Promoting Model-Informed Reasoning through Engagement with Multiple Models

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Overview

- ❖ Identify model-informed reasoning strategies that students use when taking a position on socioscientific issues (SSI)
- ❖ SSIs are complex problems of society that can be negotiated using scientific evidence.
- ❖ This study explores how students use scientific and socio-scientific models to inform their positions on an SSI related to viral disease spread.

Research Questions:

1. How do students engage in model-informed reasoning while taking a position during an SSI-based task?
   a. What model sources do students draw upon to inform their decisions?
   b. For what purposes are the models used?
   c. What combinations of model sources and purposes are students frequently using?

Task Design

- ❖ We worked with 20 middle school students organized into 5 groups during a 3-day summer camp.
- ❖ We engaged them in multiple modeling activities throughout the camp.
- ❖ We audio and video recorded them as they worked on an hour-long culminating activity.
- ❖ During the task, students worked together to use and develop multiple models to support a policy recommendation (See Multiple Types of Models).
- ❖ They also made a t-chart to identify advantages and disadvantages of each policy

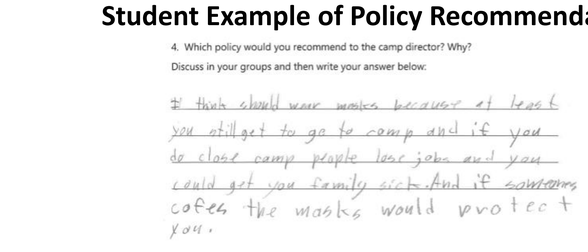
Student Task:

Which policy would you recommend to a summer camp director to reduce the spread of a viral disease through the camp?

Policy 1: Close the camp down and send campers home

Policy 2: Require everyone at the camp to wear masks

Student Example of Policy Recommendation



4. Which policy would you recommend to the camp director? Why?

Discuss in your groups and then write your answer below:

I think should wear masks because at least you still get to go to camp and if you do close camp people lose jobs and you could get you family sick. And if someone cofes the masks would protect you.

What is Model-Informed Reasoning?

- ❖ Models are tools that can help students make sense of challenging scientific topics such as viral disease spread.
- ❖ Combining multiple models creates an opportunity for epistemic reflection on the affordances and limitations of different model types (Ke et al., 2021).
- ❖ Model-informed reasoning occurs when students draw upon models to support a claim, argument, or decision.
- ❖ We developed a framework to code students' model sources and purposes while they take a position on the SSI.

Model-Informed Reasoning Matrix (All Model Types)

	Model is…	Used as example	Used to identify relationship	Used to explain idea	Used to compare or contrast	Used to answer question	Used to ask question	Used to justify position	Used to critique position	Used to legitimize position	Used to propose/ revise policy
Spontaneous	Referenced explicitly by student			2		1		2			
Spontaneous	Designed by student										
Spontaneous	Aligned with previous modeling activity			3		2			1	1	1
Prompted	Prompted by researcher		3	22	4	30	2	3			2
Prompted	Prompted by other student			8		7	1		1	1	
Prompted	Prompted by the task	1	17	21		11	3	1	1		1

Multiple Types of Models

Chain of Infection Model

Students consider where a policy would break the chain of infection.

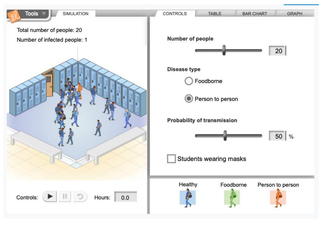
Mechanistic Model

Students represent how a healthy person becomes infected with a pathogen.

Systems Model

Students propose factors (bubbles) related to a policy and connect factors using cause-and-effect arrows.

Computational Model



Students use a computer simulation, Gizmos (2022), to understand the probability of disease transmission.

Systems Model Reasoning Strategies

Frequency of Reasoning Strategies

	Model is…	Used as example	Used to identify relationship	Used to explain idea	Used to compare or contrast	Used to answer question	Used to ask question	Used to justify position	Used to critique position	Used to legitimize position	Used to propose/ revise policy
Spontaneous	Referenced explicitly by student			1		1		1			
Spontaneous	Designed by student										
Spontaneous	Aligned with previous modeling activity			2		1					2
Prompted	Prompted by researcher		3	16	4	20	1	3			2
Prompted	Prompted by other student			4		3			1		
Prompted	Prompted by the task	1	17	13			3	1			1

Key Findings

- ❖ Students most frequently used models to:
  1. Answer a question
  2. Explain an idea
  3. Identify a relationship
- ❖ Model sources were more often prompted than spontaneous. This reflected the nature of the task which prompted students to use and develop specific models.
- ❖ When students did spontaneously use a model, it was typically used to explain an idea.
- ❖ Students used different model types for different purposes.
- ❖ For example, the systems model was used to identify relationships, propose/revise the policy recommendation, and compare and contrast, which were purposes not observed for the break the chain model.
- ❖ Large variation in model uses across student groups.

References

- Explore Learning. (2022). Disease Spread. https://gizmos.explorelearning.com/find-gizmos/launch-gizmo?resourceId=379Reference two.
- Ke, L., Sadler, T. D., Zangori, L., & Friedrichsen, P. J. (2021). Developing and using multiple models to promote scientific literacy in the context of socio-scientific issues. Science & Education, 30(3), 589-607.

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