

## The development and validation of two new assessment options for multiplicative thinking

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The capacity to recognise, represent, and reason about relationships between different quantities, that is, to think multiplicatively, has long been recognised as critical to success in school mathematics in the middle years and beyond. Data analysis from the *Reframing Mathematical Futures II* (RMFII) (Siemon, et al., 2019; Siemon et al., 2018) suggested a strong relationship between multiplicative thinking (MT) and mathematical reasoning (MR). A secondary analysis of these data together with archived data from the *Scaffolding Numeracy in the Middle Years* project (Siemon et al., 2006) was conducted to test whether this link could be empirically established. This proved to be the case and a single, integrated scale connecting MT and MR was developed and validated (Callingham & Siemon, 2021).

Given evidence of the strong relationship between MT and MR, an opportunity arose in the *Growing Mathematically - Multiplicative Thinking* (GM-MT) project to trial two new assessment options for MT that included MR items from the single scale for MT and MR. The research question that was addressed was: To what extent is it possible to develop valid assessments of multiplicative thinking that incorporate aspects of algebraic, geometrical, and statistical reasoning?

The analysis reported in the paper showed how assessment tasks used in previous research can be combined to create two new assessment options for MT that relate MT to algebraic, geometrical and statistical reasoning. Overall, the new scale performed in a manner remarkably similar to previous scales, meaning that the new assessment options can be used with confidence to place students on the MT learning progression with sufficient accuracy to support targeted teaching. This finding is significant, especially for secondary teachers, as they are more likely to see the importance of multiplicative thinking when they see its relationship to the broader mathematics curriculum.

### References

- Callingham, R., & Siemon, D. (2021). Connecting multiplicative thinking to mathematical reasoning in the middle years. *Journal of Mathematical Behavior*, 61, 1-12. <https://doi.org/10.1016/j.jmathb.2020.100837>
- Siemon, D., Barkatsas, T., & Seah, R. (2019). *Researching and using progressions (trajectories) in mathematics education*. Brill Sense.
- Siemon, D., Breed, M., Dole, S., Izard, J., & Virgona, J. (2006). *Scaffolding Numeracy in the Middle Years – Project findings, materials and resources, Final report*. Retrieved from <http://www.education.vic.gov.au/school/teachers/teachingresources/discipline/maths/assessment/Pages/scaffoldingnum.aspx>
- Siemon, D., Callingham, R., Day, L., Horne, M., Seah, R., Stephens, M., & Watson, J. (2018). From research to practice: The case for mathematical reasoning. In J. Hunter, P. Perger, & L. Darragh (Eds.). *Making waves, opening spaces. Proceedings of the 41<sup>st</sup> annual conference of the Mathematics Education Research Group of Australasia* (pp. 40-49). Auckland: MERGA.