IMPACTS & MODERATION OF THE MODEL-BASED BIOLOGY EDUCATIONAL RESOURCE (MBER) ON STUDENT OUTCOMES

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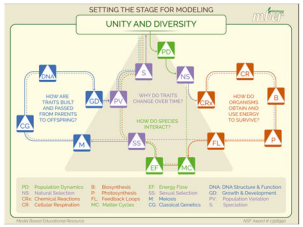
Overview

The **Model-Based Educational Resource (MBER)** is a year-long high school biology program designed to provide students opportunities to engage in modeling to generate scientific understanding. The curriculum is built around a clear storyline with explicit connections between biological ideas and provides teachers with pedagogical supports that outline how to engage students in the intellectual work of the classroom. An instructional framework highlights the connections between the three main components of any modeling lesson: the phenomenon, the question about the phenomenon, and the model that explains the phenomenon. The efficacy study seeks to answer the following **research questions**:

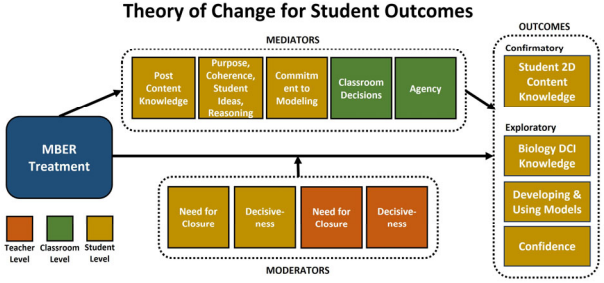
1. To what extent does experiencing the MBER program impact student achievement compared to BaU biology programs?
2. How much variance in student achievement can be explained by each of the mediating and moderating variables?



Research Methods

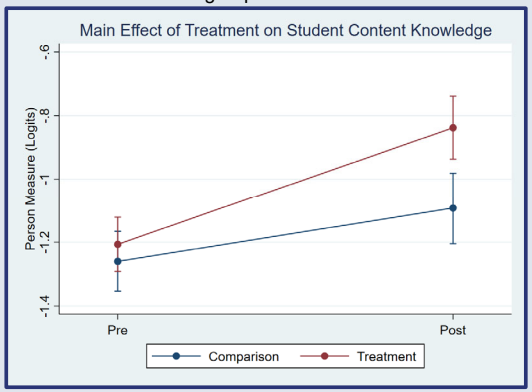
A quasi-experimental study was conducted in northern California with assignment at the teacher level. Comparison teachers taught using their business-as-usual materials. The model-based reasoning student outcome assessment focused on genetics and natural selection. Treatment teacher n=25, Comparison teacher n=17.

Theory of Change for Student Outcomes

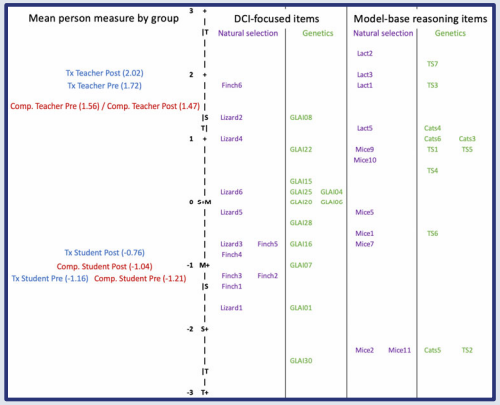


Main Effects Findings

Both groups of students showed increases in their ability to use model-based reasoning in biology, but the increase in the MBER treatment group was significantly greater than the comparison business-as-usual group ($p<0.05$, Hedges' g effect size = 0.154). Baseline equivalence was present for the two treatment groups.



Rasch modeling was used to estimate person measures. The Wright map below shows the range of item difficulties compared to the mean person measure for each group in the study.



Moderation Findings

Of the four moderating variables that were explored, the **teacher's Need for Closure** was a significant negative moderator on the student achievement outcome. Measured with 9 5-point Likert items (McLain, 1993). A higher score indicates a higher need for closure and a lower tolerance of ambiguity. The Need for Closure items were:

* = reverse coded

• I'm drawn to situations which can be interpreted in more than one way.*	• Problems which cannot be considered from just one point of view are a little threatening.	• I enjoy tackling problems which are complex enough to be ambiguous.*
• I would rather avoid solving a problem that must be viewed from several different perspectives.	• I pursue problem situations which are so complex some people call them "mind boggling".*	• I try to avoid problems which don't seem to have only one "best" solution
• Some problems are so complex that just trying to understand them is fun.*	• I avoid situations which are too complicated for me to easily understand.	• I find it hard to make a choice when the outcome is uncertain.

Conclusions

Conclusions from the study include:

- MBER has a significant impact on students' ability to use model-based reasoning in biology, above and beyond that of business-as-usual high school biology materials.
- A teacher's need for closure appears to impact the effectiveness of the program, with teachers with a higher tolerance for ambiguity being more effective.
- No other moderating variables were significant.
- The Rasch Wright map suggest that implementing MBER increased teachers' ability to use model-based reasoning in biology.

Future Directions

Future directions of the study include:

- Investigate the impact of MBER on the exploratory outcomes.
- Determine which variable mediate the impact of MBER on student outcomes.
- Explore the impacts of teaching MBER on teacher variables such as teacher model-based reasoning.

McLain, D. L. (1993). The MSTAT-I: A new measure of an individual's tolerance for ambiguity. *Educational and psychological measurement*, *53*(1), 183-189

Acknowledgements

This project is funded by the National Science Foundation, grant # DRL1814263. Any opinions, findings, and conclusions or recommendations expressed in these materials are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.