PROCEEDINGS OF THE 46TH ANNUAL MEETING OF THE NORTH AMERICAN CHAPTER OF THE INTERNATIONAL GROUP FOR THE PSYCHOLOGY OF MATHEMATICS EDUCATION

Envisioning the Future of Mathematics Education in Uncertain Times

EDITED BY

Karl W. Kosko

Joanne Caniglia

Scott A. Courtney

Maryam Zolfaghari

Grace A. Morris

Kent State University

MAPPING ERRORS IN PROBLEM-SOLVING TO MATHEMATICAL PRACTICES

Kristin Koskey
Drexel Univ.
kk3436@drexel.edu

Yiyun Fan
Drexel Univ.
yf366@drexel.edu

Timothy Folger
BGSU
tfolge@bgsu.edu

Michael Klein
Drexel Univ.
mak523@drexel.edu

Casey Hanna
Drexel Univ.
cey325@drexel.edu

Cindy Yovanov
Drexel Univ.
cy454@drexel.edu

Jonathan Bostic
BGSU
bosticj@bgsu.edu

Toni May
Drexel Univ.
tas365@drexel.edu

Gabriel Matney
BGSU
gmatney@bgsu.edu

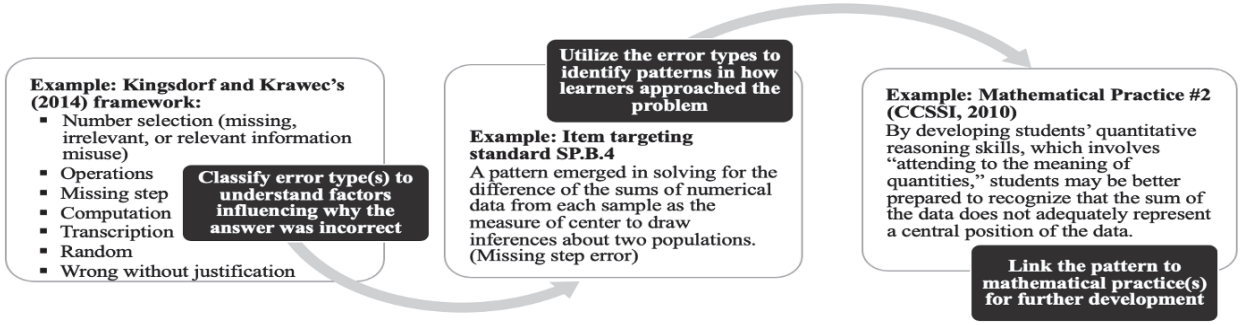
Gregory Stone
Clarity Assessment Systems, Ltd.
gregory@clarityassessmentsystems.com

Keywords: Assessment; Research methods

K-12 assessment practices have been identified as needing advancement (Datnow & Hubbard, 2015; Harris et al., 2023). Strategies for using assessment data to inform instruction is a key practice to advance (Wilson, 2018). Careful analysis of students' errors on mathematical assessments in particular has been shown to provide insight into their conceptual understanding (Rakes & Ronau, 2019). In turn, information from incorrect responses is maximized to support teaching and learning (Lannin et al., 2006). Mathematical problem-solving skills are a needed area of study given the continued focus internationally (Mullis et al., 2016) and in the Common Core State Standards - content and practice (CCSSI, 2010). The aim of this poster is to share a process for analyzing incorrect responses to gain insight into targeted areas for development related to mathematical practices. Incorrect written responses (N=2,115) on the seventh grade Problem-Solving Measure CAT prototype items were analyzed collaboratively in coder pairs (≥90% inter-coder agreement). The PSM has substantial reliability and validity evidence (Bostic et al., 2015, 2017, 2024). Fifty-nine items were sampled to represent the content standards. A cyclical approach involving expert (n=5) and practitioner (n=16) feedback through surveying and interviewing informed iterative refinements to the process. Thematic analysis (Braun & Clarke, 2006) of practitioner data revealed the usefulness of describing common errors. Expert data revealed a refinement needed was to re-frame error descriptions to reflect how students approached a problem to adopt a more asset-based lens. This resulted in a three-step process (see Figure). This process contributes to the call for advancements in assessment practices (Harris et al., 2023), namely offering a process for using results to identify targeted areas for learning.

Figure 1: Three-Step Process

Kosko, K. W., Caniglia, J., Courtney, S., Zolfaghari, M., & Morris, G. A., (2024). *Proceedings of the forty-sixth annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Kent State University.



Acknowledgments

This research was funded by the NSF (#2100988, #2101026) and does not necessarily reflect the views of the NSF.

References

Bostic, J., May, T., Matney, G., Koskey, K., Stone, G., & Folger, T. (2024, March). Computer adaptive mathematical problem-solving measure: A brief validation report. In D. Kombe & A. Wheeler (Eds.), *Proceedings of the 51st annual meeting of the* Research Council on Mathematics Learning (pp. 102–110). Columbia, SC.

Bostic, J. D., & Sondergeld, T. A. (2015). Measuring sixth-grade students' problem-solving: Validating an instrument addressing the mathematics common core. *School Science and Mathematics Journal, 115*(6), 281–291.

Bostic, J. D., Sondergeld, T. A., Folger, T., & Kruse, L. (2017). PSM7 and PSM8: Validating two problem-solving measures. *Journal of Applied Measurement, 18*(2), 1–12.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3,* 77–101. https://doi/org/10.1191/147808870qp063oa

Common Core State Standards Initiative. (2010). *Common core standards for mathematics.* https://learning.ccsso.org/common-core-state-standards-initiative

Datnow, A., & Hubbard, L. (2015). Teachers' use of assessment data to inform instruction: Lessons from the past and prospects for the future. *Teachers College Record, 117*(4), 1–26. https://doi.org/10.1177/016146811511700408

Harris, C., Wiebe, E., Grover, S., & Pellegrino, J. (Eds.) (2023). *Classroom-Based STEM assessment: Contemporary issues and perspectives. Community for Advancing Discovery Research in Education* (CADRE). Education Development Center, Inc.

Kingsdorf, S., & Krawec, J. (2014). Error analysis of mathematical word problem solving across students with and without learning disabilities. *Learning Disabilities Research & Practice, 29*(2), 66–74.

Lannin, J. K., Arbaugh, F., Barker, D. D., & Townsend, B. E. (2006). *Teaching Children Mathematics, 13*(3), 182–186.

Mullis, I. V. S., Martin, M. O., & Loveless, T. (2016). *20 years of TIMSS: International trends in mathematics and science achievement, curriculum, and instruction.* https://timssandpirls.bc.edu/timss2015/international-results/timss2015/wp-content/uploads/2016/T15-20-years-of-TIMSS.pdf

Rakes, C. R, & Ronau, R. N. (2019). Rethinking mathematics misconceptions: Using knowledge structures to explain systematic errors within and across content domains. *International Journal of Research in Education and Science, 5*(1), 1–21.

Wilson, M. (2018). Making measurement important for education: The crucial role of classroom assessment. *Educational Measurement, Issues and Practice, 37*(1), 5–20. https://doi-org.ezproxy2.library.drexel.edu/10.1111/emip.12188