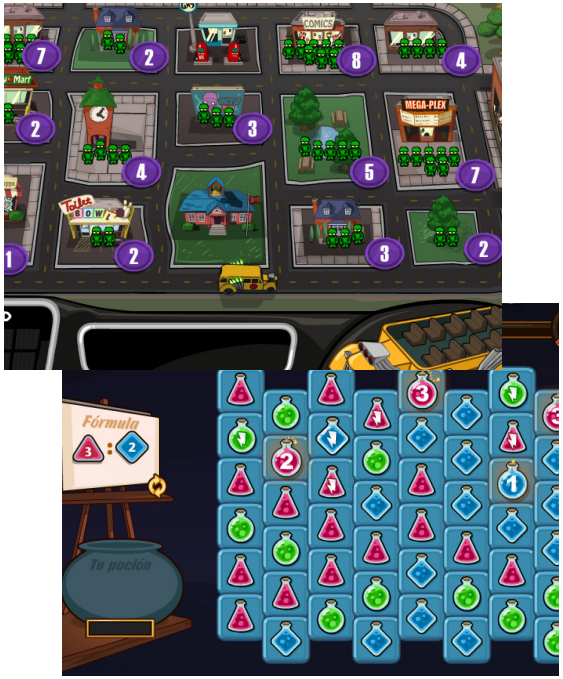
What Is the Effectiveness of the Math Snacks Learning Intervention?

Research Summary

Students engaged in *Math Snacks* in class **learned more math** than those with access to just classroom instruction.

Students work with number systems during a hands-on activity used as a follow up to an online *Math Snacks* game.



http://www.mathsnacks.org

Summary of Impact

Mathematics educators, mathematicians, learning specialists and game developers collaborated to develop and test these games and media tools; *Math Snacks* are grounded in theory-based pedagogy that support the construction, not just the transmission, of knowledge. Accompanying teacher guides, learner guides, "teaching with" videos, and correlations to the Common Core reflect an inquiry-based and constructivist approach.

Research was a driving factor throughout the development of *Math Snacks* materials, including investigations into learners' needs, extensive user testing, and summative research to measure the effectiveness of the tools.

- Decisions about what content teachers needed in classrooms relied on research **pinpointing concepts sixth grade students find difficult.**
- User testing ensured that games and animations were **appealing and engaging to the users**.
- Summative research showed that students engaged with *Math Snacks* in class **learned more math** than those students with access to just classroom instruction.
- Other research showed that the use of *Math Snacks* tools and activities **increased students' conceptual knowledge**.

Students and researchers testing *Math Snacks* animations and games in the Learning Games Lab at New Mexico State University.

The *Math Snacks* Intervention supported **significant gains** in the short term, and these gains were maintained over time.

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Designing the Intervention

Preliminary Findings

Before developing the intervention, researchers at New Mexico State University examined over 20,000 standards-based test results for K–8 students in four different districts to determine gaps in conceptual understanding, paying special attention to open-ended questions. They also conducted over 500 hours of classroom observations to explore and confirm the identified gaps, identifying why students misunderstood the questions they did. Middle school math students showed the greatest learning gaps in the areas of fractions, decimals, ratio/proportion, and number system concepts. These results were consistent regardless of socio-economic status, grade level, type of school, or education level of parents.

Students test *Ratio Rumble* on iPads in the Learning Games Lab at New Mexico State University.

Developing and Testing the Intervention

Educators, mathematicians, learning specialists and game developers collaborated with teachers and students to develop, test and research six animations, five games, teacher resources and learner guides. Students visited the Learning Games Lab to provide feedback about gameplay, and learner guides (games underwent 40–60 user testing sessions). Students helped decide what the game characters would look like, how to title the games and how game levels should be balanced. Teachers in local public schools actively engaged in developing and revising lesson plans and supporting materials. Developers and researchers spent time with teachers while they created these tools, and also observed in classrooms as *Math Snacks* materials were being implemented. Students and teachers at *Math Snac*ks Summer Camps also tested the intervention and provided feedback on gameplay, learner guides, bonus activities and testing instruments.

Math Snacks animations and games support the **construction of knowledge** rather than just its transmission

Pilot Research

Pilot Study, 2011–2012

Participants

- 9 middle school teachers in 14 schools in one low-income urban school district in southern New Mexico

Methodology

- All teachers taught five lessons with *Math Snacks*, but one group of teachers was provided with a scripted lesson (experimental), and the other group was only provided access to the website (control). Students took a pre-test and a post-test for each lesson.

Finding

- The groups of students showed significant, parallel learning gains with and without the scripted lesson plan.

Implication

- Although the study suggested that a scripted lesson plan was not crucial, the team decided to provide a scripted lesson for future in-depth research projects in order to encourage fidelity of implementation.

Further Reading

Kinzer, C., Wiburg, K., & Virag, L. (2010). University public school research partnerships in Mathematics. *Border Walking Journal*, 8(1), 61-69.

Study on Use of Animations and Related Tools, 2012–2013

In 2012–2013, a randomized controlled study was conducted with the students of 38 sixth grade teachers and 2 seventh grade teachers from 9 districts in New Mexico and one district in Arizona. The results showed that students taught ratio and number line concepts using the five *Math Snacks* animation lessons showed higher gains than students taught these concepts using only the district-approved curriculums. Even though these differences were not statistically significant, they showed that the *Math Snacks* lessons could be used as an effective teaching tool and suggested that students using *Math Snacks* show learning gains.

An educator and a student work together on a hands-on activity tied to one of the *Math Snacks* modules.

Large-Scale Randomized Control Study

Randomized Control Trial on Use of Games & Tools, 2013–2014

Findings

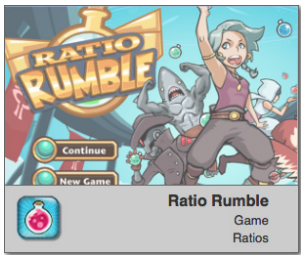
1. At Test 1, Groups A and B were statistically similar.
2. At Test 2, after only Group A had received the intervention, both groups gained, as to be expected with any intervention. The group that received *Math Snacks* had a **significantly greater response.**
3. Test 3 was administered after Group B received the intervention; after receiving *Math Snacks*, **Group B caught up with Group A.**
4. Group A continued to show **they retained their growth and continued to show some growth** over six weeks after receiving the treatment.

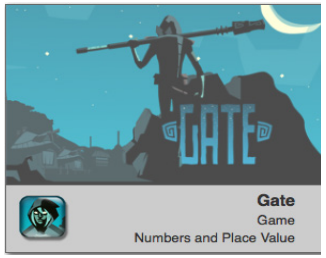
Methodology

- Teachers were asked to use four *Math Snacks* games.
- Each lesson protocol included:
  - **one gameplay session with group discussion** (30–40 min.)
  - **one hands-on activity tied to gameplay** (30–40 min.)
  - **a second gameplay session with a final discussion** (30–40 min.)
- Students took Test 1 before any gameplay, Test 2 after Group A had completed the 5- week intervention (with Group B serving as the control) and Test 3 after Group B had completed the intervention.

Participants

- 48 fifth grade classrooms in 14 schools in one **low-income urban school district** in southern New Mexico
- 741 students (75% Hispanic, 24% Caucasian, and 1% Other)
- Two groups, with Group A engaging in *Math Snacks* activities for a five-week period while Group B continued traditional instruction, after which **the groups switched for the second five-week period,** with Group B engaging in *Math Snacks* activities.





Four *Math Snacks* games were included in the *Math Snacks* Intervention in 2013–2014: *Ratio Rumble*, *Monster Schoolbus*, *Gate*, and *Game Over Gopher*.

Both groups showed **significant gains** after receiving the *Math Snacks* intervention.

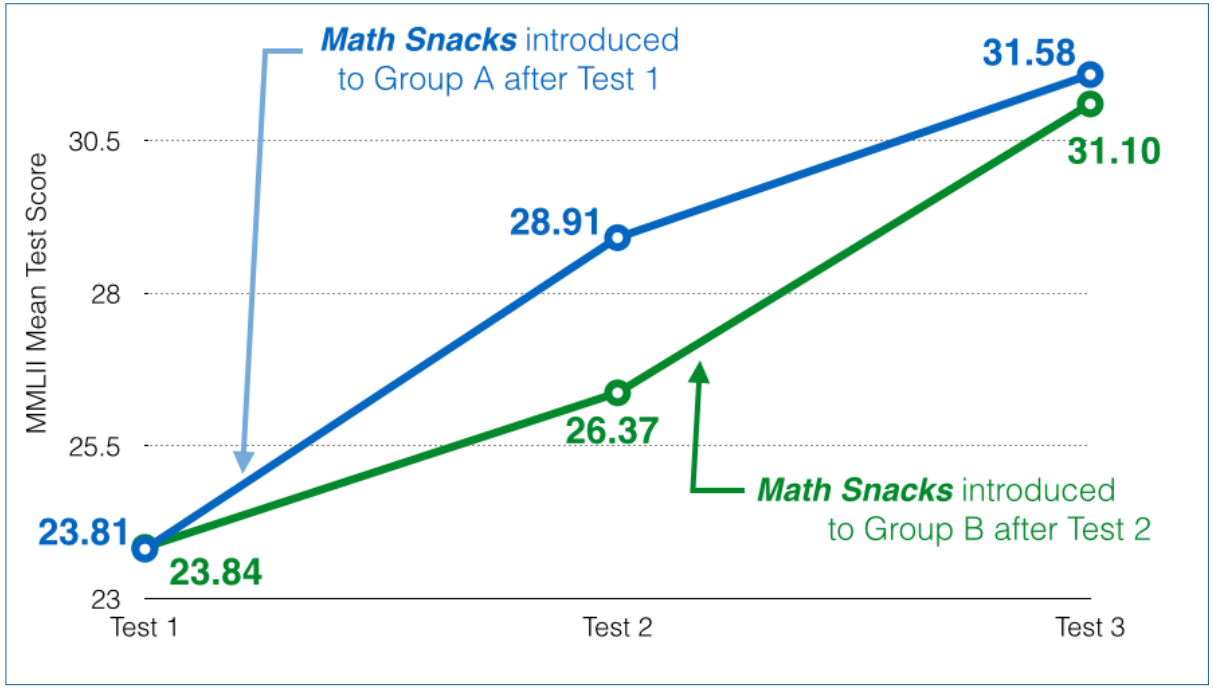


***Figure 1*. Learning gains** of fifth-grade students (**n=741**) using *Math Snacks* plus the district curriculum vs. those using only the district curriculum. Group A received the intervention during the first five weeks and **showed distinct learning gains** compared to Group B (Test 2). After receiving the intervention, Group B **subsequently caught up** with Group A (Test 3). The test used was the Measure of Mathematics Learning II (MMII), developed by the researchers.

Acknowledgments

Math Snacks is based on the work of over 40 game developers, artists, animators, writers, researchers, educators, scientists, and mathematicians. This research summary discusses research designed, conducted, and in some cases published by: **Wiburg, K., Valdez, A., Korn., K.,Trujillo., K., Chamberlin, B.A.,Gallagher, R., Garza, M., McKee, K., Sandoval, M., Savic, M. Trespalacios, J.H., Stanford, T., & Valeta, V.**

Further Reading

Chamberlin, B., Trespalacios, J., & Gallagher, R. (2012). The Learning Games Design Model: Immersion, collaboration, and outcomes-driven development. *International Journal of Game-Based Learning* (IJGBL), 2(3), 87-110. doi: 10.4018/ijgbl.2012070106

Trespalacios, J., & Chamberlin, B. (2012). Pearl Diver: Identifying numbers on a number line. *Teaching Children's Mathematics*, 18, 446-447.

Valdez, A., Trujillo, K., & Wiburg, K. (2013). Math Snacks: Using animations and games to fill the gaps in Mathematics. *Journal of Curriculum and Teaching*, 2(2), p154. doi: 10.5430/jct.v2n2p154

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