



**Codesign Product Research**

# **Logic Model**

**Prepared for XtraMath**

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## Overview

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XtraMath worked with LeanLab Education to document the connections between using XtraMath and improving outcomes for students primarily in grades K-6.

XtraMath is an online math fact fluency program and supplemental curricular tool that helps students develop quick recall and automaticity of basic addition, subtraction, multiplication, and division facts through an individualized program tailored to each student's pace of growth.

Students develop fluency in basic math operations through short daily XtraMath sessions that include practice activities, progress quizzes, and assessments. Students earn awards and certificates for completing various milestones, while teachers and family members receive regular student progress reports. School administrators also track school-wide usage of XtraMath activity through a weekly school usage report.

When used as intended, there is a strong argument that XtraMath helps students build a solid foundation for greater success in more advanced mathematics, and in turn become more confident when facing complex problems. This can lead to greater educational and professional opportunities throughout their life.

## Requirements

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- XtraMath users are based in the United States.
- XtraMath users either speak English or are Spanish-speaking English Language Learners.
- XtraMath is used in conjunction with a separate core math curriculum.
- XtraMath users have access to an internet connected device with an up-to-date browser and JavaScript enabled. Compatible devices include Apple devices with iOS 9 or later, Android 4.4 or later and Chromebooks that can run Android apps, and Fire devices running Fire OS 4 or later.

## Problem Statement

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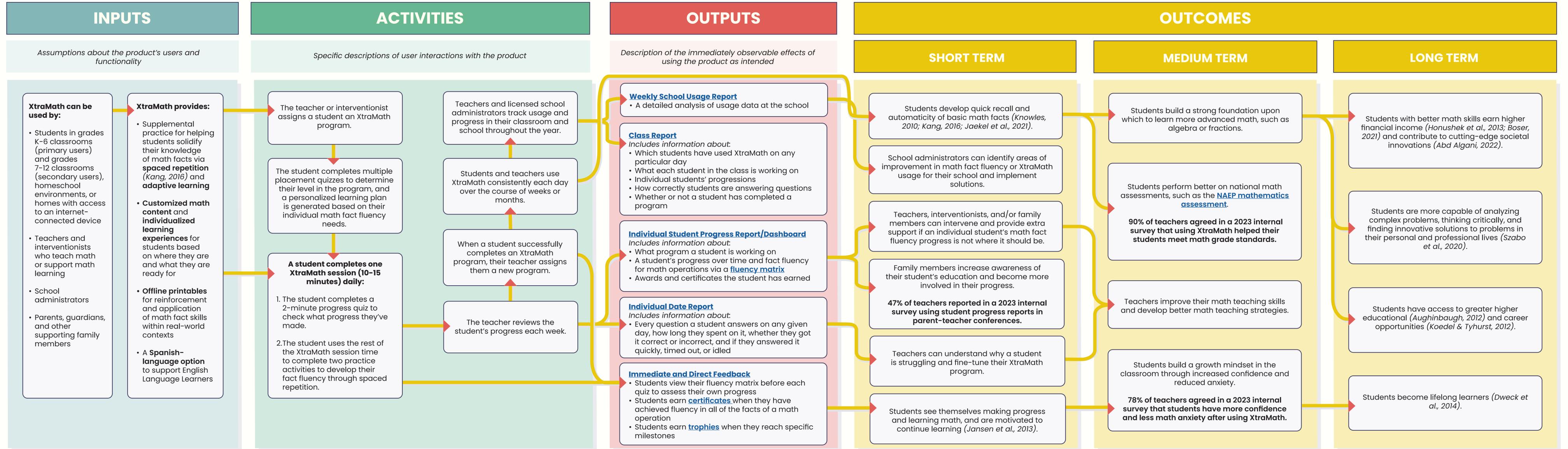
Many K-6 students do not receive adequate practice to achieve fluency in basic arithmetic operations. Traditional classroom methods like 'mad math minutes' (i.e., worksheet-based math drills) are time-consuming to prepare, difficult to grade, and are not tailored to each student's zone of proximal development. These methods can lead to or result in:

1. **Math Anxiety:** Inadequate and stressful practices contribute to math anxiety, affecting students' confidence and willingness to engage in mathematical tasks.
2. **Poor Academic Performance:** Lack of fluency in basic math facts hinders progress in more advanced topics, creating a vicious cycle of poor performance and widening gaps in mathematical understanding.
3. **Inefficient Use of Educational Resources:** Teachers spend disproportionate time on preparation and grading, diverting resources from identifying and addressing gaps in conceptual understanding.

## Outcomes Assumptions

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- Seeing one's own learning progression can help develop a growth mindset.
- A growth mindset that is developed in school or at a young age persists into adulthood.
- Motivation and a growth mindset gained in a school setting or in a particular subject can be transferred to a different context (i.e., life outside of the school or applied to a different subject).



# INPUTS

# ACTIVITIES

# OUTPUTS

Assumptions about the product's users and functionality

Specific descriptions of user interactions with the product

Description of the immediately observable effects of using the product as intended

## XtraMath can be used by:

- Students in grades K-6 classrooms (primary users) and grades 7-12 classrooms (secondary users), homeschool environments, or homes with access to an internet-connected device
- Teachers and interventionists who teach math or support math learning
- School administrators
- Parents, guardians, and other supporting family members

## XtraMath provides:

- Supplemental practice for helping students solidify their knowledge of math facts via **spaced repetition** (Kang, 2016) and **adaptive learning**
- **Customized math content** and **individualized learning experiences** for students based on where they are and what they are ready for
- **Offline printables** for reinforcement and application of math fact skills within real-world contexts
- A **Spanish-language option** to support English Language Learners

The teacher or interventionist assigns a student an XtraMath program.

The student completes multiple placement quizzes to determine their level in the program, and a personalized learning plan is generated based on their individual math fact fluency needs.

## A student completes one XtraMath session (10-15 minutes) daily:

1. The student completes a 2-minute progress quiz to check what progress they've made.
2. The student uses the rest of the XtraMath session time to complete two practice activities to develop their fact fluency through spaced repetition.

Teachers and licensed school administrators track usage and progress in their classroom and school throughout the year.

Students and teachers use XtraMath consistently each day over the course of weeks or months.

When a student successfully completes an XtraMath program, their teacher assigns them a new program.

The teacher reviews the student's progress each week.

## Weekly School Usage Report

- A detailed analysis of usage data at the school

## Class Report

Includes information about:

- Which students have used XtraMath on any particular day
- What each student in the class is working on
- Individual students' progressions
- How correctly students are answering questions
- Whether or not a student has completed a program

## Individual Student Progress Report/Dashboard

Includes information about:

- What program a student is working on
- A student's progress over time and fact fluency for math operations via a **fluency matrix**
- Awards and certificates the student has earned

## Individual Date Report

Includes information about:

- Every question a student answers on any given day, how long they spent on it, whether they got it correct or incorrect, and if they answered it quickly, timed out, or idled

## Immediate and Direct Feedback

- Students view their fluency matrix before each quiz to assess their own progress
- Students earn **certificates** when they have achieved fluency in all of the facts of a math operation
- Students earn **trophies** when they reach specific milestones

# OUTCOMES

## SHORT TERM

Students develop quick recall and automaticity of basic math facts (*Knowles, 2010; Kang, 2016; Jaekel et al., 2021*).

School administrators can identify areas of improvement in math fact fluency or XtraMath usage for their school and implement solutions.

Teachers, interventionists, and/or family members can intervene and provide extra support if an individual student's math fact fluency progress is not where it should be.

Family members increase awareness of their student's education and become more involved in their progress.

**47% of teachers reported in a 2023 internal survey using student progress reports in parent-teacher conferences.**

Teachers can understand why a student is struggling and fine-tune their XtraMath program.

Students see themselves making progress and learning math, and are motivated to continue learning (*Jansen et al., 2013*).

## MEDIUM TERM

Students build a strong foundation upon which to learn more advanced math, such as algebra or fractions.

Students perform better on national math assessments, such as the [NAEP mathematics assessment](#).

**90% of teachers agreed in a 2023 internal survey that using XtraMath helped their students meet math grade standards.**

Teachers improve their math teaching skills and develop better math teaching strategies.

Students build a growth mindset in the classroom through increased confidence and reduced anxiety.

**78% of teachers agreed in a 2023 internal survey that students have more confidence and less math anxiety after using XtraMath.**

## LONG TERM

Students with better math skills earn higher financial income (*Hanushek et al., 2013; Boser, 2021*) and contribute to cutting-edge societal innovations (*Abd Algani, 2022*).

Students are more capable of analyzing complex problems, thinking critically, and finding innovative solutions to problems in their personal and professional lives (*Szabo et al., 2020*).

Students have access to greater higher educational (*Aughinbaugh, 2012*) and career opportunities (*Koedel & Tyhurst, 2012*).

Students become lifelong learners (*Dweck et al., 2014*).

# References

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1. Abd Algani, Y.M. (2022). Role, need, and benefits of mathematics in the development of society. *Journal for the Mathematics Education and Teaching Practices* 3(1), 23-29.  
**"The history of mathematics indicates that whenever a civilization placed a high value on mathematical knowledge, it made remarkable progress. Mathematics offers a commitment to technology and science development. Mathematics has an essential and distinctive effect on human communities and a strategic part in the growth of humanity as a whole."**
2. Aughinbaugh, A. (2012). The effects of high school math curriculum on college attendance: *Evidence from the NLSY97. Economics of Education Review* 31(6), 861-870.  
**"...students who take an advanced academic math curriculum in high school (algebra II or precalculus, trigonometry, or calculus) are about 17 percentage points more likely to go to college and 20 percentage points more likely to start college at a 4-year school by age 21 compared to those students whose highest math class was algebra I or geometry."**
3. Boser, U. (2021). *Education and Income: How Learning Boosts Salary* [White paper]. The Learning Agency. [https://the-learning-agency.com/wp-content/uploads/2021/04/white\\_paper\\_education\\_and\\_the\\_economy.pdf](https://the-learning-agency.com/wp-content/uploads/2021/04/white_paper_education_and_the_economy.pdf)  
**"If a student had improved reasoning ability with data, statistics, graphs, and spatial relationships — as measured by a standardized exam — the total expected increase in earnings would be an additional \$21,000 per year for an 35-54 year old, full-time U.S. worker. The total accrued amount in earnings for an individual for better math skills over two decades would be \$400,000."**
4. Dweck, C.S, Walton, G.M., & Cohen, G.L. (2014). *Academic Tenacity Mindsets and Skills that Promote Long-Term Learning*. Bill & Melinda Gates Foundation. <https://files.eric.ed.gov/fulltext/ED576649.pdf>  
**"Longitudinal research shows that students' mindsets about intelligence predict their academic performance in real-world settings...Analyses showed that the students with a growth mindset earned higher grades because they valued learning over looking smart. They saw effort as a virtue, because effort helps to develop ability. And they tended to perceive academic setbacks as a call to increase their effort or to try new strategies."**
5. Hanushek, E.A., Schwerdt, G., Wiederhold, S., & Woessmann, L. (2013). *Returns to skills around the world: Evidence from PIAAC* [Working paper no. 19762]. National Bureau of Economic Research.  
**"On average, a one standard deviation increase in numeracy skills is associated with...a 28 percent [wage increase among prime-age workers] in the United States."**
6. Jaekel, J., Heuser, K.M., Zapf, A., Roll, C., Nuñez, F.B., Bartmann, P., Wolke, D., Felderhoff-Mueser, U., & Huening, B. (2021). Preterm children's long-term academic performance after adaptive computerized training: an efficacy and process analysis of a randomized control trial. *Pediatric Research* 89(6), 1492-1499.  
**"Results revealed that the computerized math training promoted higher short-term academic performance growth than the active control condition...the findings of this study provide tentative novel evidence that computerized trainings targeting specific math skills may help support preterm children's success in school short term."**
7. Jansen, B.R.J., Louwse, J., & van der Maas, H.L.J. (2013). The Influence of Experiencing Success in Math on Math Anxiety, Perceived Math Competence, and Math Performance. *Learning and Individual Differences* 24, 190-197.  
**"The higher the success rate, the more children played in Math Garden (computer-adaptive math program), and the larger the improvement in math performance. This result suggests that practicing math frequently at one's own ability level improves math performance, and that the experience of success stimulates this practice."**
8. Kang, S.H.K. (2016). Spaced Repetition Promotes Efficient and Effective Learning: Policy Implications for Instruction. *Policy Insights from the Behavioral and Brain Sciences* 3(1), 12-19.  
**"Having the initial study and subsequent review or practice be spaced out over time generally leads to superior learning than having the repetition(s) occur in close temporal succession (with total study time kept equal in both cases)." "Across 254 studies comparing massed versus spaced practice on later memory for verbal information (e.g., words, sentences, facts, passages), overall, spaced practice dominated massed practice in recall performance."**
9. Knowles, N.P. (2010). *The relationship between timed drill practice and the increase of automaticity of basic multiplication facts for regular education sixth graders*. [Doctoral dissertation, Walden University]. Walden Dissertations and Doctoral Studies Collections at ScholarWorks.  
**"...students who were administered daily timed practice drills performed statistically higher on the posttest than did the control group [no timed practice drills] and first treatment group [weekly timed practice drills]." "...after 8 weeks, students who received written, timed practice drills, either daily or weekly, outperformed students who received no treatment." "These results confirm...that written, timed practice drills did significantly change the automaticity rate in basic multiplication facts for sixth-grade math students, and the change is a positive one. With regards to the frequency of written, timed practice drills, an ANOVA showed a significant difference in the gain scores of students who received daily written, timed practice drills compared to the groups who received weekly drills or no treatment of drills."**
10. Koedel, C. & Tyhurst, E. (2012). Math Skills and Labor-Market Outcomes: Evidence from a Resume-Based Field Experiment. *Economics of Education Review* 31(1), 131-140.  
**"...we sen[t] fictitious resumes in response to online job postings, randomly assigning some resumes to indicate stronger math skills, and measure employer responses. The resumes that are randomly assigned to indicate stronger math skills receive more interest from employers than the comparison resumes."**
11. Szabo, Z.K., Körtesi, P., Guncaga, J., Szabo, D., & Neag, R. (2020). Examples of Problem-Solving Strategies in Mathematics Education Supporting the Sustainability of 21st-Century Skills. *Sustainability* 12(23), 10113.  
**"...problem solving is one of the most valuable skills in modern work. In this respect, this paper presents teaching models and strategies that prove that teaching problem-solving thinking in mathematics is an efficient way to develop transversal and cross-curricular skills, such as critical thinking, creativity, collaboration, communication, information, media and technology literacy, and life skills, in order to develop learners' abilities to face non-mathematical challenges."**