An Evidence-based Learning Solution for PreK-5 Students

PLTW LAUNCH

Introduction

Project Lead The Way (PLTW) is the leading PreK-12 applied learning curriculum and teacher professional development provider with pathways in computer science, engineering, and biomedical science. PLTW provides engaging, high-quality activities and projects that encourage students to use what they learn in the classroom to solve real-world problems. Developed by teachers and industry experts, the PLTW curriculum enables students to gain mastery of important science standards and concepts, while building on collaboration, communication, and self-regulation skills. PLTW's teaching and learning approach uses activities to build content knowledge, and incorporates projects and open-ended problems to achieve understanding, develop meaning, and reinforce transportable skills.

Problem Statement

Now more than ever, schools are facing intense pressure to maximize every instructional minute to ensure students master essential content standards while developing transportable skills. Educational leaders recognize the added value of new or existing programs reinforcing current priorities and cross-pollinating research-based strategies across district-wide initiatives.

Background

We know from research that "social, emotional, and academic development is an essential part of PreK-12 education that can transform schools into places that foster academic excellence, collaboration and communication, creativity and innovation, empathy and respect, civic engagement, and other skills and dispositions needed for success in the 21st Century" (Jones, Kahn, & the Aspen Institute, 2017, p. 6). Furthermore, research shows that problem-based (PBL) and project-based (PjBL) learning approaches positively impact student achievement, increase intrinsic motivation and participation, and develop critical thinking skills (Dole et al., 2017; Drake & Long, 2009; Karacalli & Korur, 2014; Krajcik, et al, 2021; Merrit et al, 2017; Nariman & Chrispeels, 2016; Permatasariet al., 2019; Rehmet & Hartley, 2020; Wirkala & Kuhn, 2011). PBL and PBjL

overlap with learning experiences that "launch from an open-ended question, scenario, or challenge" (Krauss & Boss, 2013, p. 10). PBL involves "facilitated problem solving" that focuses on engaging students in solving open-ended, real-world situated problems while building both content and critical thinking and collaboration skills (Hmelo-Silver, 2004, p. 265). PBjL is a "model that organizes learning around projects" that stem from challenging questions and involve students in problem-solving, investigation, designing, making decisions, and result in products or presentations (Thomas, 2000, p. 1).

Grounded in the evidence-based research on PBL and PBjL, the **PLTW APB (activity-, project-, problem-based) instructional approach** develops conceptual understanding as students are "actively gathering information, making observations, formulating questions, and then creating new ideas or solutions to answer their own inquiries" (Krauss & Boss, 2013, p. 31). Research indicates that coupling a problem- or project-based approach with STEM learning has a positive impact on student learning, critical thinking skills, and social-emotional learning (Krajcik et al., 2021; Rehmat & Hartley, 2020). Embedded social-emotional learning "can enhance children's confidence in themselves; increase their engagement in school, along with their test scores and grades; and reduce conduct problems while promoting desirable behaviors" (Greenberg et al., 2017, p. 13). APB learning allows students to develop social, emotional, and cognitive skills through authentic problem-solving.

PLTW has transformed traditional, teacher-led classrooms into collaborative spaces where students solve problems, think creatively, and apply their learning in real-world contexts. The APB approach helps students become active and engaged learners by creating student-centered learning experiences in which teachers act as facilitators, rather than lecturers. In this environment, students learn by doing and begin to lead their own discovery as they work through hands-on activities, projects, and problems that become increasingly open-ended as they progress through the curriculum and become more challenging as they advance to higher grades. Students "develop flexible knowledge, effective problem-solving skills, self-directed learning skills, effective collaboration skills, and intrinsic motivation" (Hmelo-Silver, 2004, p. 235). Critical thinking is embedded in the process as students investigate phenomena and make sense of the world around them.

- **Activities** engage students to develop knowledge and skills they'll use to navigate a real-world project and problem. They are structured, hands-on learning experiences that engage students in exploring phenomena as they seek to make sense of the world around them.
- **Projects** encourage meaning-making as students draw on their learning and background understandings to investigate concepts or skills.

- **Problems** are open-ended with no clear or best solution intended. They challenge students to apply their learning in novel situations that reflect real-world challenges placing students in the role of scientists and engineers.

Hmelo-Silver (2004) concluded, "Problem-based learning is well-suited to helping students become active learners because it situates learning in real-world problems and makes students responsible for their learning" (p. 236). Students "gain important knowledge, skills, and dispositions…" as they work collaboratively to investigate open-ended questions (Krauss & Boss, 2013, p. 5). Providing a scaffold for students as they actively learn is a critical component of PBL (Allen, et al., 2011). The APB approach builds problem-solving and process thinking, technical expertise, collaborative practices, and communication skills as students develop conceptual understanding.

APB learning also fosters a strong sense of self-efficacy as students may set higher goals for themselves, demonstrate firmer commitment to their goals, consider more career options as possibilities, and see an impact on academic achievement (Bandura, 1993, 1997; Parajes, 2003). We know that, "in order for students to meet high expectations for learning and development, the heavy lifting must be done by the student, but schools and teachers need to provide relevant, rigorous, grade-level, opportunities and support" (Aspen Institute, 2019, p. 6). Based on an overarching theme and using the APB approach, each instructional module is designed to build students' capacity for responsible decision-making, self- and social-awareness, and relationship skills (Greenberg et al, 2017; Taylor et al., 2017).

Essential features of the APB approach include **student-centered learning**, the teacher as facilitator, collaborative learning experiences, application of learning to solve problems, meaningful feedback and assessment, and a scaffold of learning experiences across the APB series. PLTW believes in this approach because it guides students toward owning their own learning, provides scaffolding, and prepares students to tackle challenges. Creating a problem scenario that is real-world and relevant to the learner's world, "effectively eliminate[s] the students' often posed question, 'Why do we need to know this?'" (Lambros, 2002, p. viii). Students thrive when given the opportunity to demonstrate evidence of their learning as they solve open-ended, real-world problems.

Solution

Students need opportunities to develop deep learning, which encompasses content mastery, critical thinking, problem solving, collaboration, effective communication, self-directed learning, and academic mindsets (Hewlett Foundation, 2013). PLTW Launch PreK-5 curriculum offers deep learning through evidence-based, interdisciplinary learning that is scaffolded for success by employing the hands-on APB instructional approach. As students navigate the open-ended problems, they are immersed in exploration of

phenomena that leads to sense-making of the world around them. The impact on student learning is why PLTW Launch has become the cornerstone of transforming teaching and learning for thousands of educators and millions of students across the U.S.

In addition to providing "best in class" STEM education, PLTW's approach to learning strengthens schools' and districts' commitment to a project- and problem-based instructional model to maximize engagement and contextualize crucial science, math, and literacy objectives. Project- and problem-based learning encourages students to develop mastery of academic learning using hands-on lessons.

Using PLTW's unique instructional activity-, project-, problem-based (APB) approach, students explore grade-level standards in science, while applying math and literacy skills to solve a real-world problem. Based on an overarching theme, each instructional module builds students' capacity for responsible decision-making, self- and social-awareness, and relationship skills (Greenberg et al, 2017; Taylor et al., 2017). By teaching essential content connected to standards using a hands-on, project- and problem-based learning model that strengthens students' social-emotional learning, PLTW's APB approach leverages research to create a high-impact, high-interest experience for students and teachers.

PLTW Launch offers 42 PreK-5th grade instructional modules that center around a developmentally appropriate open-ended problem. PLTW Launch modules cover PreK-5 grade-level standards, including the **Next Generation Science Standards**, **Common Core State Standards** for mathematics and English language arts/literacy (ELA), and **Computer Science Teachers Association Standards**. The breadth of PLTW Launch content allows schools to maximize their investment by using PLTW Launch during the school day, in after-school learning, and/or as summer learning experiences.

We know that teachers provide the necessary conditions for student success, and that ongoing participation in robust professional learning experiences prepares teachers to create these conditions in their classrooms. PLTW Professional Development empowers teachers to engage students in real-world and transformative APB learning experiences, inspiring them to impact the world with their learning. PLTW Professional Development is grounded in research that indicates effective professional development "leads to improvements in teacher knowledge or practice, or in student learning outcomes (Jaquith et al., 2011, p. 2). Embedding "a focus on **curriculum** and shared instructional challenges; **collective participation**; opportunities for **active learning**; sustained **duration**; and **coherence** with student achievement goals and other policies," PLTW Professional Development transforms teaching and learning (National Institute for Excellence in Teaching, 2012, p. 1).

Conclusion

The impact of the APB instructional approach extends far beyond a single classroom. In many cases, it has reinvigorated the learning experience across entire schools, as teachers are intentionally finding more opportunities for student exploration. This means more student-to-student discussion and discourse and less teacher-centered instruction, allowing for creativity, collaboration, and problem-solving in all subject areas. “Students need to see purpose in their learning and experience of school” (Aspen Institute, 2019, p. 6). Kris Kahn, a PLTW Launch teacher, expressed it this way: “Students, teachers, and parents all have that spark again – that spark being the thing that gets them talking and extends the learning far beyond the classroom.”

Research confirms that PLTW Launch offers a program that prepares students for success cognitively, socially, and emotionally. The APB instructional approach and the integrated curriculum design found in the 42 PreK-5 PLTW Launch modules is a proven and effective way to deliver meaningful engagement in learning to complete the cradle-to-college pipeline for students. When students get a strong start in PLTW Launch, they build a conceptual understanding in STEM, as well as developing transportable skills that include critical thinking, collaboration, communication, problem-solving strategies to benefit them in learning and in life.

References

Allen, D.E., Donham, R. S., & Bernhardt, S.A. (2011). Problem-based learning. *New Directions for Teaching and Learning, 128,* 1-9. http://dx.doi.org/10.1002/tl.465

Aspen Institute. (2019) *Integrating social, emotional, and academic development: An action guide for school leadership teams.* Washington, D.C.: Aspen Institute. Retrieved from https://www.aspeninstitute.org/wp-content/uploads/2019/03/UPDATED-FINAL-Aspen_Integrating-Report_4_Single.pdf

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*(20, 117-118.

Bandura, A. (1997). *Self-Efficacy: The exercise of control.* New York, NY: Freeman.

Dole, S., Bloom, L., Doss, K. K. (2017). Engaged learning: Impact of PBL and PjBL with elementary and middle grade students. *Interdisciplinary Journal of Problem-based Learning, 11*(2), Article 9. http://dx.doi.org/10.7771/1541-5015.1685

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 4th-grade classrooms. Journal of Elementary Science Education, 21(1), 1-16. Retrieved from https://eric.ed.gov/?id=EJ849707

Greenberg, M. T., Domitrovich, C. E., Weissberg, R. P. & Durlak, J. A. (2017). Social and emotional learning as a public health approach to education. *The Future of children, 27*(1), 13-32. Retrieved from . *https://www.wallacefoundation.org/knowledge-center/Documents/FOC-Spring-Vol27-No1-Compiled-Future-of-Children-spring-2017.pdf*

Hewlett Foundation. (2013, April). *Deeper Learning Competencies.* Retrieved from https://hewlett.org/library/deeper-learning-defined/

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review, 16*(3), 235-266. http://dx.doi.org/10.1023/B:EDPR.0000034022.16470.f3

Jaquith, A., Mindich, D., Wei, R. C., & Darling-Hammond, L. (2011). *Teacher professional learning in the United States: Case studies of state policies and strategies.* Oxford, OH: Learning Forward.

Jones, S. M., Kahn, J., & The Aspen Institute (2017). The evidence base for how we learn: Supporting students' social, emotional, and academic development. Consensus Statements of Evidence from the Council of Distinguished Scientists. Washington, D. C.: Aspen Institute. Retrieved from https://www.aspeninstitute.org/wp-content/uploads/2017/09/SEAD-Research-Brief-9.12_updated-web.pdf

Karacalli, S., & Korur, F. (2014). The effects of project-based learning on students' academic achievement, attitude, and retention of knowledge: The subject of 'electricity in our lives." *School Sciences 7 mathematics, 114*(50, 224-235. https://doi.org/10.1111/ssm.12071

Krajcik, J., Schneider, B., Miller, E., Chen, I-C., Bradford, L, Bartz, K., Baker, Q., Palinscar, A., Peek-Brown, D., & Codere, S. (2021, January 11). *Assessing the effect of project-based learning on science learning in elementary schools (Research Report).* Michigan State University. Retrieved from https://mlpbl.open3d.science/techreport

Krauss, J. & Boss, S. (2013). *Thinking through project-based learning: Guiding deeper inquiry.* Thousand Oaks, CA: Corwin University.

Lambros, A. (2002). *Problem-based learning in K-8 classrooms.* Thousand Oaks, CA: Corwin.

Merritt, J., Lee, M. Y., Rillero, P., & Kinach, B. M. (2017). Problem-based learning in K-9 mathematics and science education: A literature review. *Interdisciplinary Journal of Problem-Based Learning, 11*(2), 1-13. https://doi.org/10.7771/1541-5015.1674

National Institute for Excellence in Teaching (2012). *Beyond "job-embedded": Ensuring that good professional development gets results.* Retrieved from https://eric.ed.gov/?id=ED533379

Nariman, N. & Chrispeels, J. (2016). PBL in the era of reform standards: Challenges and benefits perceived by teachers in one elementary school. *The Interdisciplinary Journal of Problem-based Learning,* 10(1), 1-16. http://dx.doi.org/10.7771/1541-5015.1521

Pajares, F. (2003). Self-efficacy beliefs, motivation, and achievement in writing: A review of the literature. *Reading & Writing Quarterly, 19*, 139-158). Retrieved from https://www.uky.edu/~eushe2/Pajares/Pajares2003RWQ.pdf

Permatasari, B. D., Gunarhadi, & Riyadi, (2019). The influence of problem based learning towards social science learning outcomes viewed from learning interest. *International Journal of Evaluation and Research in Education, 8*(100, 39-46. Retrieved from https://eric.ed.gov/?id=EJ1211318

Rehmat, A. P., & Hartley, K. (2020). Building engineering awareness: Problem-based learning approach for STEM integration. *Interdisciplinary Journal of Problem-based Learning, 14*(1), 1-15. https://doi.org/10.14434/ijpbl.v14i1.28636

Taylor, R. D., Oberle, E., Durlak, J. A., Weissberg, R. P. (2017). Promoting positive youth development through school-based social and emotional learning interventions: A meta-analysis of follow-up effects. Child Development, 88(4), 1156-1171. https://doi.org/10.1111/cdev.12864

Thomas, J. W. (2000). *Review of research on project-based learning*. Retrieved from http://www.bobpearlman.org/BestPractices/PBL_Research.pdf

Peterson, A., Gaskill, M., & Cordova, J. (2018). Connecting STEM with social emotional learning (SEL) Curriculum in elementary education. In E. Langran & J. Borup (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference,* 1212-1219. Washington, D.C.: Association for the Advancement of Computing in Education (AACE). Retrieved from https://www.learntechlib.org/primary/p/182681/

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. https://doi.org/10.3102/0002831211419491