Establishing a Longitudinal Efficacy Study Using SimCalc MathWorlds®

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Research Questions

• Do we see learning gains following an implementation of an 8 to 12-week set of materials in Algebra 1?
• Do we see learning gains following an implementation of a 6 to 8 week set of materials in Algebra 2?
• Does exposure to our materials increase students’ motivation to do mathematics and help retain more students in mathematics post 10th grade vs. historic numbers in our local districts?
• Do our materials support a deeper, more longitudinal, development of mathematical growth, particularly with respect to problem solving and modeling?
Year 1
ALGEBRA I
Existing Materials
- Training/
Recruitment/
Planning

Year 2
ALGEBRA I & II
Initial Analysis of Yr 1
- Refine Alg 1 Materials/
Teacher Focus Group

Year 3
ALGEBRA II
Initial Analysis of Yr 2
- Refine Alg 2 Materials/
Teacher Focus Group

Year 4
ALGEBRA II
Analysis of Yr 3
- Teacher Focus Group

Alg I Pilot
(Fall ‘07/Sp ’08)

Alg II Pilot
(Fall ‘08/Sp ’09)

Alg I Main
(Fall ‘08/Sp ’09)

Alg II Main
(Fall ‘09/Sp ’10)

Alg I Main
(Fall ‘08/Sp ’09)

Alg II Main
(Fall ‘10/Sp ’11)
Design (Year 1 Pilot)
Cluster Randomized Study

Algebra 1 Pilot (Year 1)
6 districts - total sample: 48 classes
N(classrooms) = 14 (7 Treatment & 7 Control)
n(students) = 254 (136 Treatment & 130 Control)
SimCalc replacement curriculum for 8-12 weeks

Algebra 2 Pilot (Year 2)
3 districts
N(classrooms) = 7 (4 Treatment & 3 Control)
n(students) = 149 (78 Treatment & 71 Control)
SimCalc replacement curriculum for 6-8 weeks

Algebra 1 Main Study (Year 2) &
Algebra 2 Main Study (Years 3 & 4)
7 districts - total sample: 60 classes
N(classrooms) = 28 (14 Treatment and 14 Control)
n(students) ≈ 700 (350 Treatment; 350 Control)
Algebra 1 SimCalc replacement curriculum for 8-12 weeks
Algebra 2 SimCalc replacement curriculum for 6-8 weeks
Instruments

- Mathematics Algebra 1 Content Test 1 & 2
- Student Attitude Survey
- Teacher Background Survey
- Teacher Attitude Survey
- SimCalc Teacher Daily Logs
  - Logs measuring implementation (for fidelity)
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• Mathematics Algebra 1 Content Test 1 & 2
• Student Attitude Survey
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• SimCalc Teacher Daily Logs
  • Logs measuring implementation (for fidelity)
Initial findings suggest:

- Treatment Group - positive impact from SimCalc

- Control group - positive impact from normal instruction

- There is not a significant difference between groups on student learning gain:
  \[ t(224)=0.490, \text{ ns} \]
• When we disaggregate by class level, we see slightly higher gains on content test 1 for SimCalc in Non-Honors classes & for Honors classes.

• Samples are not comparable. (See n for Honors Control)
Variation
(Content Test 1)

• Growth regression between groups:
  • Significant correlations between pre- and post-test scores for both groups
  • R squared for the treatment group was only 0.43 compared to the control group’s 0.70 - unexplained variation in the treatment group. This warrants further investigation.

• Need to disaggregate the data
Disaggregating the Data
(Content Test 1)

Gain by School

- Schools 1, 3 & 6: Class levels are not equal. Comparing a non-honors (T) & honors (C) class

- But what is going on in school 5?

- Questions of fidelity - What did teachers do in class?
Initial findings suggest:

• Treatment Group - positive impact from SimCalc

• Control group - positive impact from normal instruction

• There is a significant difference in gain between groups, $U=3320.500$, $Z=-2.952$, $p=.003$. 
Treatment vs. Control (Content Test 2)

- When we disaggregate by class level, we see slightly higher gains for the SimCalc Honors group. The difference in gain is not significant, \( t(56) = .344, p = .735, \text{ ns.} \)

- The difference in gain between groups in non-Honors classes is significant, \( U = 1464.000, Z = -2.637, p = .008. \)

- Again, samples are not comparable.
Gain by School

• Schools 1, 3 & 6: Class levels are not equal. Comparing a non-honors (T) & honors (C) class

• Differences in gain between groups is only significant for School 6, U=160.000, Z=-3.436, p=.001.

• Reason to look at fidelity of implementation in this school.
Treatment vs. Control
(Content Test 2)

Without School 6, gain between groups is no longer significant, U=1978.000, Z=-.807, p=.420, ns.
An Attitude Model derived from a previous study yielded 4 constructs:

1. Positivity towards math and school ($\alpha = .717$)
   • “I think mathematics is important in life.”
2. Working collaboratively & related affect ($\alpha = .692$)
   • “I sometimes feel nervous talking out-loud in front of my classmates.”
3. Working privately ($\alpha = .727$)
   • “I learn more about mathematics working on my own.”
4. Technology ($\alpha = .674$)
   • “Technology can make mathematics easier to understand.”
Fidelity of Implementation

Assumptions of implementation:

- Follow the outlined order of SC materials
- Implement intervention as a replacement unit of traditional curriculum

Found, for some teachers, this was not the case.

- Aim to develop a fidelity index
- Does high fidelity index predict high student learning gains?
  - Correlation?
- Issues with long intervention unit
  - 2 mathematics content tests
  - Some teachers express concern about not enough time to cover other topics
Lessons Learned

1. Biased sampling
2. Disaggregating data: look at systematic vs. un-systematic variation
   • How do we accurately represent an effect of our intervention?
3. Disaggregate and look at issues of fidelity at the teacher level
   • Create a fidelity index
   • Generic daily log to track business-as-usual in Control classrooms
4. Dealing with a long intervention
   • C1 is a function of C2
   • More frequent administrations of student attitude survey
5. Revisions
   • Curriculum revisions (assessments)
6. Recruit & retain teachers for Algebra 2
Thank You!

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