Assessing Secondary Teachers' Algebraic Habits of Mind

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WHAT IS ASTAHM?

Assessing Secondary Teachers' Algebraic Habits of Mind

- NSF DRK-12 project funded in 2012.
- Collaboration between Boston University, Education Development Center, Inc., and St. Olaf College.
- Aimed at developing instruments to assess secondary teachers' mathematical habits of mind (MHoM).

WHAT DO WE MEAN BY MHOM?

We define mathematical habits of mind (MHoM) to be:

the specialized ways of approaching mathematical problems and thinking about mathematical concepts that resemble the ways employed by mathematicians.

INITIAL MOTIVATION FOR RESEARCH

- Through our prior MSP, we've seen that MHoM is indeed something that teachers can acquire/develop.
- Teachers report that developing these mathematical habits has a tremendous effect on their teaching.
- We recognize the need for scientific-based evidence to verify what we saw in working with teachers.
- Instruments to measure these habits have not existed.

RESEARCH QUESTION

What are the mathematical habits of mind that secondary teachers use, how do they use them, and how can we measure them?

INSTRUMENTS FOR CONDUCTING RESEARCH

To investigate our research question, we've been developing:

- Detailed definition of MHoM, based on literature, our experiences as mathematicians, and classroom observations.
- A paper and pencil (P&P) assessment that measures how teachers use MHoM when doing math for themselves.
- An observation protocol measuring the nature and degree of teachers' use of MHoM in their classroom work.

Focus on MHoM

Our current focus is on three categories of MHoM:

- Seeking mathematical structure
- Using mathematical structure
- Using mathematical language clearly (i.e., "Describing")

Remark: Focusing on three habits has allowed us to create instruments that are not too burdensome to use.

CONNECTION TO CCSSM



We've parsed the SMPs for measurement purposes. E.g., the two processes of *seeking* and *using* structure in SMP7 look different when people do them, so we study them separately.

P&P ASSESSMENT: OVERVIEW

- We are developing a P&P assessment that measures how teachers use MHoM when doing math for themselves.
- The assessment has been field-tested with over 700 teachers. Field-tests are ongoing.
- Initial validity and reliability testing yielded excellent results. More testing is being planned.
- This is a tool for research, *not* for teacher evaluation.

P&P ASSESSMENT: KEY FEATURES

- Assessment measures how secondary teachers use mathematical habits of mind when doing mathematics.
- Items are accessible: most secondary teachers can solve them, or at least begin to solve them.
- Coding focuses on the *approach* to each item, not on obtaining "the correct solution."
- Assessment items are drawn from multiple sources, including our classroom observation work.

MAXIMUM VALUE

Find the maximum value of the function $f(x) = 11 - (3x - 4)^2$. Habit measured: Using mathematical structure

- Though most teachers obtained the same (correct) answer, there were vast variations in their approaches.
- These various approaches came in "clumps," as assessment experts and research literature had told us to expect.
- Using these responses, we developed a rubric that allows us to code how each teacher solved the problem.

SAMPLE CODE: SQUR

$$F(x) = || - (3x - 4)^2$$
. Anything squared is ≥ 0 .
Therefore, $|| - (stuff squared)$ must be $\le ||$. So || is the max.

SAMPLE CODE: SYMM

$$f(x) = 11 - (3x - 4)^{2}$$

$$= -9x^{2} + 34x - 5$$

$$= 11 - (3(\frac{4}{3}) - 4)^{2}$$

$$= -9x^{2} + 34x - 5$$

$$= 11 - (4 - 4)^{2}$$

$$= 117$$

$$= 117$$

$$= 117$$

$$= 117$$

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MEASURING TEACHER CHANGE¹

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		Mean	Std. Deviation	Std. Error Mean
Pair 1*	Full Assessment, Time 1	4.9	2.4	0.6
	Full Assessment, Time 2	5.4	2.6	0.7
Pair 2	Using Structure, Time 1	4.7	2.8	0.7
	Using Structure, Time 2	5.4	2.9	0.8
Pair 3	Language, Time 1	5.9	2.5	0.6
	Language, Time 2	5.8	2.5	0.6
Pair 4*	Seeking Structure, Time 1	4.3	2.6	0.7
	Seeking Structure, Time 2	5.3	3.3	0.9

Paired Samples Statistics for Teacher MHoM subscales, Time 1 and Time2 (N = 20)

¹Gates, M., Cordner, T., Kerins, B., Cuoco, A., Badertscher, E., & Burrill, G. (2016). Creating a hybrid immersive mathematics experience. *Mathematics Teacher*, 110(4), 288–297.

FURTHER QUESTIONS

- How can we ensure that we are indeed measuring MHoM and not simply capturing teachers' prior knowledge?
- What constitutes evidence of a "way of thinking" or "intent of an approach"?
- What aspects of MKT are we capturing with the P&P assessment? What aspects are we missing?
- How can data from the P&P assessment inform professional development for teachers?

LEARN MORE OR PARTICIPATE

Want to use the assessment, or participate in the research? Learn more about our project at:

mhomresearch.edc.org

If you have further feedback and/or questions, email us at:

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