Scaffolding Engagement for All Learners in Project-Based Learning

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Problem of Practice: Project-Based Learning (PjBL) has been part of the educational landscape for many years and teachers are motivated to include PjBL in their classrooms for its benefits on student motivation, engagement and learning. However, PjBL can be challenging to define, difficult to implement, and time-consuming. In addition, PjBL may come in conflict with meeting other learning goals and with addressing needs of special populations, such as English Language Learners.

In order to better support teachers in implementing evidence-based practices, such as PjBL, coaches can provide guidance for teachers by illustrating the components and structure of PjBL within the context of required content and English language proficiency standards. One such illustration is provided by this Research Brief, in the context of a fifth grade unit on Force and Motion.

This Brief is framed with the characteristics of PjBL as defined by Krajcik and Bloomenfeld and with the Arizona State Science Standards (AZ Science Standards, 2018), which have comparable elements to the Next Generation Science Standards. In addition, we also rely on the Arizona English Language Proficiency (ELP) Standards (Arizona English Language Proficiency Standards 2019), which are intended to support English speaking, listening, reading, and writing skills of students who are English Language Learners.

Characteristics of Project-Based Learning

1. A Driving Question/Problem to Be Solved

The driving question should be able to be answered using scientific practices. A good question is one that is meaningful to students. When students find their schoolwork interesting or relevant to their lives, they are more likely to engage deeply with the content (Eccles & Wigfield, 2020).

In our example, the driving question is *Why do some things stay still and other things move*? This is one that students can relate to their real lives at home, in school, and on the playground. Students can come up with relevant examples of things that stay still and things that move and can make conjectures about items like balls, cars, and roller coasters.

2. Focus on Learning Goals

Within PjBL, the activity should focus on learning goals that are relevant to the educational situation. For example, relevant state or other standards.

In the Forces and Motion unit, one of the focal science learning goals for the context of our example, in Arizona, is Arizona state standard, 5.P3U1.4: Obtain, analyze, and communicate evidence of the effects that balanced and unbalanced forces have on the motion of objects.

Within the PjBL process, the activities also allow a focus on Arizona English Language Proficiency Standards, including Standard 6, which involves participation in in grade appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions.

PjBL activities provide a rich setting for conversation, including those among English Language Learners, provided that teachers provide appropriate scaffolds.

3. Students Participate in Scientific Practices

The National Research Council defines eight scientific practices: ask questions, develop and use models, plan and carry out investigations, analyze and interpret data, use mathematics and computation thinking, construct explanations, engage in argument from evidence, obtain, evaluate, and communicate information

In the Forces and Motion unit students had an opportunity to engage in a number of these practices. For example, they asked questions and constructed explanations around how and why objects moved. For example, in viewing a video of an archer who shoots at an unknown surface, the arrow rebounds, but begins to descend. Students offer ideas about why this happened.

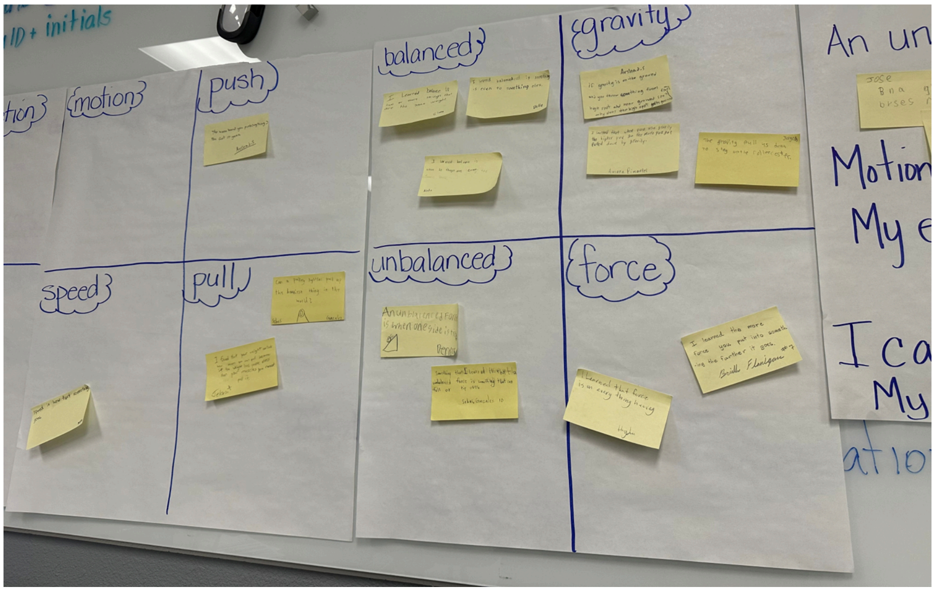
The culminating activity of the unit involved the development of a model to explain force and motion using the example of a design-a-ride (e.g., a roller coaster). Students had to create at least two amusement park rides demonstrating their knowledge around the driving question "*Why do some things stay still and other things move?*" utilizing their level of understanding of force and motion ideas and terms, such as balanced and unbalanced forces, friction, gravity, and acceleration. Students were given a choice of medium to create their artifact to provide student agency in their design: digital (CoSpaces), 3D physical model, or a Canva presentation with video (student created or referenced). Students could choose to work in teams of two–four, but needed at least one partner for design and concept collaboration. Students labeled where the force and motion terms were located on their design. Each student also had to use one of these terms in a complete sentence to explain how it related to their model. As a team, they each had to contribute to the explanation of their design, engaging in the necessary language functions of informing, describing, and explaining required by the ELP Standards.

A large focus for the district is to improve student writing, including writing using claims and evidence from activities and text. Within the Force and Motion unit, students use their model and collaborative experience working on the model, coupled with a reading provided to explain why some things stay still and others move.

Scaffolding During Engagement in Science Practices

All students are supported through the provision of sentence starters and question frames, such as, I think…because…, I agree with…because…, I have a question about…., Can you explain how….

Students are also scaffolded into their introduction of scientific vocabulary. Concepts are introduced in everyday language and with examples; the vocabulary is introduced in the context of these examples (not merely with definitions). Multiple visual and verbal scaffolds remind students of how vocabulary operates in context. For example, an interactive word chart invites students to draw or write on a sticky note the context of a vocabulary word used and add it to a grid displaying the vocabulary word. This provides opportunity for practice and a reference when students are discussing the science concepts. These references and practice opportunities are particularly aligned with ELP Standard 6.



4. Students, Teachers, and Community Engage in Collaboration

PjBL provides a rich environment for students to work with each other, their teacher, and other community members around scientific concepts and practices. Collaborative activities have been found to motivate students and encourage engagement (Wu et al., 2013) and skills in this area can be end goals in themselves, as future scientific practice, schooling, and work, require the ability to work successfully on teams.

Throughout the Forces and Motion unit, students explain their thinking and current understanding during lessons using collaborative strategies that provide structured discussions, such as Timed Pair Share and Stand Up, Hand Up, Pair Up (Kagan Cooperative Strategies), as well as See, Think, Wonder and Parts, Purposes, and Complexities from Visible Thinking Routines (Project Zero) in order to share, listen to, and ask questions of each other's understanding and changes in thinking.

5. Students' Practices are Scaffolded with Technology and Tools

In PjBL, students can use technology and tools to graph data, to run simulations, or to design presentations of their work.

Lessons within the Force and Movement unit included videos, demonstrations, and simulations to provide students with varying illustrations of the driving questions. Tools and resources included those from MergeEDU and Phenomena for NGSS.

The choice of format (including technology-rich formats) for the presentation of the students' final models supported student autonomy, an important aspect of motivation (Deci & Ryan, 2012).

6. Students Create Tangible Products

Developing artifacts is the tangible representation of students' construction of knowledge within the PjBL unit. These artifacts provide a means for students to demonstrate their competence and to construct and reconstruct their knowledge as they share ideas with peers and the teacher.

In the Forces and Motion unit, the culminating build-a-ride activity provides a tangible product that students work on over multiple days of the lesson. During this process, students engage in formulating and testing their models and rely on the scaffolds and tools in the classroom—such as the word wall—as they design. These products provide evidence of students' mastery and a representation of their learning that they can showcase to other students, teachers, and their families.

Examples of student final build-a-ride products are below.

<placeholder for where example images will go for student artifacts>

References

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