Simulations and Models in Math and Science Conversations

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Published by *K20 Center*

Time Frame 120-180 session(s)

Essential Question(s)

- How can simulations and models be incorporated in the classroom to enhance learning experiences?

Summary

The Simulations and Models in Math and Science Conversations professional development session enables participants to apply research-based practices to support the use of simulations and models in the curriculum. Participants learn how to use simulations and models in classroom instruction and design a standards-based activity on a topic they teach that includes simulations or models.

Learning Goals

- Participants will apply research-based practices to justify the use of simulations and models in the curriculum.
- Participants will design a standards-based activity on a topic they teach that will include simulations or models.

Attachments

- 3-2-1 Handout for Math and Science Simulations.docx
- 3-2-1 Handout for Math and Science Simulations.pdf
- Earth Simulation Cheat Sheet.docx
- Earth Simulation Cheat Sheet.pdf
- Goal Setting Half Page.docx
- Goal Setting Half Page.pdf
- How to Use Desmos.docx
- How to Use Desmos.pdf
- Math_Simulation_Tasks.docx
- Math_Simulation_Tasks.pdf
- Science_Simulation_Tasks.docx
- Science_Simulation_Tasks.pdf
- Simulations Spreadsheet.xlsx
- Simulations and Models in Math & Sci.pptx

Materials

- "Simulations and Models in Mathematics and Science: More than a Pretty Face" slideshow
- Internet-capable device (preferably a laptop)
- Science or mathematics simulation task
- "How to Use Desmos" handout
- Simulation cheat sheet
- Goal setting half-page handout
- Simulations spreadsheet
- 3-2-1 Handout for Math and Science Simulations

Engage

Presenter's Note: Initial Setup

During this lesson, there will be one activity that asks participants to contribute to a spreadsheet. The attached Science Simulations spreadsheet can be uploaded to a shared workspace (e.g., Google Sheets) for participant collaboration, then you may add the URL for the shared document to the slide, "Expanding the Ideas to More Simulations."

To begin the session, introduce yourself and the theme of today's session. Transition to slide three and introduce the objectives and goals. Explain that the session will allow participants to apply research-based practices to support the use of simulations and models in the curriculum. Participants then design a standards-based activity they plan to teach that includes simulations or models.

Research supports simulations as effective science instruction tools. They can also be integrated into lessons without significant additional planning. Many simulations for science instruction are easy to execute. The simulation chosen for this session is complex and offers a wide application across grade levels. By executing such a multifaceted simulation, you will be empowered to incorporate simulations of varying complexity into your instruction.

Presenter's Note: Contextualizing The Activity

This session will help participants feel more comfortable using simulations or models to provide deeper, richer access to content that might not be available in an average classroom. The following activity uses a photo, which is not a simulation. So, you may want to finish this slide by contextualizing that although this is only a picture and not a full simulation or model, it aims to orient participants toward the idea of providing accessible experiences for learning.

Transition to the slide, "Photo Deconstruction." Read each question aloud, giving participants time after each one to discuss their thoughts with an Elbow Partner. Allow approximately five minutes for this activity.

Explore

Proceed to the next slide, "Exploring a Simulation," and direct participants to https://earth.nullschool.net/. The website and basic instructions are included on the back/second page of the Simulations Cheat Sheet handout.

Additional Context For Earth Simulations Data

The Earth simulation participants will use is a collection of near-real-time atmospheric and oceanic models. The data are aggregated from a variety of sources (e.g., NOAA, Mesonet) and contain current measurements and satellite imagery as well as scientific projection models. Categories of data are grouped as “modes” in the simulation menu. Within each mode, specific variables have “overlays” that visually display the data for each one. These data are updated between once an hour to once every five days depending on their source. The “About” section of the simulation menu takes you to a new page with information on the data sources and update frequency, as well as explanations of the variables. Explanations for variables relevant to this simulation are provided on the Simulation Cheat Sheet handout.

Have participants follow along on their own devices as you demonstrate how to find the basic functions in the Earth simulation menu. Slide six shows a static image of the menu with these functions annotated. But before showing these annotations to the participants and beginning the Explore tasks, be sure to demonstrate these functions on the actual simulation.

After demonstrating the functions on the live model, display slide six and keep it visible for the participants' reference during work time. Work time for the four Explore tasks begins after your transition to this slide and point out the annotations to the participants.

Presenter's Note: Using Additional Resources

Make sure to remind the group that additional resources are available to them during these tasks, particularly if you hear concerns and questions voiced as they work. Participants have the Simulation Cheat Sheet to help them with variables and with navigating to the Earth simulation and Desmos graphing site.

Divide participants into four content-specific groups, with two for math and two for science. Both science tasks are designed around seventh-grade standards, but math teachers may be separated into grade-level groups as well. The Alabama Tornado task is geared toward seventh-grade math standards, while the El Niño-La Niña task uses eighth-grade math standards.

Presenter's Note: Grouping Strategies

If the group is small enough, grouping participants into pairs works well. In this case, you might end up with more than one group working on the same task which is fine. Try to limit groups to no more than four participants. Groups with more than four participants are not easily manageable for these tasks.

Presenter's Note: Providing Additional Copies

Participants may want hard copies of both tasks for their content area, so plan to have extra copies of each to give out at the end of the workshop.

Provide groups enough time to work through their task if possible. If the workshop is three hours long or more, give participants at least 30 minutes; if you have less than three hours, allow 15–20 minutes. If your total time for this professional development is less than three hours and you have to limit the amount of time spent on this task, it is unlikely that participants will complete it.

Move on to the Explain activity after the allotted time or when groups have completed their task.

Explain

Tell participants they have just experienced a simulation from the perspective of a student. Now in the role of a teacher, they will create a presentation about their experience and share.

Transition to slide seven, "Presenting your Findings."

Pass out the 3–2–1 handout (for smaller groups, you may choose to simply present the slide). Staying within the same groups that worked on the simulation tasks, allow a short time (less than 10 minutes) for groups to prepare their presentations.

Presenter's Note: Presentation Options

The media and means that groups use to make their presentations may be adapted dependent on the workshop size and technology constraints. Google Slides is an excellent format for sharing if the environment allows, but posters or something similarly informal may be more appropriate.

Each presentation, for the sake of time, should be limited to five minutes with only a question or two afterward. Have groups take turns sharing their presentation with a lead presenter directing the transitions (if using Google Slides). Each group will present, with a focus on the two "aspects" and three "ways" from the 3–2–1 strategy.After presentations are completed, take time to discuss the research foundation for simulations (see below). When ready, transition to slide nine, "Expanding Ideas to More Simulations."

Extend

At this point, slide nine should have been augmented to include a URL for the shared Science Simulations spreadsheet (as directed in the Presenter's Note for initial setup). Have participants use their own devices (preferably a laptop) and visit the URL. Ask them to sign up for one of the resources listed by typing their name in the corresponding cell under "Name."

Presenter's Note: Live Document Presentation

Remind participants that this is a live, collaborative spreadsheet. Encourage them to be mindful of revisions history or if they're replacing someone else's content.

This activity is independent, but interaction is allowable and may be helpful. Walk around and assist participants as necessary. When completed, transition to the "Translating from Here to the Classroom" slide.

Evaluate

Pass out the "Goal Setting" half-sheet. Each participant should receive a copy.

Instruct participants to think about what stood out to them and could be incorporated into their own classroom. Encourage them to answer each question with the intention of actually implementing the goal in their classrooms.

Follow-up Activities

Follow through with the ideas you came up with on your goal-setting sheet. Attempt at least one learning experience with your students involving a simulation or digital model.

Research Rationale

A major component of authenticity in education is a basis in the real world. While the direct observation of phenomena is not always readily accessible, virtual simulations and models allow educators a wealth of options. Games, simulations, and virtual worlds are shown to be effective in improving learning outcome gains. (Merchant, Goetz, Cifuentes, Keeney-Kennicutt, & Davis, 2013). Findings have also indicated a significant difference in the performance achievement between students using desktop virtual reality and control. (Lee & Wong, 2014).

Resources

- K20 Center. (n.d.). 3-2-1. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f5059a7b
- K20 Center. (n.d.). Elbow partners. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/ccc07ea2d6099763c2dbc9d05b00c4b4
- Earth (Simulation). (n.d.). Retrieved from https://earth.nullschool.net/.
- Lee, E.A., & Wong, K.W. (2014). Learning with desktop virtual reality: Low spatial ability learners are more positively affected. Computers & Education, 79, 49-58.
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