Modeling in High School Earth and Space Science

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Introduction and Background

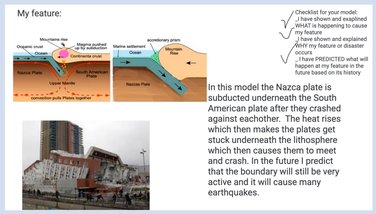
Bremerton High School is an urban high school located in Bremerton, Washington. Physical Science and Engineering 9 is the general science course for freshman. This study involved 72 freshman and the research was conducted during first semester. This course includes Earth, space, and an introduction to physics with an emphasis on problem-based learning and engineering and design.

Model based instruction is designed to help students develop both their science content knowledge and their skills within the discipline (Carrejo & Reinhartz, 2014). Using high interest scientific phenomena sparks student interest in learning and the practice of modeling builds student skills in arguing from evidence, seeing patterns, and describing the structure and function of systems (Windschitl, Thompson, & Braaten., 2018).

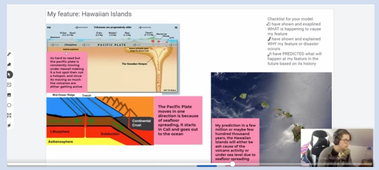
Assessments and Student Work

Build a Better Model: Solar System

Build a Better Model: Solar System



Why is the Earth so Restless Model



Why is the Earth so Restless Model

The COVID Curveball

For the first semester of the 2020-21 school year, we were in an all-remote school model due to the coronavirus pandemic. This presented a serious challenge to my usual hands-on, collaborative style of teaching.

I met on Zoom with my students 2x per week, 45 minutes per session. Students were expected to work asynchronously the days we did not meet. This was a reduction by nearly 65% of my typical in-person class time with students.

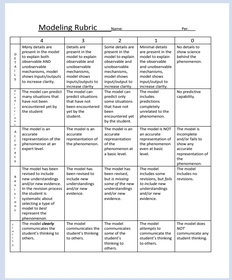
Questions and Tools

How does model based instruction impact student performance on phenomena-based assessments?

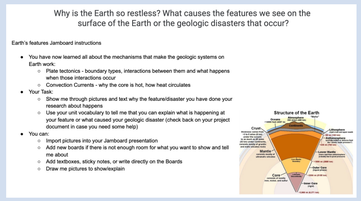
- Developing and Using Models pre and post treatment surveys
- Build a Better Model: Solar System and Why is the Earth so Restless? Summative modeling assessments and NGSS aligned rubric.
- Student reflections after summative modeling assessments via Google Forms

What effect does model-based instruction have on student engagement during remote learning?

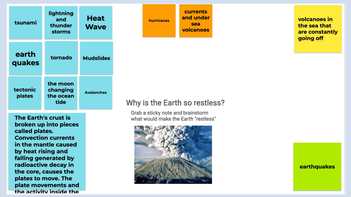
- Tracking engagement (cameras on/chat/activity contributions) during synchronous modeling-style activities.
- Teacher reflection journal and observations



Modeling Assessment NGGS Rubric



Why is the Earth so Restless Assessment



Initial Brainstorming: The Restless Earth

Conclusions

- Student self-evaluation of confidence and ability to use models changed very little from pre to post survey (Figure 1).
- No significant gains were made from the first to the second modeling assessment (Figure 2). Poor assessment submission rates severely impacted the data.
- Student engagement varied dramatically across the weeks and the activities and no pattern or increase in engagement was observed (Figure 3).
- Students self-reported enjoying the modeling activities and assessments, however, doing such complex tasks at home was overly challenging.

Data

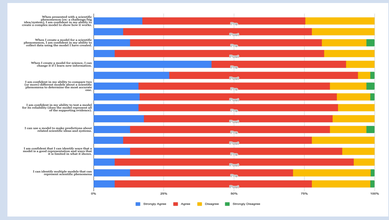


Figure 1. Developing and Using Models pre and post survey results

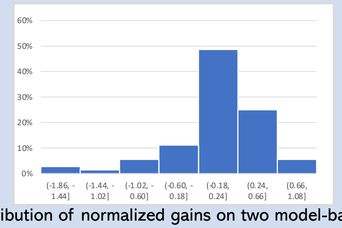


Figure 2. Distribution of normalized gains on two model-based assessments

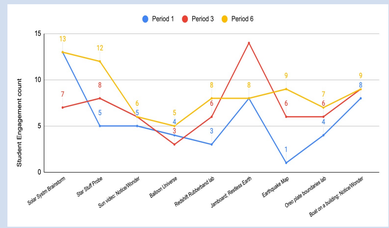


Figure 3. Student Engagement Tracking data during synchronous class periods

Student and Teacher Reflections

" I enjoy using models because they help me, it is just hard to create them!"
"Thank you for finding a way during virtual learning to make us be engaged."

Remote Teaching and Learning Challenges:

- WiFi capacity at home
- Attendance
- Assignment Submission rates
- Lack of independent learner skills
- Exhaustion and fatigue of curriculum overhaul

References

Carrejo, D. J., & Reinhartz, J. (2014). Facilitating Conceptual Change through Modeling in the Middle School Science Classroom. Middle School Journal, 46(2), 10–19. doi: 10.1080/00940771.2014.11461905

Windschitl, M., Thompson, J., & Braaten, M. (2018). Ambitious Science Teaching. Harvard Education Publishing Group (HEPG).