

## **Research on Project-Based Learning and Systems Thinking**

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Borton's magnet focus of systems thinking and project-based learning provides an approach to integrating curriculum in ways that are meaningful and relevant to students' lives at school, at home, and in their communities. That's why Borton Magnet School's motto is "Using project-based learning and systems thinking to educate children for a future yet unknown."

### **Project-Based Learning**

The Buck Institute for Education describes Project-Based Learning as a "systematic teaching method that engages students in learning important knowledge and 21<sup>st</sup> century skills through an extended, student-influenced inquiry process structured around complex, authentic questions and carefully designed products and learning tasks." (Hallermann, Larmer, & Mergendoller, 2011, p. 5) The essential elements of PBL include significant content, 21<sup>st</sup> century skills, in-depth inquiry, driving questions, a need to know, voice and choice for students, revision and reflection, and a public audience. In developing projects with students, Borton teachers integrate literacy, math, and content area knowledge and standards in purposeful work that revolves around answering questions of importance to students' lives both in and outside of school. A considerable body of research exists attesting to the success of PBL in providing benefits to students, from deeper learning of academic content to stronger motivation to learn and the acquisition of 21<sup>st</sup> century skills. The following studies, along with our Borton stories of project work, provide the evidence we need to justify implementing this approach to learning:

#### **Academic Achievement:**

- Students learning through PBL retain content longer and have a deeper understanding of what they are learning. (Penuel & Means, 2000; Stephen, Gallager, & Workman, 1993)
- In specific content areas, PBL has been shown to be more effective than traditional methods for teaching math, economics, language, science, and other disciplines. (Beckett & Miller, 2006; Boaler, 2002; Finkelstein et al, 2010; Greier et al., 2008; Mergendoller, Maxwell & Bellisimo, 2006)
- On high-stakes tests, PBL students perform as well or better than traditionally taught students. (Parker et al., 2011)

#### **21<sup>st</sup> Century Competencies:**

- Students demonstrate better problem-solving skills in PBL than in more traditional classes and are able to apply what they learn to real-life situations. (Finkelstein et al., 2010)
- Opportunities for collaborative learning provide benefits to students across grade levels, academic subjects, and achievement levels. (Johnson & Johnson, 2009; Slavin, 1996)

**Equity:**

- PBL shows promise as a strategy for closing the achievement gap by engaging lower-achieving students. (Boaler, 2002; Penuel & Means, 2000)
- PBL can work in different types of schools serving diverse learners. (Hixson, Ravitz, & Whisman, 2012)
- PBL also can provide an effective model for whole-school reform. (National Clearinghouse for Comprehensive School Reform, 2004; Newmann & Wehlage, 1995)

**Motivation:**

- In PBL classrooms, students demonstrate improved attitudes toward learning. They exhibit more engagement, are more self-reliant, and have better attendance than in more traditional settings. (Thomas, 2000; Walker & Leary, 2009)

In our own stories of project based learning, Borton teachers have noticed that this approach to learning provides opportunities to shine for children with learning difficulties and children who traditionally are perceived as low-performing. It gives these students chances to reveal their particular areas of expertise and disrupt the identity that has been established for them as unsuccessful learners.

**Systems Thinking**

Systems Thinking is a world view that recognizes the interdependencies and interrelatedness of systems in the world. Rather than seeing them as a collection of distinct elements, Systems Thinking sees how these elements function as a whole. Systems thinkers develop certain habits of mind that lead to analytical and problem-solving skills. These habits include: Understanding the big picture; observing how elements within systems change over time, generating patterns and trends; recognizing that a system's structure generates its behavior; identifying the circular nature of complex cause and effect relationships; surfacing and testing assumptions; considering how mental models affect current reality and the future; using understanding of system structure to identify possible leverage actions, and considering short-term, long-term and unintended consequences of actions, among several others. At Borton, we develop these capacities with our students through the use of visual tools and models, kinesthetic activities, and skillful discussion as systems thinking is integrated into classroom projects.

Since 2005, Borton has been a demonstration site for the Waters Foundation Systems Thinking in Schools Project. The mission of the project "is to increase the capacity of educators to deliver academic and lifetime benefits to students through the effective application of systems thinking concepts, habits and tools in classroom instruction and school improvement." ([www.watersfoundation.org](http://www.watersfoundation.org))

The Waters Foundation carried out a large-scale, collaborative action research project over a five-year period from 2001-2006. Findings represented a culturally diverse cross section of students, classrooms, and schools covering a wide range of geographic and socio-economic settings in 197 separate studies. Based on a meta-analysis of all these action research projects, the following trends were noted:

- Students used systems thinking tools to clarify and visually represent their understanding of complex systems.
- Systems thinking tools helped students make connections between curricular areas and relevant life experiences.
- Students of all ages learned and independently used systems thinking problem-solving strategies.
- When using systems thinking concepts and tools, many students showed increased motivation, engagement, and self-esteem.
- Systems thinking concepts and tools helped students develop as readers and writers.

Across the schools in the Waters Foundation Project, systems thinking classrooms effectively addressed the basic and applied skills as interdependent capabilities that students need to understand and work within the complex systems that surround them. Educators working within the project found that the short-term goals of mastery of grade-specific skills was best accomplished and transformed into long-term learning through a systems thinking approach that immersed students in relevant problem-solving, interdisciplinary connections, and opportunities for in-depth analysis and thought provoking dialogue. Moreover, they found the systems thinking learning environment to be particularly motivating and engaging for the most reluctant learners, enabling them to organize and express their thinking. (Systems Thinking in Schools: A Waters Foundation Project)

Borton Magnet School participated in the Waters Foundation study, finding that students showed improved retelling scores, produced stronger pieces of writing and expressed their thinking with greater clarity. With proper scaffolding, even the youngest students in PreK and kindergarten were capable of far more than the teachers had previously believed. (Senge, 2012) Two teachers at the school who engaged in an action research project concluded that students for whom English was a second language demonstrated improvement in communicating their thinking both orally and in writing a result of using systems thinking tools to organize their thoughts as measured by the AZELLA, Arizona's standardized test for assessing language learning. In 2010, Borton was labelled an excelling school by Arizona Learns, partly on the basis of its successful integration of systems thinking in the school's curriculum. (Systems Thinking in Schools: A Waters Foundation Project)

In other studies, similar outcomes have been noted in learners of all ages. Warburton (2003) includes strategies to guide the implementation of systems thinking at the curriculum level: using a wide range of conceptual and material content, explicitly demonstrating connections and dependency, and emphasizing the dynamic state of systems. Connell, Remington, and Armstrong (2012) carried out a systems thinking experimental study at the undergraduate level and found that "to maximize students' abilities to think in systems, educators need to explore ways to integrate systems thinking skills throughout a course, or better yet, an entire curriculum." (p. 9)

All of these results, and once again, our own stories of success, point to the importance of embedding systems thinking across the curriculum through our project-based approach. In this way, students acquire the necessary basic academic skills alongside 21<sup>st</sup> century skills as they apply their learning for real purposes. These approaches hold tremendous promise for students who are perceived to be disadvantaged. In earlier studies addressing the politics of education, researchers like Anyon (1980, 1981), Moll & Diaz (1987), and Oakes (1985) noted that children in schools were subjected to the stratification of the greater society. Children at the lower end of the

socio-economic scale were likely to receive instruction that was far less challenging, less interesting, and less controlled by the learners than were students from more affluent, professional backgrounds and elite communities. African American, Latino, and children who speak languages other than English are, even now, likely to fall into these categories. However, Project-based Learning and Systems Thinking provide for working class and minority children the very type of educational experiences often reserved for children of the upper class, and thereby, hold the potential for narrowing the achievement gap between ethnic and racial groups. By resisting the assumption that these children have reduced intellectual abilities, our students are empowered to demand challenging experiences and expectations, through Borton's magnet focus and throughout their lives.

In a recent column in the Huffington Post, "[Why Good Schools Are Happy Places](#)," (2016) Carrie Brennan, Executive Director of the CITY Center for Collaborative Learning & Public Voices Project and a Borton parent, described Borton and the importance of a positive school culture:

In environments where safety, trust, and relationships are valued, students are more likely to be focused on their learning, to take risks, and to challenge themselves. ..Schools with a healthy school culture tend to be [mission-focused schools](#) with a shared sense of purpose. The mission shows up in school-wide activities that are done well and consistently, like a daily morning meeting. Other commonalities include: a principal who is visible and accessible, routine time for teacher collaboration, activities for students before and after school, a discipline system rooted in restorative justice, and regular events for parents to participate in.

At Borton, where student inquiry into social, environmental, scientific, and communal problems through projects and systems thinking occupy the curriculum in culturally relevant ways, a community such as the one described by Brennan exists and flourishes.

In order to maintain the high level of project work and the integration of systems thinking, continuous professional development is critical. Borton welcomes new teachers almost yearly, teachers who usually have not had experiences with our magnet focus. Intensive professional development at the start, collaborative support for planning and teaching, and ongoing professional learning experiences for all faculty and staff are needed to maintain and strengthen our work with students. We are teaching for the future, helping our students become question posers, problem-solvers, and understand the need for sustainability in all systems of the earth.

Links to many of the following research articles can be found on the following sites:

Edutopia: <http://www.edutopia.org/pbl-research-annotated-bibliography>

Buck Institute Education: <http://bie.org/objects/cat/research>

Waters Foundation Systems Thinking in Schools Project: <http://watersfoundation.org/>

Creative Learning Exchange: <http://www.clexchange.org/resources/research.asp>

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