See it in action:

Assessing the Impact of Support During a Teacher-Led SAFMEDS Numeracy Intervention: A c-RCT

Kaydee Owen, Dr Stacey Hunter, Dr Richard Watkins, Joshua Payne, Dr Tom Bailey, Prof Richard Hastings, and Prof J. Carl Hughes
Collaborative Institute for Education Research, Evidence, and Impact; Bangor University

Background Literature

- Say-All-Fast-Minute-Every-Day-Shuffled (SAFMEDS) is an application of Precision Teaching principles[1]. The procedure acts as a practice and assessment tool; aiming to increase skill accuracy and speed[2].
- Typically, SAFMEDS is presented through a deck of flashcards; with a stimulus on the front (e.g., a maths questions), and the corresponding correct answer on the back[3].
- The procedure includes elements of immediate feedback, error correction, fluency practice, and data-driven decisions[4].
- Charting SAFMEDS performance allows us to see how learners are progressing towards skill mastery. If they show little, or no, progress then we can intervene early[5].
- Previous research has demonstrated that a researcher-led SAFMEDS programme can yield positive results [6,7]. Typically this research is conducted under efficacious conditions in the context of a 1:1 or small n design (i.e., under experimental control).
- Recently, effectiveness studies have investigated the use of SAFMEDS in environments that mirror the "real-world". For example, assessing the effects of peer-tutoring[8] or teacher-led implementation[9] on SAFMEDS performance.
- The current study aimed to gain insight into the role that research support can offer to a teacher-led SAFMEDS programme following teacher training.

Ethics

- This study received full ethical approval from the Bangor University and Research Committee.
- We obtained parental consent to analyze their child's anonymized data.
- Half of the schools in this project were not allocated to receive support following training. However, if they encountered any problems then support was offered and their data was removed from the final dataset.
- Schools could withdraw from the project at any time without giving a reason.

Fluency practice

Data-driven decisions

Methods

- **Recruitment**: GwE advertised this project to schools via events and their newsletter. Schools could express and interest in taking part via email.
- **Sample:** 58 schools across North Wales; including data from 532 children.
- **Training:** All participating schools received standard SAFMEDS training at the beginning of the project before being randomly allocated to a research condition.
- **Design:** Cluster-randomized controlled trial (c-RCT).
- **Conditions:** (1) **Standard training** *(*29 schools)– Following training this group did not receive any ongoing input from the research team. (2) **Enhanced support** 29 schools)– Following training, schools in this group received three 1-hour in-house implementation support visits from a researcher (November, February, & May).
- Teachers/TAs in all schools were responsible for the running of SAFMEDS sessions throughout the academic year (October-June)
- **Measures:** Two standardized numeracy fluency assessments (MFaCTs: Grades 1-2 and MFaCTs: Grades 3-5) and a standardized questionnaire assessing children's attitudes towards math (TOMA-3).
- **Analysis:** Multi-level linear effects model using *STATA.* Fixed effects: county, language, age; Random effects: schools & pupils; Interaction effects: condition & time of test; Dependent variable: score on measure.

Results

The results of this research are presented in Figure 1, Table 1, and Table 2.

Table 1.Marginal means and effects sizes for each measure.

	Marginal Mean (95% CI)		Cohen's *d* (95% CI)
	Pre	Post	
MFaCTs: Grades 1-2			
Standard	11.65 (10.06 to 13.25)	14.45 (12.90 to 15.99)	0.34 ` (0.17 to 0.51)
Enhanced	11.66 (10.17 to 13.14)	18.10 (16.48 to 19.72)	
MFaCTs: Grades 3-5			
Standard	6.15 (4.74 to 7.56)	13.29 (11.87 to 14.70)	0.29 (0.12 to 0.46)
Enhanced	7.52 (6.15 to 8.89)	17.33 (15.90 to 18.77)	
TOMA-3: Attitude toward math			
Standard	39.93 (38.45 to 41.42)	39.79 (38.32 to 41.26)	0.21 (0.04 to 0.38)
Enhanced	39.13 (37.76 to 40.51)	40.96 (39.41 to 42.52)	

Table 2. Pairwise comparison of pre-post marginal means using Bonferroni ; split by condition.

	z (95% CI)	*p*	Cohen's *d* (95% CI)
MFaCTs: Grades 1-2			
Standard	3.72 (0.81 to 4.77)	.001	0.29 (0.12 to 0.46)
Enhanced	8.69 (4.49 to 8.40)	<.001	0.57 (0.40 to 0.74)
MFaCTs: Grades 3-5			
Standard	13.25 (5.72 to 8.86)	<.001	0.87 (0.70 to 1.04)
Enhanced	17.67 (8.34 to 11.27)	<.001	0.99 (0.82 to 1.16)
TOMA-3: Attitude towards math			
Standard	-0.18 (-2.35 to 2.06)	1.00	-0.01 (-0.18 to 0.17)
Enhanced	2.20 (-0.36 to 4.02)	1.00	0.20 (0.03 to 0.37)

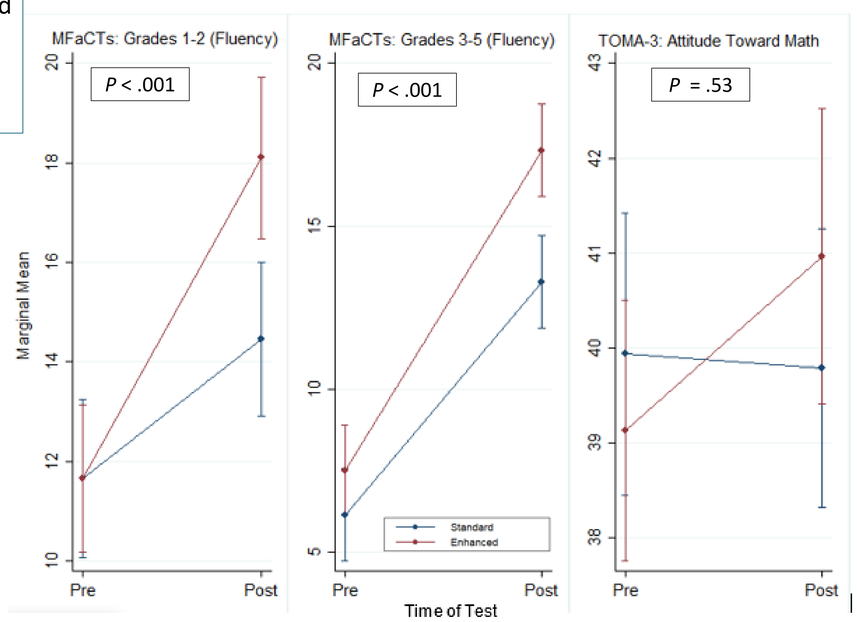

Figure 1. Interaction effects between the marginal means of the MFaCTs and TOMA measures .

Discussion

- **Maths fluency:** Both groups showed significant gain from pre-post test on MFaCTs. Moreover, the results demonstrate that researcher support is necessary following teacher training on the SAFMEDS procedure to yield the greatest improvements.
- **Attitude:** Children's attitude towards maths was not significantly effected by taking part in the SAFMEDS programme.
- **Observations:** From observations across support visits, not all teachers charted data or used it to make decisions about intervention.
- Several schools reported incidences of the children cheating (e.g., writing the wrong score down, looking at the answers).
- **Attrition:** Some schools were unable to complete the SAFMEDS programme due to timetabling and staff availability.
- **Social validity:** We are currently collecting data from staff (survey) and children (interviews) to enhance our understanding of the SAFMEDS procedure.

Conclusions

- This study provided insight into the need of expertise input following SAFMEDS training.
- Future research could: (1) investigate how to increase staff engagement with the children's data; particularly in relation to graphing their progress and making data-driven decisions. (2) Establish methods to reducing cheating during SAFMEDS sessions.

Contact

Email: kaydee.owen@bangor.ac.uk
Twitter: @KaydeeOwen

References

1. Potts, L., Eshleman, J. W., & Cooper, J. O. (1993). Ogden R. Lindsley and the historical development of precision teaching. *The Behavior Analyst, 16*, 177-189.
2. Graf, S., & Lindsley, O. (2002). *Standard celeration charting*. Graf Implements.
3. Quigley, S. P., Peterson, S. M., Frieder, J. E., & Peck, K. M. (2017). A review of SAFMEDS: Evidence for procedures, outcomes and directions for future research. *Perspectives on Behavior Science,* 1-19.
4. Beverley, M, Hughes, J. C., & Hastings, R. P. (2009). What's the probability of that? Using SAFMEDS to increase undergraduate success with statistical concepts. *European Journal of Behavior Analysis, 10*(2), 235-247.
5. Lindsley, O. R. (1995). Precision Teaching: By teachers for children. *Journal of Precision Teaching, 7*(2), 9-17.
6. Hartnedy, S. L., Mozzoni, M. P., & Fahoum, Y. (2005). The effect of fluency training on math and reading skills in neuropsychiatric diagnosis children: A multiple baseline design. *Behavioral Interventions*, *20*(1), 27-36.
7. Casey, J., McLaughlin, T. F., Weber, K. P., & Everson, M. (2003). The effects of five-minute practice, unlimited practice, with SAFMED cards on correct and error rate in math facts for two elementary school children with learning disabilities. *International Journal of Special Education*, *18*(1), 66-72.
8. Greene, I., Mc Tiernan, A., & Holloway, J. (2018). Cross-Age Peer Tutoring and Fluency-Based Instruction to Achieve Fluency with Mathematics Computation Skills: A Randomized Controlled Trial. *Journal of Behavioral Education*, *27*(2), 145-171.
9. Hunter, S. H., Beverley, M., Parkinson, J., & Hughes, J. C. (2016). Increasing high school students' maths skills with the use of SAFMEDS class-wide. *European Journal of Behavior Analysis*, *17*(2), 154-165.

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