SETTING THE STANDARD FOR PROJECT BASED LEARNING

A PROVEN APPROACH TO RIGOROUS CLASSROOM INSTRUCTION

JOHN LARMER || JOHN MERGENDOLLER || SUZIE BOSS

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Preface

Project based learning (PBL) is not a new instructional approach, but it now has a new respectability and an ever-growing number of proponents. The Buck Institute for Education (BIE) has played a central role in PBL's growth, and for the past 20 years, it has worked to identify and shape PBL best practices. Initially this effort seemed pointless in an era of "covering standards" and test-based accountability. Rigor was defined by recitation and excellence by compliance. But times have changed. Current concerns with college and career readiness, and the performance-based emphases of Common Core State Standards, have caused educators to take another look at project based learning and recognize its ability to not only help students develop deep content understanding, but also to help students learn and practice the skills they will need for college, career, and life success.

A Google search for "project based learning" yields over 3,000,000 results. Newspapers feature back-to-school stories about PBL. Parents and school boards are encouraging their schools to adopt PBL, and many charter schools are making it a centerpiece of their program. An ever-growing number of PBL teachers are connecting online to share ideas and to blog about their experiences. You can find 30,000 of them in the BIE PBL Community on Edmodo (see https://www.edmodo.com/publisher/biepbl). More and more publishers and curriculum providers are producing materials to meet the demand. Organizations such as New Tech Network, Asia Society International Studies

Schools, Expeditionary Learning Schools, Envision Schools, and the National Academy Foundation's career-oriented academies, which place PBL at their instructional core, have grown dramatically. Virtually every national and state education conference has sessions about PBL. The methodology of AP classes and the nature of the SAT are adapting to meet the movement toward PBL. Momentum is building.

Popularity, though, has an unavoidable result: variation in quality. Project based learning, like any worthwhile instructional method, requires time, thought, and careful planning to achieve quality. If PBL is not done well, its reputation will suffer. Poorly designed and poorly executed projects can result in wasted time, misdirected student energy, and failure to achieve learning goals. Some projects might be "too loose," with students taking part in a variety of activities that do not add up to much beyond "fun" and a low-quality product or two. On the flip side, some teachers might simply add a group report and presentation to a traditionally structured unit and call that a project—which will fail to yield the promised benefits of PBL. Another threat to the reputation of PBL comes from what we call "dessert projects" (more on that in Chapter 4), which are hands-on activities that are easily completed with little planning, thought, or research. Do we really need to see another classroom stocked with sugar-cube pyramids or Styrofoam solar systems? To ensure that PBL doesn't become another one of yesterday's innovations (remember open classrooms?), we need to make sure that the best PBL practices rise to the top.

In 2010, BIE wrote an article for ASCD's *Educational Leadership* magazine entitled "7 Essentials for Project Based Learning" to describe what differentiated rigorous PBL from simply "doing projects" that bordered on busywork. Our publications and professional development workshops for teachers were infused by these "Essential Elements"—later increased to 8 with the addition of "Significant Content" as a reminder that PBL was meant to teach content, not just build "soft skills" as some stereotypes had it. Those 8 Essential Elements have served us well in promoting effective classroom practices, but now it's time to step it up a notch with a more comprehensive, research-based model for PBL.

We've written this book to help teachers and school leaders understand and implement the highest-quality project based learning—what we refer to as *Gold Standard PBL.* As you will see, a number of educational thinkers and researchers have contributed to the development of Gold Standard Project Based Learning, which brings together proven instructional practices and learning strategies. Gold Standard PBL is systematically planned and carefully facilitated, and the work students do is assessed, both formatively and summatively, by teachers, students, and often an external audience.

Gold Standard PBL involves more than students working to complete products; it explicitly includes teachers and the judicious use of traditional instructional practices—what we call *project based teaching.* PBL requires much more of the teacher than finding or creating a project and then turning it over to the students. Teachers' modeling, explanation, scaffolding, and coaching, among other traditional instructional methods, continue to be important. Teachers also need to help students adjust to the new learning demands of PBL, a process that requires time for students to develop new skills and self-expectations (Schmidt, Boshuizen, & de Vries, 1992).

To develop this new model for Gold Standard PBL, we have ourselves used best PBL practices. We collaborated with our board of directors and as a staff. We engaged in an iterative process of critique and revision, by sharing our work-in-progress at the PBL World gathering in June 2014, in several blog posts, in numerous conference presentations, in meetings of our 60-strong National Faculty, and with a group of representatives of several PBL-savvy organizations. We reflected on what we heard—resulting in 42 draft versions of the Gold Standard language—and are now ready to make our work public.

We believe PBL is vital for preparing young people for the modern world, and we want to help ensure that PBL becomes a regular practice in more and more classrooms. Making this vision a reality will require the combined efforts of teachers and school leaders—and, of course, students—with the support of parents and communities. We've written this book with all these stakeholders in mind.

This book is intended to be practical as well as visionary and inspirational. Our first three chapters make the case for PBL, describe

what Gold Standard PBL looks like, and provide an overview of what research says about PBL. The middle chapters explain how teachers can successfully design and manage projects, including notes and examples for teachers in the primary grades through high school. Following this is a chapter for school and district leaders, because their supportive policies, structures, and culture are what will make PBL a systemwide practice. Finally, we discuss the possibilities for PBL in informal education spaces such as after-school clubs, community programs, and summer learning. Appendix A contains sample projects of a variety of types, in a wide range of grade levels and subject areas.

Project based learning is gaining traction around the world. A growing number of educators on every continent recognize the need for new approaches to teaching and learning in the 21st century. Three of the project snapshots you'll read about and that are described in Appendix A attest to PBL's global appeal; they are from Mumbai, India, Manitoba, Canada, and Crestmead, Australia. In recent years we've also gotten to know educators interested in PBL from Canada, Mexico, Korea, England, China, South Africa, Singapore, Costa Rica, Pakistan, Japan, Brazil, Jordan, Taiwan, the Dominican Republic, and many more places. Although we use terminology and descriptions of schooling drawn mainly from the United States' system of education, we think the project design principles and management practices we recommend can be applied anywhere.

We hope this book will bolster the few who are already doing Gold Standard PBL, guide the many who want to improve their practice of PBL, and lead many more to begin using PBL with their students—all of whom need and deserve it.

John Larmer
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Novato, California

1 Why Project Based Learning?

In the hundreds of "PBL 101" workshops conducted each year by the Buck Institute for Education across the United States and in other nations, we ask teachers and administrators to describe an "ideal graduate" from the K–12 system. Our school and district partners sometimes do the same exercise in their communities with parents, people from local businesses and civic organizations, and other stakeholders. Every time, everywhere, the lists generated are remarkably similar, with items such as these:

- Problem solver
- Responsible
- Works well with others
- Can work independently
- Critical thinker
- Confident
- Manages time and work effectively
- Communicates well with a variety of people

When asked *how* students learn these qualities of an ideal graduate, teachers and administrators say that it sometimes happens in traditionally taught classrooms, but they acknowledge that it's inconsistent at best. Our workshop participants then go on to learn how

project based learning (PBL) provides opportunities for students to build these qualities, as well as more deeply learn traditional academic content and understand how it applies to the real world.

We do have to be wary of excessive hype in today's education landscape. Some advocates for PBL make it sound like a cure-all for what ails schools: PBL will inspire and motivate passive students, restore the joy of teaching, rebuild communities, help solve world problems, and… dramatically raise test scores! Although PBL is not a panacea, there is some truth behind (most of) these claims. We can confidently state that project based learning is a powerful teaching method that does the following:

- Motivates students.
- Prepares students for college, careers, and citizenship.
- Helps students meet standards and do well on tests that ask students to demonstrate in-depth knowledge and thinking skills.
- Allows teachers to teach in a more satisfying way.
- Provides schools and districts with new ways to communicate and to connect with parents, communities, and the wider world.

Let's take a closer look at how PBL benefits students, teachers, and schools.

Motivating Students

Elementary school children are typically motivated to learn and do good work in school because they arrive with a natural desire to learn about the world and they want to be able to read, write, and use numbers. They also tend to like and want to please their teachers, and the teaching methods—especially in the primary grades—often still have an element of fun and play. But even young students may grow tired of worksheets, drills, or other traditional instructional methods if such approaches are used too much.

Once they reach middle school and especially high school, many students report that they are not engaged at school for much of the

time. Some might still be motivated by the desire to earn good grades and please their teachers and parents, but far too many simply go through the motions of listening to their teachers, completing assignments, doing homework, and studying for tests. Even many "model" students with high GPAs who take challenging courses admit that, although they know how to play the game of school, they don't find their work intrinsically interesting or meaningful. Generally speaking, students are driven to learn by external factors, not the real "need to know" that is one of the keys to PBL's motivational effect.

The High School Survey of Student Engagement (Yazzie-Mintz, 2010) surveyed 275,925 students in the United States from 2006 to 2009. It found that 49 percent of students in grades 9 through 12 reported being bored in at least one class every day; another 17 percent were bored in every class, every day. In response to a question about why they were bored, the students gave various reasons, with these as their top three:

- "Material wasn't interesting" (81 percent)
- "Material wasn't relevant to me" (42 percent)
- "No interaction with teacher" (35 percent)

The students were also asked about what instructional methods engage them most. Here are their top four responses:

- Discussion and debate (61 percent)
- Group projects (60 percent)
- Projects and lessons involving technology (55 percent)
- Student presentations (46 percent)

Grant Wiggins, author and cofounder of Understanding by Design, found similar results when he recently surveyed students at a "typical American high school" in a Midwestern suburban community. Most students reported being bored much of the time and suggested that teachers should "make learning active and fun," do more "hands-on activities," and provide opportunities to "discuss my ideas with others" (Wiggins, 2014).

More Motivated, Better Behaved

Experienced teachers know that when students are deeply engaged by a topic or a task, a lot of classroom management issues fade away. Students who used to disrupt class behave differently when they're doing active work on a project that engages them (Lambros, 2002). Students who previously did not do their assignments, or turned in shoddy work, become more responsible and step up their work quality when they care about a project.

The results of these surveys clearly point to the need for instruction that's more engaging, and project based learning is just that. Interesting and relevant topics, issues, and challenges are central to every well-designed project. Interaction with the teacher is likewise baked into the whole process, as we describe in detail in the following chapters. Discussions and debates occur frequently in projects, whether as a whole class or in small groups. Most projects today involve technology to some extent, and student presentations are also a key element.

A survey of gifted high school students showed they, too, were often bored and disengaged from classroom learning (Kanevsky & Keighley, 2003). The researchers listed five features that distinguished "boring from learning experiences": control, choice, challenge, complexity, and caring teachers. Once again, project based learning fits the bill.

Motivating Students to Stay in School

Students drop out of school for many reasons, and one of them is being bored and disengaged. According to a 2006 report on high school dropouts (Bridgeland, Dilulio, & Morison), the response "classes were not interesting" was the top vote-getter in surveys, a reason given by 47 percent of students. When asked in the survey about what might help them stay in school, 81 percent of the students said there should be more real-world learning. The report's authors recommended that schools "improve teaching and curricula to make school more relevant and engaging and enhance the connection between school and work" (p. iv). This is exactly what well-designed project based learning does.

Motivating Students to Stay in School—(*continued*)

In another study of the dropout problem (Balfanz, 2007), the author noted an additional benefit that projects give to students who are at risk:

> It is also paramount that avenues for short-term success through projects, performances, and experiential learning be built in. If you enter high school significantly below grade level it will require hard work and considerable time to produce quality high school work. In the meantime, students need to be experiencing success. (pp. 19–20)

Preparing Students for College, Careers, Citizenship, and Life

Much of the talk about getting students "ready for college and career" focuses on making sure they take the right courses and learn enough in math, science, English/language arts, history, and other subjects. But being ready for the next step beyond the K–12 school system has another aspect, which has more to do with attitudes, habits, and skills that fall outside the boundaries of traditional academic disciplines.

A major study (Conley, 2005) of what it takes to succeed in entry-level college courses found the following general "habits of mind" to be key, along with subject-specific knowledge and skills:

- Critical-thinking skills
- Analytical-thinking skills
- Problem-solving skills
- Open to and utilizes critical feedback
- Open to possible failures at times
- Clear and convincing written and oral expression
- Can weigh sources for importance and credibility
- Can draw inferences and reach conclusions independently
- Time management skills

When employers are asked what it takes to succeed in the workplace, in addition to job-specific knowledge and skills, they generate a similar list. Take a look at one example:

- Critical-thinking and analytical-reasoning skills
- The ability to analyze and solve complex problems
- The ability to effectively communicate orally
- The ability to effectively communicate in writing
- The ability to apply knowledge and skills to real-world settings
- The ability to locate, organize, and evaluate information from multiple sources
- The ability to innovate and be creative
- Teamwork skills and the ability to collaborate with others in diverse group settings (Hart Research Associates, 2013, p. 8)

The consensus is clear: students need more than basic subject-area knowledge. The competencies and personal qualities included in these various lists have been given many names: 21st century skills, cross-curricular skills, soft skills, interdisciplinary skills, habits of mind and work, deeper learning, and college- and career-readiness skills. We call them "success skills." Some are as old as Socrates; some are products of the modern age. But can traditional schooling meet the need to teach them?

As we mentioned at the beginning of this chapter, many of the things educators, parents, colleges, and employers want to see in a graduate tend to fall between the cracks of traditional subject areas and teaching methods. Some teachers might teach, say, critical-thinking skills as they pertain to a specific discipline, but others may not at all. And even if such opportunities are provided, they may only be implicit or assumed to be embedded in an assignment or activity.

But a good project brings it all together like nothing else can. In PBL done well, students not only find themselves needing to use college- and career-readiness skills; they are explicitly taught them, assessed on them, and asked to reflect on their growth in them. Students who graduate from school systems in which they have completed multiple projects over the years will have had many more opportunities to gain these skills, and systematic support in doing so, than students who have had only scattered or unfocused opportunities.

By the way, we are *not* saying that students should learn college- and career-readiness skills at the expense of learning how to read, write, do math, and know something about history, literature,

and other traditional subjects. Even though information on any topic is readily available in our digital age, people still need some background knowledge to be able to make sense of the information and to be well-rounded, culturally literate members of society. Learning key knowledge and understanding should always be one of the twin goals of a project, along with gaining key success skills. After all, students need something to think critically or communicate *about* in a project, and they can't solve a problem simply by applying a process devoid of content knowledge.

College Challenges

When some educators and parents hear about PBL, they might say, "But that's not how students are taught in college, so wouldn't we be doing them a disservice? Shouldn't they learn to listen to lectures, take notes, and take tests that measure how much information they've memorized?"

We offer two responses to this concern. First, it's true that listening and note taking are important skills that students should practice in high school, but such opportunities can be included within a project. Contrary to some stereotypes, there's still room for lectures in PBL. During a project, the best way for students to learn something—once they see a genuine need to know it—might, in fact, be a lecture by the teacher. Or they might be called upon to interview an expert and take notes. Likewise, a test on content knowledge might be an effective and necessary assessment tool in a project.

Second, as students advance through college they will encounter more and more courses that are not lecture based. Even at fairly traditional colleges and universities, undergraduates will be asked to work in teams, to use knowledge in real-world applications, to analyze problems, and to communicate findings to an audience. A growing number of postsecondary institutions are using an explicitly project-based approach, particularly in the fields of engineering, architecture, and business. Olin College of Engineering, for example, emphasizes collaborative projects throughout its curriculum. Harvard University's undergraduate Applied Physics 50 course is entirely project based (Perry, 2013). Stanford University's popular Design for

Extreme Affordability and MIT's D-Lab are multidisciplinary project based courses in which students develop products and services for the world's poor.

Additionally, students who develop a sense of being independent learners through PBL are well prepared for the self-advocacy and initiative it takes to thrive in a college environment. Although the findings are preliminary, because most of its graduates have not yet completed college, students from the PBL-infused New Tech Network high schools have been found to have high rates of persistence into their second year of college (New Tech Network, 2014). Envision education schools show similar results (www.envisionschools.org/impact/). A 2014 study found high rates of college success among students from high schools that feature "student-centered instruction," which researchers defined as including project based teaching, collaborative learning, relevant curriculum, and performance-based assessments (Friedlaender, Burns, Lewis-Charp, Cook-Harvey, & Darling-Hammond, 2014). For example, 97 percent of the graduates from City Arts and Technology High School in San Francisco who enrolled in four-year colleges were still enrolled in their fourth year, as were 69 percent of the graduates from Life Learning Academy in Oakland. Both schools far exceeded national averages for their high-minority populations, which included many students who were the first in their families to attend college.

The Modern Economy

School systems designed more than a century ago to send workers into that era's industrial economy emphasized only the basics: the 3 Rs and a little knowledge of history and civics. Factory jobs did not require much else and mainly called for the ability to follow routines. Although jobs like that still exist, they're fewer in number, and even those require more complex skills than they used to.

In today's "knowledge economy," success at most jobs demands the kinds of skills seen on the lists presented earlier in this chapter. The report *Dancing with Robots: Human Skills for Computerized Work* (Levy & Murnane, 2013) makes the case that because of technology, "the future of middle-class work will necessarily have to rely on

uniquely human brain strengths" such as flexibility, solving nonstandard problems, and working with new information and communicating it to others (p. 4).

On the job, and even in college, people also benefit from having leadership skills. It pays to be able to organize a team, get others to do their best work, and manage a complex, extended set of tasks that must be accomplished by a deadline. Projects provide students—sometimes especially those who are not the typical leaders in a classroom—with multiple and varied occasions to build these kinds of skills. Equally valuable are self-management skills, such as being able to organize one's time and tasks, work independently, handle stress, and take the initiative. Rigorous projects require all of the above.

Finally, it's a fact in today's economy that most people will change jobs several times, requiring them to stay flexible and to know how to learn new skills. Students get practice in this by taking on new and varied roles in projects. In a shifting economy, personal qualities such as persistence and resilience—also known as grit—will come in handy. A project-based environment in school helps build these capabilities, as students investigate questions and issues that do not lead them down a straightforward path. It's almost a given that any project will involve unexpected twists and turns, setbacks, reconsideration of ideas, and recognition that something more must be learned.

Citizenship and Life

Becoming an informed, active citizen in a community, state, or nation requires many of the same skills asked for by colleges and employers. Whether it's discussing issues with fellow members of a community, asking a government or a corporation to address a need, negotiating a bureaucracy to get something done, or simply voting in an election, it pays to be able to think critically, evaluate information, communicate well, and make defensible decisions. And just as in the workplace, citizens in a diverse society must be able to work well together to identify and solve problems.

Finally, we should also note that PBL helps prepare young people for life in general, where adults tackle many "projects," from planning

a wedding to building a toolshed to taking a road trip. Everyone can benefit from learning how to set goals, plan a complex undertaking, gather resources, and successfully complete a "performance-based assessment."

Helping Students Meet Standards and Do Well on Rigorous Tests

Most states in the United States, whether they have updated their own standards or adopted the Common Core State Standards (CCSS) for English/Language Arts and Mathematics, are asking students to reach new kinds of learning goals, for which PBL is especially well suited. A growing sense is developing in the United States and around the world that knowing a lot of facts (which older standards documents often listed at length) is not enough for today's students. Information in the modern world is easily accessible; what's needed is the ability to ask the right questions, find the best information, and apply it to the real world. So rather than "cover content," these standards ask teachers to help students gain deeper conceptual understanding and learn how to apply their knowledge.

Recent standards also emphasize the interdisciplinary, 21st century competencies described earlier. Here are some examples from states that have not adopted CCSS:

- *Texas Essential Knowledge and Skills for English Language Arts and Reading:* "Students work productively with others in teams."
- *Indiana Academic Standards, English Language Arts:* "Create engaging presentations that include multimedia components."
- *Virginia Standards of Learning, English:* "Analyze, evaluate, synthesize, and organize information from a variety of sources to produce a research product."

Common Core State Standards and PBL

"Aligned with CCSS" is a claim made all too readily these days by school district curriculum committees, publishers of instructional

materials, and purveyors of educational tools and programs. But to say project based learning "aligns" with the Common Core State Standards is an understatement. Although we can't claim that PBL is the *only* way to achieve the goals of the Common Core, it is one of the *best* ways. As we said in the preface, PBL's recent popularity is evidence that educators are recognizing this.

It's widely acknowledged that instructional methods have to change in order to meet new standards. We believe PBL should be one of the key methodologies in every teacher's toolbox, for two reasons. First, PBL reflects the broad implications and underlying principles of the standards:

• *Fewer standards, more depth (ELA and mathematics)*—Well-designed projects have always emphasized deep conceptual understanding and critical thinking when solving problems, developing and answering a driving question, and creating high-quality products.

• *More emphasis on reading informational text in a variety of content areas (ELA)*—Many projects are interdisciplinary and create a purposeful context for reading a wide variety of texts to find information, from reference books to new media, from expert interviews to web pages.

• *More emphasis on inquiry and evidence-based reasoning (ELA)*—Close reading of a text in search of meaning is a form of inquiry—an important skill that is often built into a project. The standards also call for students to ask questions, do research, evaluate sources, and develop well-supported answers—processes that are fundamental to PBL.

• *Real-world applications (mathematics)*—The Common Core's Standards for Mathematical Practice highlight the ability to apply math to solve "problems arising in everyday life, society, and the workplace"—exactly what happens in a good project.

Second, a project enables a teacher to teach several specific standards in one context rather than as isolated lessons. For example, students could learn, through various assignments and activities scattered throughout a year of traditional instruction, how to make

multimedia presentations, have collegial conversations with peers, and conduct research to investigate a self-generated question (all of which appear in new standards for ELA). But imagine how much more frequent and focused the opportunities to build these skills would be if students were engaged regularly in projects that require them every time.

Most ELA standards for reading and language, as well as standards for mathematics, could be taught in the context of projects. But some specific standards for ELA are especially well suited for PBL, as shown in Figure 1.1.

New and Revised Assessments

For states that are members of either the Smarter Balanced Assessment Consortium (SBAC) or the Partnership for Assessment of Readiness for College and Careers (PARCC), PBL is an excellent "test prep" methodology—although most PBL practitioners would shun that term. One part of the tests these organizations are developing will be a performance task, in which students will have to *do* something rather than simply select the best multiple-choice answer.

For example, to measure research skills, the SBAC test asks students to read and compare various points of view on an issue, then write an evidence-based argument for a real-world situation (Smarter Balanced, 2014). Students who are used to the demands of a project will be comfortable with these kinds of tasks when they sit down to take the test. PARCC is developing similar research simulation tasks. Both groups are creating performance tasks for mathematics that call for modeling and application in a real-world context or scenario—familiar territory for students who have been taught with PBL.

Next Generation Science Standards

The Next Generation Science Standards (NGSS) are also a good fit with PBL. The standards were developed by a group of 26 states, with a writing team coordinated by Achieve, Inc. (see http://bit.ly/1iGN9c2). Like Common Core, NGSS marks a shift to a "focus on understanding and application as opposed to memorization of facts devoid of context" (Next Generation Science Standards, 2013).

Figure1.1 How PBL Applies to Common Core State Standards for English/Language Arts

CCSS for ELA	Application to PBL
Writing 6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.	Many projects feature a written product created with word-processing tools and self-publishing websites. Student project teams can use online tools for sharing documents, conducting meetings, and keeping track of tasks and deadlines.
Writing 7. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.	Most projects include research of some sort, whether it's reading a variety of sources to develop and support an answer to a driving question, conducting a scientific study, or interviewing experts, community members, or end users to inform the creation of a product. Student-generated questions that guide investigations are a hallmark of PBL.
Speaking and Listening 1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.	In a project, when students work in teams, they have regular and multiple opportunities to discuss plans, ideas, and products. They may also talk with outside experts, mentors, and family and community members.
Speaking and Listening 4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.	Projects culminate when students present their work to a particular public audience, depending on the nature of the project. In addition to showing their final product or explaining their answer to a driving question, students defend their reasoning and describe their process.
Speaking and Listening 5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.	When students present project work to a public audience, they must be clear and persuasive, choosing the most appropriate digital media and creating effective visual displays.
Speaking and Listening 6. Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.	Many projects require students to interact with other adults, not just teachers, and make presentations to audiences beyond their classmates and teacher, creating a variety of opportunities to practice formal speech.

Compared to earlier state standards for science, NGSS also has a much greater focus on engineering—a natural link to projects in which students design and build models, devices, structures, and other such products. The following NGSS "Science and Engineering Practices" align with practices common in PBL:

- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Some of the science standards, like many in Common Core, even point directly to potential projects:

- *Grade 3–5 Physical Science:* Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. (3-PS2-1)
- *Middle School Physical Science:* Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. (MS-PS1-6)
- *High School Life Science:* Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. (HS-LS2-7)

SAT, Advanced Placement, and Other Tests

In 2014, College Board President David Coleman, who helped write the Common Core State Standards, announced changes to the SAT test for 2016. Many of the changes reflect the PBL-friendly trend seen in CCSS and other recent state standards, such as a greater emphasis on thinking skills in ELA, coverage of fewer topics in math,

and "problems grounded in real-world contexts" (see https://www.collegeboard.org/delivering-opportunity/sat/redesign).

According to the College Board,

- The Evidence-Based Reading and Writing section will feature "continued emphasis on reasoning alongside a clearer, stronger focus on the knowledge, skills, and understandings most important for college and career readiness and success." (See https://www.collegeboard.org/delivering-opportunity/sat/redesign/compare-tests.)
- The Math section will feature "multistep applications to solve problems in science, social science, career scenarios, and other real-life contexts. Students will be presented with a scenario and then asked several questions about it. This allows students to dig into a situation and think about it, then model it mathematically." (See https://www.collegeboard.org/delivering-opportunity/sat/redesign.)

Advanced Placement courses and tests are also changing in ways that support greater use of PBL. According to the College Board, AP is shifting toward a "greater emphasis on… inquiry, reasoning, and communication skills" and "a balance between breadth of content coverage and depth of understanding" (see http://advancesinap.collegeboard.org/overview). The new exam and curriculum for AP Physics, AP Biology, and AP U.S. History are the first to reflect this shift.

In addition, AP has created a Capstone diploma program designed to "equip students with the independent research, collaborative teamwork, and communication skills that are increasingly valued by colleges" (see http://advancesinap.collegeboard.org/ap-capstone). This program, for which students accustomed to a PBL environment would be well prepared, requires them to do the following:

- Consider and evaluate multiple points of view to develop their own perspective on complex issues and topics.
- Hone critical- and creative-thinking skills.
- Ask questions and conduct inquiry and investigation.
- Work in teams.
- Make a public presentation, performance, or exhibition.

Another well-known test is considering changes that move in the direction of PBL. In *Leading Assessment into the Future*, a report for the National Assessment of Educational Progress (NAEP), a panel recommends using new technologies to "assess new constructs, such as critical thinking, problem solving, and collaboration" (NCES, 2012, p. 9).

An international test that already reflects the goals of PBL is the Programme for International Student Assessment (PISA). The test is given every three years to 15-year-old students in over 65 countries in schools that join the Global Learning Network, run by the Organisation for Economic Co-operation and Development (OECD). The network's goal is to "help more students succeed at globally competitive levels" (America Achieves, n.d.). PISA assesses how well students can apply their knowledge of reading, mathematics, and science in real-world contexts. It has recently begun offering a test of "creative problem solving" that measures students' ability to respond to a "non-routine situation"—which is exactly what every good project is (OECD, 2014).

Allowing Teachers to Teach in a More Satisfying Way

> *What we need are schools organized in ways that put the joy back into teaching and that do not confuse rigor with rigor mortis.*
>
> —Phil Schlechty

In today's era of standards, testing, and accountability, many teachers feel constrained in their choices about curriculum and instruction, or are actually told they must teach in a certain way. In schools where raising test scores is the be-all and end-all, a "test-prep" approach dominates, which might entail following a prescribed script for a lesson and using only approved instructional materials. All teachers must be on the same page on the same day, following a pacing guide. In our PBL workshops we've noted that many teachers who have entered the classroom in recent years, especially in the elementary grades, have not even had the opportunity to plan a unit. It's always been done for them.

Schools dominated by the need to raise test scores claim to have no time for "frills" (the arts and other untested subjects), connecting with the community, using technology in new ways, or teaching students how to work in teams and make presentations. They say it's impossible to spend the time it takes to create high-quality products students can be proud of. Pedagogies such as PBL are discouraged or even outright forbidden because they're seen as too unstructured and inefficient in terms of "covering" the standards.

Many teachers faced with this situation still find ways to inject their personality into the classroom and make their teaching as creative and lively as they can. Others go along with the program, but grow weary of the constraints and hate seeing their students lose interest in learning when it's textbooks, worksheets, and drills every day. Some teachers might even leave the profession or move to a charter or private school where they can teach in a more satisfying way.

Most teachers like to plan their own lessons and units, not simply "deliver instruction" based on off-the-shelf materials or a long march through a textbook. They like to teach about topics and issues they and their students find interesting. They want to see their students get actively engaged in learning, and they like learning new things themselves. They enjoy engaging closely alongside young people, rather than always directing a whole group from the front of the classroom. All of these things happen in a PBL environment.

We get feedback along these lines in our PBL professional development workshops, where teachers often say, "This is how I've always wanted to teach!" Some veteran teachers might put it differently: "This is how I used to teach!"—although they might have to admit that their projects back in the day were not as rigorous as they should have been. In either case, they now feel liberated once they see that PBL can work in a standards-based world. The appeal of PBL to teachers was confirmed by a 2010 study of a project-based high school economics curriculum, in which teachers who used the PBL approach felt more satisfied with their teaching methods than those who did not (Finkelstein, Hanson, Huang, Hirschman, & Huang, 2010).

Is PBL for Everybody?

Some teachers might *not* prefer to use PBL. Some are concerned about controlling the classroom and planning every minute, so conducting a project with student voice and choice just seems too "messy" and fraught with uncertainty. Other teachers, particularly in high schools, prefer traditional teaching methods over PBL because they're more focused on their academic discipline than on working as closely with young people as PBL requires. They like being the "sage on the stage" and would find the role of "guide on the side" unfamiliar and uncomfortable. We offer two thoughts for teachers who don't feel PBL is for them:

- *You can still have structure and use traditional instructional tools in a project-based approach.* Especially in their first few projects, we advise teachers to design the key pieces of the project in advance and map out a project calendar in detail, allowing for more limited student input than you might have assumed PBL requires. As teachers gain experience with PBL, they begin to see how much they are able to let go and trust the process. And rest assured, traditional tools such as lectures and structured lessons have a place in PBL—when and as needed.
- *Try it—you might like it! And your expertise still has a place.* Some high school teachers tell us, after they've done their first project or two, that although they found it challenging to work with teenagers in new ways, it was more fulfilling and, well, fun. And they could still give that wonderful lecture about Civil War battles or the DNA evidence for evolution, but now students paid more attention because they saw its purpose in the context of an engaging project.

Providing Schools and Districts with New Ways to Connect with Parents, Communities, and the Wider World

We've talked about what PBL can do for students and teachers—but how about what it can do for a school as a whole or a school district? Let's start with a couple of stories.

Communicating with Stakeholders

Katherine Smith Elementary School is a public K–6 school in San Jose, California, part of the Evergreen School District. It has a high number of English language learners, and most of its students come from low-income families. Faced with the need to dramatically improve student achievement and reenergize its culture of disengaged students and parents, the school reinvented itself in 2012.

With an eye on the demands of the Common Core, teachers and newly hired principal Aaron Brengard made a commitment to "deep learning" and teaching students how to think critically, collaborate, communicate, create, and innovate. They adopted a "college bound, no excuses" attitude, brought in technology, and beautified the campus. And they adopted project based learning as a primary teaching method in all grades, for all students, providing teachers with extensive professional development and coaching. The parent community, when they were informed about the school's new direction, rallied in support. The school's turnaround efforts have been paying off, and it's now a very different place.

In the spring of 2013 and again in 2014, Katherine Smith School hosted an Exhibition Night at which students shared their project work with the public. Students made interactive presentations and walked visitors through displays of project products, explaining the process they had followed and reflecting on what they had learned. Many of the students had first delivered their project presentations earlier in the year to other public audiences, such as realtors' associations and the city council. (You can see a video about the 2013 Exhibition Night at https://www.youtube.com/watch?v=PQ_xnExy4LI.)

The other story involves two school districts: Metropolitan Nashville Public Schools in Tennessee and York County School Division, southeast of Richmond, Virginia. Both partnered with the Buck Institute for Education in a multiyear effort to implement project based learning in all their schools by providing teachers with extensive professional development and creating systemic support. In 2014, both districts took a bold step and asked students, teachers, and administrators to conduct a public exhibition of the students' project work.

York asked each of its 19 schools to conduct its own event in April or May, so the format of the exhibitions varied. Some were held during the day and others were evening events. Some showcased particular projects, subject areas, or grade levels, whereas other exhibitions were more like fairs, with tabletop displays of a variety of projects, hosted by students. Teachers, other students, parents, community members, and representatives of local businesses attended.

Metro Nashville decided to hold one big exhibition in April from 8:00 a.m. to 8:00 p.m. at a local community college's exhibit hall. More than 300 projects were on display, hosted by student teams. Over 900 people attended, including middle school and high school students, parents, teachers, administrators, and partners from the business community.

Highlighting More Than Test Scores

In both of these stories, the schools and districts met a need to communicate with stakeholders in new ways. Traditionally, community members learn about a school or district through stories in the local media and word-of-mouth. Parents might also hear from their children and teachers, attend events on campus, read newsletters, or visit websites. A key piece of information these people use to judge the quality of a school or district is its test scores.

But as any teacher would tell you, a test score is only a snapshot of what happens in a classroom; students learn more than what's measured on standardized tests. Parents see evidence of that when their children bring work home from school, at a parent-teacher conference, or when they visit a classroom on Open House night. A public exhibition of students' project work takes this a big step further, by helping schools and districts tell more of the story.

What Katherine Smith, Metro Nashville, and York are doing, then, is more than a celebration of students' accomplishments and a way to build a shared vision for a new form of instruction. It's more than an opportunity for students to present their work to an audience, which is one of the essential elements of PBL that we discuss in the next chapter. A public exhibition is a powerful way to tell stakeholders, "We're more than our test scores."

Some schools and districts that do not have high test scores have adopted PBL as an instructional strategy because they believe it can improve student achievement on traditional measures, but meanwhile helps them meet other goals. In these places, a public exhibition of project work sends the message that, despite the current scores, "Great things are happening here." Students are not only learning important content knowledge; they're also gaining skills such as critical thinking, problem solving, collaboration, and self management. And they're fully engaged in their education.

According to instructional coach Sonya Mansfield of Metro Nashville, many people in the city have a negative view of the public schools and the students in them. But at the PBL exhibition, "When people from the business community and parents came in, it gave them a different perspective on the students and what they're learning."

For schools and districts whose test scores are generally high enough to satisfy their stakeholders, a public exhibition of students' project work can meet a related but slightly different need. Teachers and school leaders may want to tell parents and the community, "We're not satisfied with high test scores alone. We want our students to learn in more depth, build 21st century success skills, and gain real-world experience. We want them to care about what they do at school, not just their grades. PBL is how we're doing it, and this is what it looks like."

As Eric Williams, past superintendent of York County Schools, said about the PBL exhibition, "It shows we don't just have a test-prep mentality. Parents of high-achieving students concerned about test scores saw the depth of learning."

Connecting Schools to Communities and the World

Many schools today want to be more closely involved with parents, local businesses, community organizations, and people in the outside world rather than remain islands in their communities. Projects can present many opportunities for a school to connect with its community. Teachers can contact local businesses or other organizations to get ideas for projects, to find resources for students, or to ask them to act as clients, mentors, and audiences.

For example, in the *Farmer Appreciation Project* described in Appendix A, 1st graders planned and hosted an event that brought dozens of local farmers to the school. To launch the *Home Sweet Home* project (see Appendix A), teachers contacted an education expert at the Detroit Zoo about writing a letter to 4th graders asking them to design new animal habitats. A parent who had worked at a zoo gave students feedback on their plans during the project, and the Detroit Zoo's education director attended their final presentations. In Telannia Norfar's high school math class in Oklahoma City, students act as consultant teams who work with local businesses to help improve their services or marketing.

Some schools want to take it a step further, and they involve their students in addressing real-world issues and solving problems that have a significant impact on others. Project based learning allows them to accomplish these goals. For example, at Maplewood High School in Nashville, teacher Danette McMillian organized an economics/personal finance project that included working with real estate agents and local bankers and focused on increasing home ownership in the community (see *The Home Ownership Project* in Appendix A). Pamela Newman, another Nashville teacher, led her 5th graders at Dupont Haley Middle School in a project that grew out of her students' interest in one of their classmates who was a cancer survivor. The class decided to raise funds for the local children's hospital by conducting an event that included dinner and exhibits based on student research on cancer and its treatments (see *The Cancer Project* in Appendix A). A project with international reach was conducted by Leah Penniman of Tech Valley High School in Rensselaer, New York. Her 9th graders met the need of a nonprofit organization that works in Haiti to design a simple, low-cost solar oven.

From the Why to the What and How

We're convinced that project based learning is an instructional strategy that can enable you and your students to go beyond content coverage and develop the deep understandings and success skills needed

to thrive in today's complex world. As we explained in the preface, we've written this book to present a new vision of PBL—what we call Gold Standard Project Based Learning—and to give you concrete suggestions for infusing your own teaching with this vision. We describe Gold Standard PBL in the next chapter, with a review of the history and theory from which it derives, and then describe the research that supports it. Later chapters explain how to make PBL a reality your classroom, school, and district. Rather than going on to Chapter 2, readers who want to see what PBL looks like in practice might want to go directly to Appendix A. The stories from real teachers about real kids provide compelling testimony about the power of PBL.

References

America Achieves. (n.d.). *The Global Learning Network: A learning community for OECD Test for Schools participants*. Available: http://www.americaachieves.org/oecd

American Management Association (AMA). (2012). AMA 2012 critical skills survey. Washington, DC: Author. Available: http://www.amanet.org/training/articles/AMA-2012-Critical-Skills-Survey.aspx

Arazm, G., & Sungur, S. (2007). Effectiveness of problem-based learning on academic performance in genetics. *Biochemistry and Molecular Biology Education, 35*(6), 448–451.

Aronson, E. (1978). *The jigsaw classroom*. Thousand Oaks, CA: Sage.

Bailin, S., Case, R., Coombs, J. R., & Daniels, L. B. (1999). Conceptualizing critical thinking. *Journal of Curriculum Studies*, *31*(3), 285–302.

Balfanz, R. (2007, May). *What your community can do to end its drop-out crisis: Learnings from research and practice.* Baltimore, MD: Center for Social Organization of Schools, Johns Hopkins University. Available: http://web.jhu.edu/CSOS/images/Final_dropout_Balfanz.pdf

Barron, B. J., Schwartz, D. L., Vye, N. J., Moore, A., Petrosino, A., Zech, L., & Bransford, J. D. (1998). Doing with understanding: Lessons from research on problem- and project-based learning. *Journal of the Learning Sciences*, *7*(3–4), 271–311.

Barrows, H. S. (1992). *The tutorial process* (Rev. ed.). Springfield: Southern Illinois University School of Medicine.

Berg, P. (2011, May 17). Service learning projects—Project based learning taken further [blog post]. Retrieved from: http://www.educationtransformation.org/2011/05/service-learning-projects-project-based.html

Berger, R. (2003). *An ethic of excellence: Building a culture of craftsmanship with students*. Portsmouth, NH: Heinemann.

Black, P. J., & Wiliam, D. (1998). Inside the black box: Raising standards through classroom assessment. *Phi Delta Kappan, 80*(2), 139–148.

Blumenfeld, P. C., Kempler, T., & Krajcik, J. S. (2006). Motivation and cognitive engagement in learning environments. In R. K. Sawyer (Ed.), *Cambridge handbook of the learning sciences*. New York: Cambridge University Press.

Blumenfeld, P. C., Mergendoller, J. R., & Swarthout, D. W. (1987). Tasks as heuristics for understanding student learning and motivation. *Journal of Curriculum Studies, 19*(2), 135–148.

Blumenfeld, P. C., Solloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating project based learning: Sustaining the doing, supporting the learning. *Educational Psychologist, 26*(3&4), 369–398.

Boaler, J. (1998). Open and closed mathematics: Student experiences and understandings. *Journal for Research in Mathematics Education, 29*(1), 41–62.

Boonchouy, S. R. (2014). *Leadership for project based learning: Exploring how principals promote change, innovation, and professional learning*. (Unpublished doctoral dissertation). University of California, Davis.

Boss, S. (2014a, May 20). How to find a home for service-learning projects. *Edutopia.org.* Available: http://www.edutopia.org/blog/home-to-service-learning-how-to-suzie-boss

Boss, S. (2014b, Aug. 21). How to design right-sized challenges. *Edutopia*. Available: http://www.edutopia.org/blog/how-design-right-sized-challenges-suzie-boss

Boss, S., & Krauss, J. (2014). *Reinventing project-based learning: Your field guide to real-world projects in the digital age* (2nd ed.). Eugene, OR: International Society for Technology in Education.

Bransford, J., Brown, A., & Cocking, R., Eds. (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Bridgeland, J. M., Dilulio, J. J., Jr., & Morison, K. B. (2006). *The silent epidemic: Perspectives of high school dropouts* (Report by Civic Enterprises in association with Peter D. Hart Research Associates for the Bill & Melinda Gates Foundation). Available: https://docs.gatesfoundation.org/Documents/TheSilentEpidemic3-06Final.pdf

Brophy, J. E. (2013). *Motivating students to learn*. New York: Routledge.

Brown, A. L., Bransford, J. D., Ferrara, R., & Campione, J. (1983). Learning, remembering and understanding. In J. H. Flavell & E. M. Markham (Eds.), *Handbook of child psychology, Vol 3: Cognitive development* (4th ed., pp. 77–166). New York: Wiley.

Brown, A. L., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18,* 32–41.

Bruner, J. S. (1966). *Toward a theory of instruction* (Vol. 59). Cambridge, MA: Harvard University Press.

Burke, K. (2010). *Balanced assessment*. Bloomington, IL: Solution Tree.

Camp, G. (1996). Problem-based learning: A paradigm shift or a passing fad? *Medical Education Online*, *1*.

Capon, N., & Kuhn, D. (2004). What's so good about problem-based learning? *Cognition and Instruction*, *22*(1), 61–79.

Casner-Lotto, J., & Barrington, L. (2006). *Are they really ready to work? Employers' perspectives on the basic knowledge and applied skills of new entrants to the 21st century U.S. workforce.* Washington, DC: The Conference Board, Partnership for 21st Century Skills, Corporate Voices for Working Families, & Society for Human Resource Management. Available: http://www.p21.org/storage/documents/FINAL_REPORT_PDF09-29-06.pdf

Chang, C. (2001). Comparing the impacts of a problem-based computer-assisted instruction and the direct-interactive teaching method on student science achievement. *Journal of Science Education and Technology, 10*(2), 147–153.

Chen, M. (2011). *Education nation*. San Francisco: Jossey-Bass.

Chen, M. (2013). The rise of a*ny time, any place, any path, any place* learning: After-school and summer as the new American frontier for innovative learning. In T. K. Peterson (Ed.), *Expanding minds and opportunities: Leveraging the power of afterschool and summer learning for student success*. Washington, DC: Collaborative Communications Group.

Cognition and Technology Group at Vanderbilt. (1998). Designing environments to reveal, support, and expand our children's potentials. In S. Soraci & W. J. McIlvane (Eds.), *Perspectives on fundamental processes in intellectual functioning: A survey of research approaches* (Vol. 1). Westport, CT: Greenwood.

College Board. (n.d.). Redesigned SAT. Available: https://www.collegeboard.org/delivering-opportunity/sat/redesign

Common Core State Standards Initiative. (n.d.). *Standards for mathematical practice*. Available: http://www.corestandards.org/Math/Practice/

Conley, D. T. (2005). *College knowledge: What it really takes for students to succeed and what we can do to get them ready.* San Francisco: Jossey-Bass.

Csikszentmihalyi, M., & Csikzentmihaly, M. (1991). *Flow: The psychology of optimal experience*. New York: HarperPerennial.

Dean, C. B. (2012). *Classroom instruction that works: Research-based strategies for increasing student achievement*. Alexandria, VA: ASCD.

Dewey, J. (1916). *Democracy and education*. New York: Macmillan.

Dewey, J. (1938). *Education and experience*. New York: Macmillan.

Dewey, J., & Small, A. W. (1897). *My pedagogic creed* (No. 25). New York: E. L. Kellogg & Company.

District Administration. (2014). *Outlook on instruction*: *Class around the clock*. Available: http://www.districtadministration.com/article/outlook-instruction-class-around-clock

Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003). Effects of problem-based learning: A meta-analysis. *Learning and instruction*, *13*(5), 533–568.

Drake, K. N., & Long, D. (2009). Rebecca's in the dark: A comparative study of problem-based learning and direct instruction/experiential learning in two fourth-grade classrooms. *Journal of Elementary Science Education, 21*(1), 1–16.

Durlak, J. A., Weissberg, R. P., & Pachan, M. (2010). A meta-analysis of after-school programs that seek to promote personal and social skills in children and adolescents. *American Journal of Community Psychology*, 45, 294–309.

Dweck, C. (2006). *Mindset: The new psychology of success*. New York: Random House.

Ebbinghaus, H. (1913). *Memory. A contribution to experimental psychology*. New York: Teachers College, Columbia University.

Edelson, D. C., Gordon, D. N, & Pea, R. D. (1999). Addressing the challenge of inquiry-based learning. *Journal of the Learning Sciences, 8*, 392–450.

Fennema, E., & Romberg, T. (1999). *Mathematics classrooms that promote understanding.* Mahwah, NJ: Erlbaum.

Finkelstein, N., Hanson, T., Huang, C. W., Hirschman, B., & Huang, M. (2010). *Effects of problem based economics on high school economics instruction* (NCEE 2010-4002). Washington, DC: U.S. Department of Education.

Friedlaender, D., Burns, D., Lewis-Charp, H., Cook-Harvey, C. M., & Darling-Hammond, L. (2014). *Student-centered schools: Closing the opportunity gap*. Stanford, CA: Stanford Center for Opportunity Policy in Education (SCOPE). Available: https://edpolicy.stanford.edu/publications/pubs/1175

Gallagher, S. A., & Stepien, W. J. (1996). Content acquisition in problem-based learning: Depth versus breadth in American studies. *Journal for the Education of the Gifted, 19*(3), 257–275.

Geier, R., Blumenfeld, P. C., Marx, R. W., Krajcik, J. S., Fishman, B. Soloway, E., & Clay-Chambers, J. (2008). Standardized test outcomes for students engaged in inquiry-based science curricula in the context of urban reform. *Journal of Research in Science Teaching*, *45*(8), 922–939.

Gordon, P. R., Rogers, A. M., Comfort, M., Gavula, N., & McGee, B. P. (2001). A taste of problem-based learning increases achievement of urban minority middle school students. *Educational Horizons*, *79*(4), 171–175.

Guilfoile, L., & Ryan, M. (2013). *Linking service-learning and the Common Core State Standards: Alignment, progress, and obstacles*. Denver, CO: Education Commission of the States.

Guskey, T. R. (2011, Nov.). Five obstacles to grading reform. *Educational Leadership*, *69*(3), 16–21.

Guskey, T. R., & Bailey, J. M. (2010). *Developing standards-based report cards*. Thousand Oaks, CA: Corwin.

Hackman, J. R., & Oldham, G. R. (1980). *Work redesign* (Vol. 72). Reading, MA: Addison-Wesley.

Halvorsen, A., Duke, N. K., Brugar, K., Block, M., Strachan, S., Berka, M., & Brown, J. (2014). *Narrowing the achievement gap in second-grade social studies and content area literacy: The promise of a project-based approach*. Working Paper #26. East Lansing, MI: Education Policy Center at Michigan State University. Available: http://files.eric.ed.gov/fulltext/ED537157.pdf

Hart Research Associates. (2013). *It takes more than a major: Employer priorities for college learning and student success. An online survey among employers conducted on behalf of: The Association of American Colleges and Universities.* Washington, DC: Author. Available: https://www.aacu.org/leap/documents/2013_EmployerSurvey.pdf

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. New York: Routledge.

Hernandez-Ramos, P., & De La Paz, S. (2009). Learning history in middle school by designing multimedia in a project-based learning experience. *Journal of Research on Technology in Education, 42*(2), 151–173.

Hewlett Foundation. (n.d.). *What is deeper learning?* Available: http://www.hewlett.org/programs/education/deeper-learning/what-deeper-learning

Hickey, D. T., Moore, A. L., & Pellegrino, J. W. (2001). The motivational and academic consequences of elementary mathematics environments: Do constructivist innovations and reforms make a difference? *American Educational Research Journal*, *38*(3), 611–652.

Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist*, *42*(2), 99–107.

Hung, W., Jonassen, D. H., & Liu, R. (2007). Problem-based learning. In J. M. Spector, J. G. van Merriënboer, M. D. Merrill, & M. Driscoll (Eds.), *Handbook of research on educational communications and technology* (3rd ed., pp. 1503–1581). Mahwah, NJ: Erlbaum.

Kanevsky, L., & Keighley, T. (2003). To produce or not to produce? Understanding boredom and the honor in underachievement. *Roeper Review: A Journal on Gifted Education*, *26*(1), 20–28.

Kilpatrick, W. (1918). The project method. *The Teachers College Record*, *19*(4), 319–335.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational psychologist, 41*(2), 75–86.

Kim, M. C., Hannafin, M. J., & Bryan, L. A. (2007). Technology-enhanced inquiry tools in science education: An emerging pedagogical framework for classroom practice. *Science Education*, *91*(6), 1010–1030.

Knoll, M. (1997). The project method: Its vocational education origin and international development. *Journal of Industrial Teacher Education, 34*(3), 59–80.

Kolodner, J. L., Camp, P. J., Crismond, D., Fasse, B., Gray, J., Holbrook, J., Puntambekar, S., & Ryan, M. (2003). Problem-based learning meets case-based reasoning in the middle-school science classroom: Putting Learning by Design into practice. *Journal of the Learning Sciences,12*(4), 495–547.

Krajcik, J. S., Blumenfeld, P. C., Marx, R. W., Bass, K. M., Fredricks, J., & Soloway, E. (1998). Inquiry in project-based science classrooms: Initial attempts by middle school students. *Journal of the Learning Sciences, 7*, 313–350.

Lambros, A. (2002). *Problem-based learning in middle and high school classrooms: A teacher's guide to implementation*. Thousand Oaks, CA: Corwin Press.

Laur, D. (2013). *Authentic learning experiences: A real-world approach to project-based learning*. New York: Routledge.

Lave, J., & Wenger, E. (1991). *Situated learning. Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.

Lee, O., Buxton, C. A., Lewis, S., & LeRoy, K. (2006). Science inquiry and student diversity: Enhanced abilities and continuing difficulties after an instructional intervention. *Journal of Research in Science Teaching*, *43*(7), 607–636.

Levy, F., & Murnane, R. J. (2013). *Dancing with robots: Human skills for computerized work* [White paper]. Washington, DC: Third Way.

Liu, M., Hsieh, P., Cho, Y. J., & Schallert, D. L. (2006). Middle school students' self-efficacy, attitudes, and achievement in a problem-based learning environment. *Journal of Interactive Learning Research, 17*(3), 225–242.

Lopez, B., Forgie, G., Dastur, F., & Hoffman, S. (2014). PBL and design thinking in first grade. *Future Forwards, 2*, 82–92.

Lynch, S., Kuipers, J. U., Pyke, C., & Szesze, M. (2005). Examining the effects of a highly rated science curriculum unit on diverse students: Results from a planning grant. *Journal of Research in Science Teaching*, *42*, 921–946.

Marconi, P., Cipriani, A., & Valeriani, E., (1974). *I disegni di architecttura dell'Archivo storico dell'Accademia di San Luca.* Rome: De Luca Editore. Cited in Knoll, 1997.

Martenson, D., Eriksson, H., & Ingelman-Sundberg, M. (1985). Medical chemistry: Evaluation of active and problem-oriented teaching methods. *Medical Education, 19*(1), 34–42.

Marx, R. W., Blumenfeld, P. C., Krajcik, J. S., Blunk, M., Crawford, B., Kelly, B., & Meyer, K. M. (1994). Enacting project-based science: Experiences of four middle grade teachers. *Elementary School Journal, 94*(5), 517–538.

Marx, R. W., Blumenfeld, P. C., Krajcik, J. S., & Soloway, E. (1997) Enacting project-based science. *Elementary School Journal*, *97*(4), 341–358.

Maxwell, N. L., Bellisimo, Y., & Mergendoller, J. (2001). Problem-based learning: Modifying the medical school model for teaching high school economics. *The Social Studies, 92*(2), 73–78.

Maxwell, N., Mergendoller, J., & Bellisimo, Y. (2005). The high school economics curriculum: Does problem-based learning increase knowledge? *Journal of Economic Education*, *36*(4), 315–331.

McCombs, B. L. (1996). Alternative perspectives for motivation. In L. Baker, P. Afflerback, & D. Reinking (Eds.), *Developing engaged readers in school and home communities* (pp. 67–87). Mahwah, NJ: Erlbaum.

Mergendoller, J. R., Markham, T., Ravitz, J., & Larmer, J. (2006). Pervasive management of project based learning: Teachers as guides and facilitators. In C. Evertson, C. M. Weinstein, & C. S. Weinstein (Eds.), *Handbook of classroom management: Research, practice, and contemporary issues* (pp. 583–615). Mahwah, NJ: Erlbaum.

Moll, L. C., Amanti, C., Neff, D., & Gonzalez, N. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory into Practice, 31(2)*, 132–141.

Murphy, P. K., Wilkinson, I. A. G., Soter, A. O., Hennessey, M. N., Alexander, J. F. (2009). Examining the effects of classroom discussion on students' comprehension of text: A meta-analysis. *Journal of Educational Psychology, 101*(3), 740–764.

National Center for Education Statistics (NCES). (2012). *NAEP: Looking ahead: Leading assessment into the future*. [Highlights]. Washington, DC: Author. Available: http://nces.ed.gov/nationsreportcard/pdf/naep_highlights_16may2012_view.pdf

New Tech Network. (2014). *Student Outcomes Report 2014*. Napa, CA: Author. Available: http://www.newtechnetwork.org/services/resources/ntn-student-outcomes-report-2014

Next Generation Science Standards. (2013). *Appendix A—Conceptual shifts in the Next Generation Science Standards*. Washington, DC: Achieve, Inc. Available: http://www.nextgenscience.org/sites/ngss/files/Appendix%20A%20-%204.11.13%20Conceptual%20Shifts%20in%20the%20Next%20Generation%20Science%20Standards.pdf

Organization for Economic Development (OECD). (2014). *PISA 2012 results: Creative problem solving: Students' skills in tackling real-life problems* (Vol. V). Paris: Author. Available: http://dx.doi.org/10.1787/9789264208070-en

Palmer, E. (2011). *Well spoken: Teaching speaking to all students.* Portland, ME: Stenhouse.

Parker, W. C., Lo, J., Yeo, A. J., Valencia, S. W., Nguyen, D., Abbot, R. D., Nolen, S. B., Bransford, J. D., & Vye, N. J. (2013). Beyond breadth-speed test: Toward deeper knowing and engagement in an advanced placement course. *American Educational Research Journal, 5*(9), 1424–1459.

Partnership for 21st Century Skills. (2007). *Beyond the three Rs: Voter attitudes toward 21st century skills.* Tucson, AZ: Author. Available: http://www.p21.org/storage/documents/P21_pollreport_singlepg.pdf

Perry, C. (2013). In AP 50, students own their education. Harvard School of Engineering and Applied Sciences. Available: http://www.seas.harvard.edu/news/2013/09/in-ap-50-students-own-their-education

Peterson, T. K. (Ed.) (2013). *Expanding minds and opportunities: Leveraging the power of afterschool and summer learning for student success.* Washington, DC: Collaborative Communications Group.

Piha, S. (n.d.) *Learning in afterschool and summer: Preparing youth for the 21st century.* Position paper of the Learning in Afterschool and Summer Project. www.learninginafterschool.org/position.htm

Pintrich, P. R., & Schunk, D. (1996). *Motivation in education: Theory, research and application.* Columbus, OH: Merrill/Prentice Hall.

Ritchhart, R., & Perkins, D. (2008). Making thinking visible. *Educational Leadership*, *65*(5), 57–61.

Rivet, A. E., & Krajcik, J. S. (2004). Achieving standards in urban systemic reform: An example of a sixth grade project-based science curriculum. *Journal of Research in Science Teaching, 41,* 669–692.

Savery, J. R. (2006). Overview of problem-based learning: Definitions and distinctions. *Interdisciplinary Journal of Problem-based Learning, 1*(1), 3, 9–20.

Schmidt, H. G., Boshuizen, H. P. A., & de Vries, M. (1992). Comparing problem-based with conventional education: A review of the University of Limburg medical school experiment. *Annals of Community-Oriented Education*, *5,* 193–198.

Schneider, R., Krajcik, J., Marx, R. W., & Soloway, E. (2002). Student learning in project-based science classrooms. *Journal of Research in Science Teaching, 39*(5), 410–422.

Schroeder, C. M., Scott, T. P., Tolson, H., Huang, T., & Lee, Y. (2007). A meta-analysis of national research: Effects of teaching strategies on student achievement in science in the United States. *Journal of Research in Science Teaching, 44*(10), 1436–1460.

Schwalm, J., & Tylek, K. S. (2012, Spring). Systemwide implementation of project-based learning: The Philadelphia approach. *Afterschool Matters, 15*, 1–8.

Scott, C. A. (1994). Project-based science: Reflections of a middle school teacher. *The Elementary School Journal, 95*(1), 75–94.

Sefton-Green, J. (2013). *Learning at not-school.* Cambridge, MA: MIT Press.

Seidel, S. (2011). *Hip hop genius: Remixing high school education*. Lanham, MD: Rowman & Littlefield.

Sizer, T. (1984). *Horace's compromise*, Boston: Houghton Mifflin.

Smarter Balanced Assessment Consortium. (2014) *Sample items and performance tasks*. Olympia, WA: Author. Available: http://www.smarterbalanced.org/sample-items-and-performance-tasks/

Stiggins, R. (2005). From formative assessment to assessment for learning: A path to success in standards-based schools. *Phi Delta Kappan*, 324–328.

Strobel, J., & van Barneveld, A. (2009). When is PBL more effective? A meta-synthesis of meta-analyses comparing PBL to conventional classrooms. *Interdisciplinary Journal of Problem-based Learning, 3*(1). Available: http://dx.doi.org/10.7771/1541-5015.1046

Strobel, J., Wang, J., Weber, N. R., & Dyehouse, M. (2013). The role of authenticity in design-based learning environments: The case of engineering education. *Computers & Education*, *64*, 143–152.

Tans, R. W., Schmidt, H. G., Schade-Hoogeveen, B. E. J., & Gijselaers, W. H. (1986). Sturing van het onderwijsleerproces door middel van problemen: Een veldexperiment [Guiding the learning process by means of problems: A field experiment]. *Tijdschrift voor Onderwijsresearch*, *11*, 35–46.

Thomas, J. W. (2000). *A review of research on project-based learning*. San Rafael, CA: Autodesk Foundation.

Tomlinson, C. A. (2011, October). Coaching: The new leadership skill. *Educational Leadership*, *69*(2), 92–93.

Torp, L., & Sage, S. (2002). *Problems as possibilities: Problem-based learning for K–12 education*. Alexandria, VA: ASCD.

Vandell, D. L. (2013) Afterschool program quality and student outcomes: Reflections on positive key findings on learning and development from recent research. In

T. K. Peterson (Ed.), *Expanding minds and opportunities: Leveraging the power of afterschool and summer learning for student success*. Washington, DC: Collaborative Communications Group.

Walker, A., & Leary, H. (2009). A problem based learning meta analysis: Differences across problem types, implementation types, disciplines, and assessment levels. *Interdisciplinary Journal of Problem-based Learning, 3*(1).

Wiggins, G. (2014, May). Fixing the high school—Student Survey, Part 1 [blog post]. Available: http://grantwiggins.wordpress.com/2014/05/21/fixing-the-high-school/

Wirkala, C., & Kuhn, D. (2011). Problem-based learning in K–12 education: Is it effective and how does it achieve its effects? *American Educational Research Journal*, *48*(5), 1157–1186.

Yazzie-Mintz, E. (2010). *Charting the path from engagement to achievement: A report on the 2009 High School Survey of Student Engagement*. Bloomington, IN: Center for Evaluation and Education Policy. Available: http://ceep.indiana.edu/hssse/images/HSSSE_2010_Report.pdf

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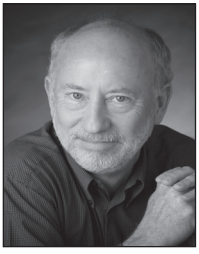
About the Authors

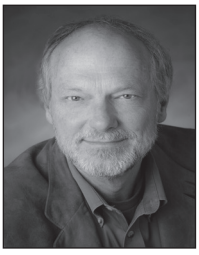
The Buck Institute for Education (BIE) is a mission-driven not-for-profit 501(c)3 organization based in Novato, California, and is beneficiary of the Leonard and Beryl Buck Trust. Since 1998, BIE has focused its work exclusively on project based learning and is considered the world's leading provider of PBL resources and professional development. Its publications have been translated into nine languages. Across the United States and around the world, BIE provides PBL workshops and coaching to well over 10,000 K–12 teachers per year and provides systemic long-term support to partner schools and districts. BIE also hosts annual *PBL World* conferences and offers online resources at its website (bie.org) and online courses at PBLU.org.



John Larmer is editor in chief at the Buck Institute for Education. He authored and/or edited BIE's project based curriculum units for high school government and economics and was a contributing author of the *Project Based Learning Handbook*. He is a writer and editor of BIE's *PBL Toolkit Series,* including the *PBL Starter Kit for Middle and High School Teachers, PBL in the Elementary Grades,* and *PBL for 21st Century Success: Teaching Critical Thinking, Collaboration, Communication, and Creativity.* He

codevelops professional development workshops and materials for teachers, including 21st century skills rubrics and project exemplars. John presents at conferences and has consulted on PBL curriculum development for the National Academy Foundation, the Oracle Education Foundation, and Pearson Education.

Prior to joining BIE, John was a senior program associate at WestEd in San Francisco. For ten years John taught high school social studies and English. He was a founding teacher at a restructured small high school, and a member of the National School Reform Faculty and school coach for the Coalition of Essential Schools. John received MA degrees in Educational Technology and in Educational Administration from San Francisco State University, and a BA in Political Science from Stanford University.



John Mergendoller joined the Buck Institute for Education in 1989 as its founding research director and was named executive director in 2000. An international advocate for project based learning, he has worked with educators throughout the United States and in China, Taiwan, Brazil, Greece, Romania, the United Kingdom, and many other countries to help them learn about and implement high-quality PBL.

Before joining BIE, he was a senior program director at the Far West Laboratory (now WestEd), a federally funded regional educational laboratory. At Far West, he also established and managed the At-Risk Student Program and the Secondary School Improvement Program. His publications span educational technology, science education, middle grades reform, and project based learning.

John holds an MA and a PhD in Psychology and Education from the University of Michigan, an EdM from the Harvard Graduate School of Education, and a BA in Letters from Wesleyan University in Middletown, CT. He was awarded a Fulbright Fellowship to study cognitive development at the University of Geneva.

Suzie Boss is a member of the Buck Institute for Education's National Faculty. She is a writer and educational consultant who focuses on the power of teaching and learning to improve lives and transform communities. She is the author of several books on education and innovation, including *Bringing Innovation to School: Empowering Students to Thrive in a Changing World* and *Reinventing Project-Based Learning: Your Field Guide to Real-World Projects in the Digital Age*. She is a regular contributor to *Edutopia* and the *Stanford Social Innovation Review*. Her work has appeared in a wide range of publications, including *Educational Leadership, Principal Leadership, the New York Times, Education Week,* and *Huffington Post*. She is a frequent conference presenter and consults internationally with schools interested in shifting from traditional instruction to technology-rich, project based learning.

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Print Products

Authentic Learning in the Digital Age: Engaging Students Through Inquiry by Larissa Pahomov (#115009)

Personalizing the High School Experience for Each Student by Joe DiMartino and John H. Clarke (#107054)

Problems as Possibilities: Problem-Based Learning for K-16 Education, 2nd Edition by Linda Torp and Sara Sage (#101064)

Real-World Projects: How do I design relevant and engaging learning experiences? by Suzie Boss (#SF115043)

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