Project Based Learning at Harmony Public Schools

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*In Project Based Learning (PBL), students go through an extended process of inquiry in response to a complex question, problem, or challenge. Rigorous projects help students learn key academic content and practice 21st Century Skills such as collaboration, communication & critical thinking.*

— Buck Institute for Education

Teachers need instructional practices that impart more sophisticated and higher-order thinking and analytical skills for students across the achievement spectrum. To meet this challenge, many educators have landed on project-based learning (PBL). PBL is an inquiry-oriented instructional method that builds rich content knowledge and real-world skills while empowering students to drive their learning. Race to the Top–District grantee Harmony Public Schools (HPS) counts itself among those who believe in the promise of PBL for their students’ deeper learning. This brief provides an overview of Harmony’s PBL vision, design and approach, concluding with a few key considerations for districts as they explore implementation of project-based learning.
Harmony’s PBL Plan

In their Race to the Top—District project plan, Harmony has identified PBL as a major lever to personalize education and one way to allow their middle and high school students to demonstrate mastery of curriculum content. HPS also believes PBL will help students hone interpersonal skills. Mastery of core content and strong interpersonal skills are critical for students’ college and career success. HPS believes that PBL will enable students to determine the focus of their studies, based on their unique interests and skills, through a curriculum that is aligned to the Common Core State Standards (CCSS) and Texas state standards. Harmony has referenced the following benefits of PBL:

- Students develop the ability to transfer their learning to new situations.
- Students demonstrate an increased ability to define problems and support their reasoning.

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1 Since 2012, the U.S. Department of Education has awarded $504 million to 21 districts and consortia of districts through the Race to the Top-District education reform initiative to implement personalized learning.


• Students are better able to tackle conceptual problems than those taught with a more traditional curriculum.
• PBL has proven effective for engaging students who have struggled in more traditional settings.

Given Harmony’s Science, Technology, Engineering, and Mathematics (STEM) focus and diverse student population, the expansion of PBL made sense. Previously, a PBL model adopted from the Buck Institute had been in place only at select, high-performing high schools. Building on six years of a piloted PBL curriculum in those high schools, HPS used the Race to the Top-District grant to expand PBL to all high schools. Through the grant, HPS also extended PBL to all middle schools in order to prepare their students for the increased autonomy over their learning and engagement and the more complex tasks encountered in high school.

Harmony’s PBL Approach

While PBL is often associated with STEM subjects, Harmony developed standards-aligned, cross-disciplinary, multi-sensory projects that integrate three core subject areas: a STEM subject of choice, social studies, and English language arts. The cross-curricular connections and hands-on learning deepen students’ conceptual understanding of topics they choose while allowing teachers to more actively engage their students in new ways of learning. Harmony’s PBL model employs three levels of projects to match students’ skill level and interest:

• **LEVEL 1 PBL:** Students work collaboratively in small groups during class to apply their learnings, draw conclusions, and solve problems to a problem at hand. As students complete their Level 1 PBLs, each group presents their end product to their class through digital media tools.¹

• **LEVEL 2 PBL:** Students select a topic from one of their STEM courses and develop a project expanding on the selected scientific principle or research idea. Students must make meaningful connections from their selected topic to arts, social sciences, history and the humanities. Level 2 projects are completed by students outside the regular school day, so teachers often meet with their students for advising during after-school hours, on Saturdays, and via online sessions.

![Figure 1. Example of Content Integration](image-url)

¹ Harmony Public Schools 2014 Annual Performance Report.
(e.g., Google Hangout) to keep students on track and provide them with feedback on their progress.

- **LEVEL 3 PBL**: Level 3 PBL is not limited to project topics within STEM course curriculum. Students generate topics or research questions for study. As with Level 2 PBLs, such students still have a project advisor who approves their project topic, but they will have to do more in-depth research to gain necessary knowledge and skills to conduct their experiments.

The table below shows the similarities and differences across Level 1, 2 and 3 projects in terms of project content, instruction, and the intensity of student agency.

<table>
<thead>
<tr>
<th></th>
<th>LEVEL 1</th>
<th>LEVEL 2</th>
<th>LEVEL 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC SUBJECTS</td>
<td>Each core subject area</td>
<td>STEM subjects</td>
<td></td>
</tr>
<tr>
<td>LENGTH OF PROJECTS</td>
<td>1-2 weeks</td>
<td>Yearlong</td>
<td></td>
</tr>
<tr>
<td>ENVIRONMENT</td>
<td>In-class lessons</td>
<td>Includes work outside the classroom</td>
<td></td>
</tr>
<tr>
<td>INSTRUCTION</td>
<td>More teacher-driven; structure and scaffolding, including a curriculum scope and sequence and curriculum pacing guides</td>
<td>Student-driven with teacher support; project hand-out provided as a self-guide tool for students</td>
<td>Student-driven with teacher or mentor advising; project hand-out not available, making the project more open-ended and expeditionary</td>
</tr>
<tr>
<td>COLLABORATION</td>
<td>Small group work</td>
<td>Independent or team projects</td>
<td></td>
</tr>
<tr>
<td>CONTENT</td>
<td>Traditional curriculum unit redesigned with PBL instruction</td>
<td>General topic or principle chosen from PBL project bank</td>
<td>Student-conceptualized advanced research project</td>
</tr>
<tr>
<td>INCORPORATION OF TECHNOLOGY</td>
<td>Moderate-High</td>
<td>Very High</td>
<td></td>
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All students must complete four Level 1 projects a year in middle school and high school, and high school students must also complete one Level 2 or Level 3 project each year by mid-Spring. These PBL projects take the place of traditional labs. Students work with teachers to determine the focus of projects, develop a long-term plan with milestones, and conduct self-assessments throughout the project using a rubric and other assessment tools. Students are also required to design project brochures, create a photo gallery or produce a video of their experiment, share their project journals and essays, and develop a website to host their project content. Throughout the course of the projects, students learn to use the scientific method, work with peers and experts, teach their classmates about their topics, and communicate their process and findings. With digital learning artifacts created during these projects, students are able to naturally build a rich e-portolio before high school graduation and use it as a testimony of their academic mindset when applying to colleges.

In the spring, Harmony hosts a STEM website contest for all students who completed their Level II and Level III PBL projects. Students showcase their work and demonstrate their projects to other students, parents, and educators at various educational conferences and expo events. Each Harmony campus engages their families and communities in the students' success through public events like school-wide science fairs and STEM festivals. Students also submit their projects to various STEM competitions such as regional, state-wide, and online science fairs, digital story telling contests, etc.

Examples of student projects can be found in Appendix A.

**Project and Tool Development at Harmony**

To ensure that teachers did not view the PBL work as detracting or separate from core academic requirements, Harmony solicited their involvement in the design process upfront. HPS created design teams led by curriculum developers, lead teachers, and expert consultants to collaboratively develop rigorous cross-disciplinary, multi-sensory, technology-enabled PBL projects.
The design team completed the following activities to develop PBL projects and supports:

- **Designed an instructional framework to specify learning objectives and scope and sequence of the projects across core subject areas.** This framework maps out the instructional plan for teaching the skills required to carry out successful projects and master core content, including:
  
  » Analytic skills required to conduct high-quality inquiries
  
  » Information, media, and technology skills to effectively navigate the content and resources available and to use the variety of tools to produce high-quality products
  
  » 21st century learning skills
  
  » Career and life skills

- **Developed assessment tools to measure student progress on learning objectives and skill outcomes.** These outcomes and accompanying assessments guide the design of projects toward mastery of critical content and skill development. Interim student progress is assessed at six-week intervals via online assessments and use of a PBL rubric. The assessments include pre-AP/AP level of rigor, address Common Core State Standards and Texas Education Knowledge and Skills, and include grade-level benchmarks.

- **Built an interactive online platform to host project content, resources, tools, and student work products.** Harmony’s PBL approach requires students to work both in the classroom during the school day and outside of school hours to enable anytime/anywhere deeper learning. Students must be able to access tools and resources, post their current work, track their progress, and interact with teachers and other students at any time, and from anywhere. To meet this need, Harmony developed a searchable online platform that holds all project resources (e.g., tutorials, project assessment rubrics, timelines, and calendar) and high-quality content and tools to support PBL investigations. On a cyclical basis, new content is evaluated for quality by a sub-group of PBL teachers in each subject area. Resources approved as high-quality are “endorsed” for the community’s use. Harmony is currently transforming this database to automate some of the functionalities and promote easy access to data and reporting features.

These activities produced PBL curriculum resources, materials, training modules and comprehensive student and teacher PBL handbooks.

Teacher involvement in the design of PBL led to increased buy-in and better implementation – teachers who helped write the PBL curriculum acted as PBL champions at their campuses and supported novice teachers in shifting to a new instructional approach. Developing the projects, rather than purchasing them off-the-shelf, allowed the team to align content to the Texas Essential Knowledge and Skills (TEKS) state standards in meaningful and authentic ways.
Professional Development & Supports

The PBL model requires a significant shift in the traditional roles of teachers and students. With PBL, students are driving self-regulated learning and teachers are acting as learning facilitators and enablers. Some Harmony teachers needed support to implement these inquiry-based activities, including the application of effective classroom practices. In response, HPS invested in high-quality, ongoing professional development (PD) and tools to support its educators. To begin development, Harmony coordinated with local education leaders to assess the needs of their staff, provided coaches for each school to support teachers and to model high-quality PBL instruction, and delivered additional assistance to novice teachers. Then, Harmony’s lead teachers and instructional leaders designed professional development modules that introduced teachers and principals to PBL environments, instructional strategies, and assessment techniques through content-specific sessions with course-specific breakouts. The sessions provided HPS teachers with hands-on practice with new technologies and included time to practice or rehearse new strategies and skills prior to returning to the classroom.

**Figure 2. Professional Development Model**

- Organize teachers by grade level and content area
- Build in time to practice/rehearse new skills or strategies
- Model implementation of PBL activities, including materials set up in lab or classrooms
- Advise on overcoming challenges
- Review examples of PBL activities
- Scaffold learning across sessions
- Teachers role-play to experience lessons as their students will
- Teachers try new practices between sessions and build on learnings in subsequent sessions

Provide opportunities for hands-on practice with new technologies
Key Considerations

For those considering implementing PBL, here are some important issues to address:

• Costs: Developing PBL project curriculum banks and supplying the necessary supports to teachers, students, and families is a significant upfront investment. Once the bank has been established, schools can draw on them long-term. Unlike development, however, costs for supplies will be recurring. Harmony is using Race to the Top–District funds to buy project materials. When funding ends, HPS will need to replace these dollars to continue PBL. Finally, HPS uses grant funds to pay licensing fees for the online platform used to house PBL materials and resources. Other costs associated with these supports need to be factored into the overall PBL budget.

• Partnerships: Partnerships with local businesses, industry organizations, and universities can be leveraged in supplying materials and advisors for projects. HPS established a partnership benchmark for schools; schools were expected to form working partnerships that benefit students, teachers, and the community. For example, physics and engineering graduate students from local colleges regularly meet with Harmony students to connect PBL work to the real world. STEM businesses and organizations recruit Harmony students for job shadowing, internship, and externship programs that serve as work-based learning experiences for students. Higher education partners provide access to their workforce and facilities to mentor Harmony students and nurture their work for advanced research projects and STEM competitions.

• Teacher development and evaluation: In many instances, PBL requires a different set of professional supports for teachers. Harmony created professional development modules tailored to PBL. Rethinking the structure and use of common planning time, in addition to focused professional learning communities, may also be needed to ensure that teachers are working together across disciplines. Similarly, it is important to detail how the upgraded skills necessary for PBL instruction are reflected in teacher evaluations, including classroom observation rubrics. Harmony allocated grant funds to align their teacher and principal evaluation system to PBL.

• Parent communication: Because PBL is different from traditional teaching and learning in many ways, it will require careful and proactive communication about the benefits of PBL for teachers and students. Explicit communication about how the projects cover core content knowledge and skills is likely necessary. For parents specifically, it’s important to outline the role that parents will play, especially for those projects that require after-school time.
Appendix A - PBL Examples

1. Chemistry – Fire Extinguisher (Level III)
   • How can a flame be extinguished just by placing it close to a mixture?
   • ELA Component: Journaling throughout project
     
     **Entry #3: 10-1-2014**
     One difficulty we are currently facing is meeting up to perform the experiment. We have the option of either performing the experiment at school or at one of our houses. If we perform the experiment at school, it would have to be after hours. As high schoolers with siblings, it’s very hard to find time in our schedules to meet up, that work with rest of the family. We are leaning towards performing the experiment after school. Although that decision seems to be working out better, there is also the task of bringing the needed materials to school. We will be splitting up the materials to bring between the two of us.

   • Social Studies Connection: An essay detailing the importance of the discovery of fire

2. Algebra – Image Creation Using Functions (Level III)
   • How do you make an image by using functions and graphing them?
   • ELA Component: Argumentative essay on math’s importance in art
   • Social Studies Connection: An essay on the history of mathematics’ use in art

     **Math is an essential in architecture. The ancient Egyptians demonstrated their understanding of geometry and ratios in the construction of the infamous Great Pyramids. In ancient Greece, temples were mapped out and constructed, also with the help of ratios. Nowadays, we use those same mathematic principles to plan out blueprints for architectural projects. Small drafts of structures are mapped out, and math is used to construct the plans large-scale. Precise measurement is key to making stable buildings.**
3. Geometry – String Designs (Level II)

- How can string designs be applicable to technology and crafting?
- ELA Component: Journaling throughout project
- Social Studies Component: Expository essay on historical uses of string design

Also when we look at flags with distinct and complex symbols on them, there must be string design along with the regular flag design in order to make them interesting. String design must also be used with creating clothing and decorative weaving on the clothing. At times we might see clothing with nice design that we did not know originated from cool string designs. Though simple weaving is involved, string design plays a large part.

4. Biology – Genetics and Probability (Level III)

- How do genetic crosses provide information about inheritance?
- ELA Component: Expository essay on probability

Probability is only defined by the likeliness of something to happen, not the actual outcome. Though theoretical probability and experimental probability are typically very close in number, there is always a possibility for the unlikely to take dominance. You can't say that something will for sure happen just because the probability is at a high rate.

- Social Studies Connection: Demographic research on how likely it is for different ethnic groups to have blue eyes

5. Computer Science – The Binary Numeral System (Level III)

- How can a binary counter be developed to provide an alternative to visualizing binary numbers and learning how to count in binary?
- ELA Component: Argumentative essay on the importance of binary numbers and their use in everyday life

A modern-day “digital” computer, as opposed to an older “analog” computer, operates on the principle of two possible states of something – “on” and “off”. This
directly corresponds to there either being an electrical current present, or said electrical current being absent. The “on” state is assigned the value “1”, while the “off” state is assigned the value “0”.

- Social Studies Connection: Expository essay on the history of binary numbers

6. Engineering – The Pinhole Camera (Level III)

- How can a box version of the pinhole camera be created?
- ELA Component: Narrative essay about the student’s love of cameras
- Social Students Connection: Expository essay on the camera’s effects on society

Around 1000 AD an Arabian scholar named Alhazen invented the very first pinhole camera, called the Camera Obscura, to explain how light travels in straight lines. As time went on, the brightness and clarity of an image produced with a Camera Obscura was discovered to be affected by the size of the aperture.