Leveraging Dynamically Linked Representations in a Semi-Structured Workspace to Cultivate Mathematical Modeling Competencies Among Secondary Students (M2Studio)

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1. Background: The world is filled with critical, unanswered questions such as disease spread, climate change, economic, population growth, etc. These questions demand mathematical modeling (COMAP & SIAM, 2019, p. 8).

2. Why M2Studio Project?

MM Curriculum: The skills of planning, organizing, and executing complex tasks are lacking among beginners (Vorhölter, 2018).

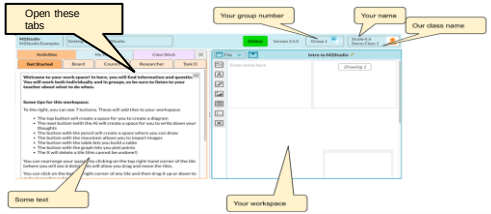
Technology: **Existing tools can assist learners in some tasks but fall short of facilitating learning in optimal ways.**

To address these two fundamental issues, we engage in a three-year design and development project (M2Studio) to develop:

- M2Studio Technology: A novel web-based technology that enables students to leverage dynamically linked representations when working on modeling tasks
- M2Studio Competency-based Curriculum: A 10.5 hour each of algebra and statistics strand curricula designed to introduce students to math modeling. Each strand targets **math modeling competencies** such as simplifying, mathematizing, interpreting, and validating.

3. Summary of Year 1&2

For the purpose of this qualitative study, we have developed the first version of the M2Studio technology and curriculum module and have piloted with 5 teachers and over 300 students. In Year 3, we will engage more teachers and students in diverse settings in our research and development work.



4. Research Questions

1. How can technology-enhanced learning environments be designed to help students develop math modeling competencies?
2. How can learning activities be designed to best leverage the affordances of the M2Studio software to support student development of math modeling competencies?
3. To what extent, for whom, and under what teaching contexts are the M2Studio curriculum modules useful in developing students' math modeling competencies?

5. M2Studio Competency-based Curriculum (10.5 hour)

Pre and post assessment
Introduction to Math Modeling & M2Studio. ***What is math modeling?*** ***How to use M2Studio?***
Simplifying Problems. ***How much time do students typically spend at school?***
Mathematizing Problems.
Interpreting and Validating Models. ***How do institutions estimate food waste?***
Final Projects. **Should people move to another town to save rent? Is the food waste estimation model used by the government a fair model?**

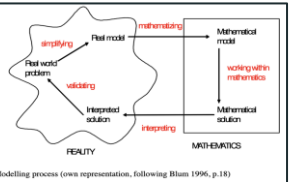


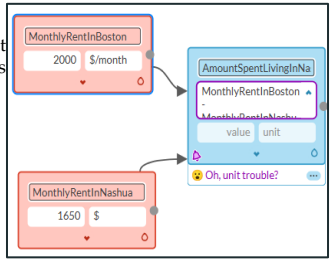
Fig. 1: Modelling process (own representation, following Blum 1996, p.18)

6. Findings:

-M2Studio works as a cognitive tool to help students perform unit analysis, name and relate variables, and identify connections between variables through mathematical operations.

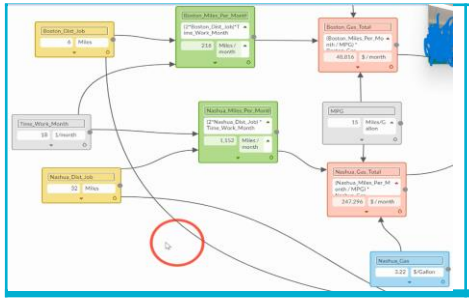
-Feedback from dynamically linked variable cards in M2Studio helps students to adjust their modeling work.

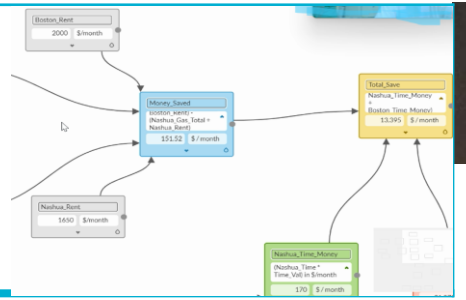
-The ways in which M2Studio allows students to organize and highlight elements of models, create and integrate submodels, and test values both reveal and influence students' thinking.



7. Future Goals:

How can teachers be prepared to use M2Studio to introduce students to Math Modeling?





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