Mars Exploration Through Project Based Learning

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Introduction

American Academy of Innovation is a new public charter school in the Daybreak area of South Jordan, Utah. Our mission is to ignite a passion in students through project based learning (PBL) in science, technology, engineering, art, and mathematics (STEAM) courses.

We began our first school-wide project at the start of second semester, which provided sufficient time for students to learn how project-based education works and for teachers to prepare. We chose four possible projects for our students to pursue at the beginning of the year.

The first phase occurred during the last four weeks of first semester. We modified our schedule to accommodate a weekly house-long Mars Seminar, where each teacher ran classes on different aspects of exploring Mars in order to bring students up to speed and to instill excitement and anticipation for the main project. Some seminar topics included the history of Mars, using 3D simulation data, building Mars rovers from candy, keeping humans healthy on Mars, in popular culture and science fiction, and humanities.

During this time, various individual classes created in-class projects related to Mars, such as: our TITAN 1:1 class designing and building a model Mars colony out of junk and found objects and our Astronomy students creating a 3D animation of a space habitat and spacecraft that will carry astronauts to Mars. They also learned about the relative orbits of Earth and Mars and why round trip missions take up to 9 months through a human orrorey project.

At the start of second semester, students wrote proposals for group projects they wished to work on, along with timelines and objectives. Thirteen proposals were submitted and approved. Remaining students applied for which teams they wanted to join by writing cover letters and resumes and signing up for interviews. The team leaders and assistants then interviewed the candidates and made final selections. Each team consisted of from 10 to 15 students and was assigned a faculty mentor. These students who did not get selected for a team were required to complete individual Mars projects of their own design. Students of these teams self-organized into smaller teams of 4-5 members.

All teams have been meeting for one hour each Friday since Feb 27 to implement their projects. This poster reports on their progress and what we have learned about project-based learning so far in the context of Mars exploration.

Project Based Learning

**Effective project-based learning (PBL) teaches key knowledge of content standards and the 21st century skills of collaboration, communication, creativity, critical thinking, problem solving, leadership, and project management.** "Gold Standard" PBL has several essential characteristics according to the Buck Institute for Education, Harris, Menzgebids, and 2013.

1. **A Challenging Problem or Question:** This driving question should be interesting to students so that they will pursue it out of a need to know, not because it is simply assigned to them. It should be open-ended, challenging without being intimidating, and involve creativity and problem-solving skills.

2. **Authenticity:** The question should lead to active investigation through gathering and analyzing data, and critical thinking. It should involve primary sources, field research, and expert interviews.

3. **Interdisciplinary:** The project should be meaningful to students with real-world applications that solve local issues. It should relate to the students' own interests and curricular goals.

4. **Student Voice and Choice:** Students need to help choose the final project theme and how they carry out the overall project. These should allow for student interpretation and in-depth study.

5. **Reflection:** Students need to continuously evaluate what, how, and why they are learning and whether or not their projects are meeting learning parameter and guiding ideas. These are formative assessments that help the students understand the changes.

6. **Public Product:** A product can be a presentation, an action, a physical object, or a project. They have to show something for their efforts, and in front of a public audience.

Student Project Descriptions

**Mars Projects:**

- **Mars Habitat:** Two teams are building Mars habitats, which will live inside for two weeks and one night. One group is designing a habitat that contributes to the mental and physical health of the Mars explorers, including the isolation of delusions. The other is trying to find Earth and not getting able to go outside for fresh air.

- **Mars Soil Simulation:** Two teams are growing radishes and edible in simulated Mars regolith, complete with known contaminants and furnace-generated, heavy metals, which they purchased from a NASA supplier.

- **Mars Science Fiction Neville:** This team is creating a novel about three generations of Mars colonists. They have worked out the complete story, nearly are done with the first draft, and are creating illustrations of characters.

- **Mars Novel: Past, Present, and Future:** This group is using the Universe As Art festival to build a Mars survival game where an expedition is stranded on Mars due to a devastating war on Earth and must survive on supplies they brought in and in situ resources they can obtain.

- **Mars Nova Ball Sport:** Two students are leading a team to plan out and practice a sporting event called Nova Ball that can be played in the reduced gravity of Mars or on Earth.

- **Mars Illustration:** This team is creating illustrations and paintings of life on Mars and what a colony or city would look like.

- **Mars Post, Present, and Future:** This group is researching and reporting on the history of Mars exploration before the establishment of this presentation. They have finished the poster and are now working on a short story about Mars.

- **Mars Simulation:** This team has planned an annual Mars simulation of several days in the life of a Mars colony, complete with crises to overcome. They have run the simulations about 20 times and have made the bugs, and are now ready to run the entire school through the simulation.

- **Mars Video Game:** This team has purchased a D-engine class two-stage rocket and are building the launch ignition system and gantry now. They are designing an acceleration coach and launch to launch up to 200 feet in height and recovery it safely.

- **Mars Video Documentary:** These students are filming and filming the other projects. Each student is embedded in another group, similar to war correspondents, and are recording interviews with students and team leaders. We will edit the footage into a final 30-minute video and a 5-7 minute trailer for YouTube.

What We've Learned So Far

- **Sending Humans to Mars:** Provides a broad yet challenging problem that allows for student interpretation and in-depth study.

- **Students were given a choice between four possible project themes:** and the Mars Exploration. Students showed initiative by proposing their own projects related to Mars. We received a wide variety of proposals across many subject areas. Students applied for the team projects they most wanted to join, and were asked to write cover letters and resumes, then interview for the job.

- **Team leaders reflect on their progress through frequent written progress reports and personal interviews with teachers, several teams adjusted course based on our discussions and made their projects more realistic.** Most of the team project members are engaged and contributing well, although some adjustments have been necessary.

- **Initial formal assessments will occur March 31 as mentor teachers provide detailed feedback on their teams. Teams will make revisions based on the feedback.**

- **Teachers need additional training on the characteristics of effective project-based learning, including research on its effectiveness and how to implement projects inside classrooms, between classes, and across the entire school.** Site visits to effective PBL schools would be beneficial.

- **With more students in the school next year, we will need more time to train students, leaders, and other technology.** Right now we have a 2:1 student to computer ratio, and this needs to increase to almost 1:1 for project-based learning to really work.

- **We need to raise funds through sponsorships before starting a school-wide project so that our budgets are guaranteed and can't be frozen mid-year. Students should start paying insurances from the start of the year for trips to present their work. Teachers need to be trained on the characteristics of effective project-based learning, including research on its effectiveness and how to implement projects inside classrooms, between classes, and across the entire school. Site visits to effective PBL schools would be beneficial.**

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