st-century skills tries to fill a genuine need. That's the patriotic reason that so many powerful groups are supporting the P21 skills movement. Its critics, on the other hand, are concerned that the emphasis on hands-on skill-projects will shift class time away from subject matter and therefore *impair* the skills students need to be productive citizens and participants in the workforce. These worries are well founded.

I am going to restrict my time to sketching how these important skills are being misconceived by P21, and go on to show how the movement needs to adjust to the underlying realities of these skills if our schools are to have any chance of actually imparting critical thinking, problem solving, creativity, and communication ability.

The idea behind the P21 recommendations is that once students have gained critical-thinking and problem-solving skills they will be able to transfer them to new and unfamiliar domains of experience. This idea of transferability to new domains is *the* fundamental idea of the P21 project, as stated explicitly in the P21 white paper entitled: "The Intellectual and Policy Foundations of the 21st Century Skills Framework." Once we learn how to be creative, how to think critically, and so on, we can apply those skills to unforeseen new challenges. This is the how-to conception of education.

P21's "Framework for 21st Century Learning," viewable [here](#).

Many, many years ago, when I was a newly-minted teacher at Yale, I had a memorable experience which was so striking that it made me receptive to the work in psychology indicating the non-transferability of thinking skills. I was participating in a conversation that included two world-class logicians, Alan Ross Anderson and Nuel Belnap. The topic was foreign policy. In the course of the conversation both of them made some unjustified inferences. Yet Anderson and Belnap are the celebrated authors of *Entailment: The Logic of Relevance and Necessity* in two volumes. They wrote the book on critical thinking. But in that particular conversation they lacked crucial factual information -- which seemed to make them just as prone to incorrect inferences as any other ill-informed person might be.

There are many reasons for the difficulty of transferring critical thinking and other 21st-century skills from one domain to another, but here's a decisive reason. A central feature of such skills is the drawing of inferences, a skill that has been mastered by all who speak a language. Every time we understand what someone says we are making inferences. The inference-making skill is observable even in 6-month-old infants, as Alison Gopnik and her colleagues explain in *The Scientist in the Crib*.

But inference-making is not purely formal process. When the skill fails it's usually because information is lacking. Inference-making can be described as supplying missing premises from one's own prior knowledge in order to complete a kind of syllogism. The purely transferable elements of thinking skills turn out to be minor elements that are easily acquired. What really counts is relevant knowledge about the problem at hand. In the scientific literature the key term is "domain-specific knowledge." Being a problem solver in one domain does not automatically make you skilled in another.

Is this true of all the 21st-century skills? What about creativity and innovation? Today there is a significant body of mainstream research on the nature of creativity. It says that skills like creativity and innovation are not how-to skills any more than critical thinking is. A recent research article carries the title: "Could Steven Spielberg manage the Yankees?" The answer is "no." The how-to elements of creativity, problem solving, language comprehension, and critical thinking are far, far less important than domain-specific knowledge.

Unfortunately, the heart of this new movement is the conception that 21st-century skills are all-purpose muscles that, once developed, can be applied to new and unforeseen domains of experience. This error is fundamental, and it is fatal. It will lead to the same disappointments as the idea that reading comprehension is a how-to skill that can be developed through strategy drills. On the contrary, reading comprehension, communication, critical thinking, and the rest are *inherently* constituted by specific knowledge. More than that, if you have domain knowledge yet lack mere technical proficiency, you will nonetheless perform *more skillfully* than a proficient person who lacks relevant knowledge. There are many experiments supporting this, going back to de Groot's famous 1946 experiments with chess masters. Incautious claims about the *transferability* of 21st-century skills from one domain to another are very misleading. No, let me put it more strongly. The how-to concept is just plain wrong.

This misconception explains why the P21 lesson plans are so indifferent to the dangers of wasteful opportunity costs in school. After all, if the main purpose isn't the gaining of knowledge but the development of all-purpose mental muscles, it doesn't much matter which exercises are used to develop them. Here's a class project in social studies from the P21 web site, designed to teach the skill of "Framing, analyzing and synthesizing information in order to solve problems."

All fourth graders in a school take an online survey about their sports and hobby interests, and results are reported in graphs on the school web site. Students use GIS and GPS to find the location of areas in which these sports can be played throughout their community and post the results online.

This project is helpful in learning to use GPS and make graphs, but that would need to be learned in any case before one could even begin this tedious, time-wasting project.

Nonetheless, the goals of P21 are right. We *do* need to teach all-purpose skills for an unpredictable and changing world. And in fact some people possess these skills. How did they manage it?

Since they can't have acquired all-purpose mental muscles, which science has shown don't exist, maybe they are just smarter than the rest of us. High IQ does help, but it's not the main story. Here's a third possibility: effective people have gained 21st-century skills because they have domain knowledge in a wide range of domains. This turns out to be the *only* answer consistent with a massive body of evidence.

How Do We Know Whether A Person Actually Possesses 21st Century Skills?

Besides the evidence from psychology, we have a highly validated test that can predict whether or not a person will in fact exhibit 21st-century skills. Level of performance on this test predicts the level of one's on-the-job critical thinking, problem solving, and collaborative ability. Scores on the test also predict one's real-world economic level; when scores on the test are taken into account, the notorious income gap between whites and blacks virtually disappears.

It is the Armed Forces Qualification Test (AFQT), administered every year to over 1 million people as a screening test for enlistees and as a counseling device in high schools. Anyone can go online and take it at [military.com](http://military.com).

You will need to give yourself plenty of time because the full battery is a long test. I took the first three parts before other duties intervened. A few days later I got a telephone call from a Navy recruiter, whose interest dimmed when I told him I was 80 years old and was taking the test for research. Here's one of the questions I encountered:

12: Which of the following statements about diffusion is false?

- A. Diffusion is very effective over very short distances.
- B. Diffusion requires energy to do its work.
- C. The diffusion of water is called osmosis.
- D. Diffusion is the movement of molecules from a greater to a lesser concentration.

The desired false answer is A. It's false to say that diffusion is effective over very short distances. But that error is not a fact we have merely rote-learned. We have to infer it from our general scientific knowledge by knowing that diffusion is a probabilistic process whose effects can be predicted only with large numbers of molecules. In a tiny volume all kinds of oddball things will be going on, including movements of molecules from a lesser to a *greater* concentration.

Taking the full The Armed Forces Vocational Aptitude Battery is rather exhilarating. It turns out to be a serious probe of knowledge across a wide range of domains. There we have it. The Armed Forces Vocational Aptitude Battery is essentially a test of general knowledge. This fact fits in with everything we know about 21st-century skills. They are knowledge based. Knowledge is skill: skill knowledge. A high score on a general knowledge test tends to correlate with 21st-century skills because the *only* reliable foundation for such skills is the possession of wide-ranging knowledge across many domains.

#### The Actual Character of 21st Century Skills

Hence the only effective system of schooling for developing 21st-century skills is one that will impart knowledge effectively across the key domains of modern life. The current proposals of P21 focus on time-wasting projects even as its advocates offer bland assurances that they are in favor of *both* knowledge and skills. Yet by suggesting that they are in favor of *both* things they misconceive the issue. There are not two things. They are not like this:

P21's "Framework for 21st Century Learning," viewable [here](#)

Nor like this:

[photo of hard-boiled egg, cut in half]

But like this:

[photo of scrambled egg]

You can't unscramble an egg.

Let it be said that no one is in favor of imparting knowledge in a mindless way. Rather, our schools should encourage critical thinking through a coherent subject-matter curriculum that progresses cumulatively without boring repetitions or serious omissions. That is precisely the kind of curriculum followed by nations like Finland and Japan whose students outperform ours on tests of problem-solving ability.

To develop the skills our students need, we need to abandon the notion that skills are separable, transferable abilities. If we press forward with the 21st Century Skills initiative as it stands, with more states and districts signing on, it may take another decade for disillusionment to set in. By then we will have further weakened student achievement and compromised our competitiveness. Children need these important skills. But they will not acquire them without a broad, well-rounded general education. Skill is knowledge. There are no shortcuts.

Thanks.