imagine learning

WHITE PAPER

Family Engagement in Middle Years Mathematics as a Design Problem

The Development of the Imagine Family Math Hub

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Executive Summary

The Design Problem

In collaboration with low-income Black and Latino families in a large urban district, Imagine Learning developed the Family Math Hub: A web-based tool that provides a suite of resources that support family engagement in mathematics learning outside of school. In this report, a detailed overview is provided of the development of the Family Math Hub. In contrast to common misperceptions of family engagement among low-income Black and Latino families as a social problem, Imagine Learning sought an asset-based framing of families. Through the development of the Family Math Hub, Imagine Learning reimagined family engagement as a design problem—one that honors low-income Black and Latino families' particular needs and practices for supporting their children's mathematics development.

The Development of the Family Math Hub

The Family Math Hub was the outgrowth of the Family Engagement Program funded by the Bill & Melinda Gates Foundation's Bright Spots in Middle Years Math. The Family Engagement Program was a design-based, research-informed project embedded in a large urban district in California. The project was split across two stages. In the first stage, families in the district participated in various activities facilitated by the Imagine Learning field team that sought to answer a set of design and baseline questions related to accessibility, usability, and mathematics content of a web tool, known as the Family Math Portal. Families reported difficulty in accessing and using the Portal. Further, families desired more pedagogical resources in the Portal to support their children's mathematical learning at home. From this feedback, Imagine Learning pursued a new design—the Family Math Hub—to replace the original Portal concept.

In the second stage of the Family Engagement Program, the emergent design of the Family Math Hub was evaluated for parent and student participation and the potential impact on mathematics achievement. A treatment and control group were formed using a quasi-experimental structure, where only the treatment group was provided access to the Family Math Hub. Data collection started in October and concluded in February. The data collection in the second stage was interrupted by the COVID-19 pandemic. The usage of the Family Math Hub collected through February was promising, with close to 90% of families finding the tool easy to use and 40% of families accessing the tool at least once, averaging approximately 10 minutes per family. Impacts on achievement proved inconclusive; however, this is unsurprising given achievement was measured about four months apart due to the pandemic.

The Lessons Learned in Collaboration with Families

Beyond the Family Math Hub development, Imagine Learning learned several key lessons through the Family Engagement Program. These included the importance of invitations to low-income Black and Latino families, the importance of family-teacher trust, the importance of family-teacher collaboration, honoring families' experiences over theoretical models, and realizing that community-based work is resource-intensive. With these lessons in hand, Imagine Learning seeks to expand the early concept of the Family Math Portal in alignment with low-income Black and Latino families' recommendations. The redefinition of family engagement in mathematics as a design problem versus a social problem appropriately repositioned low-income Black and Latino families as their children's greatest asset.

Introduction

Families in the Mathematical Success of Children

This introductory chapter describes the role of families, particularly Black and Latino low-income, working-class families, in supporting their children's mathematics success through the middle years.

A dismal image of families has been constructed concerning parent involvement. Families have long been positioned as obstacles to their children's academic success instead of assets, particularly in mathematics. As Dr. Kara Jackson notes in mathematics education, "[P]arents are depicted as either (a) not understanding mathematics themselves, (b) not understanding their children's mathematics and thus characterizing their children's work as 'wrong,' (c) not interested in their children's (math learning), or (d) resistant to change."[1] While parent involvement is not uniformly defined, parental involvement is almost always taken from the school's perspective. As such, parent practices and forms of advocacy that do not align with conventional notions of parent involvement (as defined by White, middle-class norms) often go unrecognized.[2]

Family Engagement in Mathematics as a Social Problem

In her seminal work, Dr. Annette Lareau importantly notes that low-and-middle class families shared similar values about the importance of educational success.[3] However, there remain key distinctions within family-school relationships based on class. For instance, low-income families were more inclined to respect teachers' professional expertise. Lareau notes, "Just as [low-income families] depended on doctors to heal their children, they depended on educators to educate them." Middle-income families were more inclined to scrutinize, monitor, and essentially conceptualize themselves as co-equals in steering their child toward educational success. These disconnects between low-income families, particularly Black and Latino families, have been described in three primary ways, as summarized by Dr. Kara Jackson:

[1] Jackson, Kara, and Janine Remillard. "Rethinking parent involvement: African American mothers construct their roles in the mathematics education of their children." GSE Publications (2005): 11.

[2] Abdul-Adil, Jaleel K., and Alvin David Farmer Jr. "Inner-city African American parental involvement in elementary schools: Getting beyond urban legends of apathy." School Psychology Quarterly 21, no. 1 (2006): 1; Chavkin, Nancy Feyl, ed. Families and schools in a pluralistic society. SUNY Press, 1993; Chavkin, Nancy F., and D. L. Williams. "Minority parents and the elementary school: Attitudes and practices." Families and schools in a pluralistic society 4, no. 2 (1993): 73-83; Cooper, Camille Wilson. "Parent involvement, African American mothers, and the politics of educational care." Equity & Excellence in Education 42, no. 4 (2009): 379-394; Epstein, Joyce L., and Susan L. Dauber. "School programs and teacher practices of parent involvement in inner-city elementary and middle schools." The elementary school journal ,91, no. 3 (1991): 289-305; McKay, Mary McKernan, Marc S. Atkins, Tracie Hawkins, Catherine Brown, and Cynthia J. Lynn. "Inner-City African American parental involvement in children's schooling: Racial socialization and social support from the parent community." American Journal of Community Psychology 32, no. 1-2 (2003): 107-114; Stone, S., and M. McKay. "Predictors of urban parent involvement." School Social Work Journal 15 (2000): 12-28.

[3] Lareau, Annette. "Social class differences in family-school relationships: The importance of cultural capital." Sociology of education (1987): 73-85.

> Lareau (1987) identified three perspectives taken in the literature [regarding the disconnect between low-income families]. Some subscribe to the "culture-of-poverty thesis," arguing that "lower-class culture has distinct values and forms of social organization," and thus, lower-class families do not value education as middle-class families. Others "accuse schools of institutional discrimination, claiming that they make middle-class families feel more welcome' than lower-class families." Finally, some researchers argue that "institutional differentiation, particularly the role of teacher leadership, is a critical determinant to parental involvement in schooling."[4]

These three perspectives locate "the problem" inside of families, schools, or teachers. Thus, parent involvement across socio-economic class statuses and race and ethnicity is generally defined as a social problem.

In mathematics, this social problem is then complicated by new mathematics teaching demands as advocated by the National Council of Teachers of Mathematics (NCTM) and mathematics education research. There has been a substantial shift from traditional mathematics within the last twenty years, which focused on answer-getting, standard algorithms, and computational fluency, towards reform-oriented mathematics. As Jackson notes, mathematics textbooks were previously developed based on market research—treating teachers and school districts as consumers.[5] Reform-oriented mathematics (or standards-based mathematics) is based on educational research, children's thinking, and best teaching practices. Standards-based mathematics focuses on communicating mathematics ideas and mathematics sense-making, such as making connections between concepts and representations. These different images of mathematics are largely generational, with parents having been socialized into so-called traditional mathematics and their children experiencing mathematics from a largely different vantage point of mathematical competence. Therefore, parents are often seeking to support their children's mathematical development and success within a new regime of mathematics, which may be unfamiliar and not particularly intuitive to them.

Black and Latino Families Engagement in Mathematics: Not Whether but How

Families play a vital role in children's mathematics socialization and learning.[6] Given the prevalence of misperceptions, it is worth stating that Black and Latino families are an unequivocal asset to their children's learning and strong advocates for their children's academic success. Research on

[4] See note 1.

[5] See note 1.

[6] Martin, Danny Bernard. "Mathematics learning and participation as racialized forms of experience: African American parents speak on the struggle for mathematics literacy." Mathematical Thinking and Learning 8, no. 3 (2006): 197-229.

parent involvement in mathematics education has named and labeled specific practices used by low-income Black and Latino families that are often unrecognized from the perspective of schools.[7] Unfortunately, many families' everyday practices of support are invisible to teachers and schools, as are the specific challenges related to their class status and cultural and linguistic background when supporting their children's mathematical growth.

In one study of Black families, researchers and educators designed weekly parent meetings to increase parent involvement, build networks, and for teachers to learn more about parents' values, goals, and beliefs regarding their children's educational futures.[8] However, researchers and teachers discovered that Black parents were already engaged in various support practices, like monitoring homework, building confidence, and creating safe spaces for development. This work revealed that educators were not always aware of what parents were doing at home.

Jackson's work, among others, notes that a broader catchment is needed to assess parent involvement for low-income families of color.[9] For example, Black families engage in mathematical activity across multiple contexts in the home, grocery store, or laundromat, as well as through card games and dominoes. Yet, these activities are often disconnected from the scope and sequence of classroom-based mathematics and thus, not typically seen as a useful resource in classroom mathematics. In addition to incorporating mathematics into everyday lived contexts, parents assist with homework (for example, ensuring its completion), communicating with teachers, and monitoring progress. Importantly, these practices are used despite obstacles, such as unfamiliarity with reform-oriented mathematics, lack of communication regarding changes in mathematical focus and emphasis, and lack of resources.[10] On the latter, in many low-income communities, textbooks are not allowed to go home because teachers do not always trust these materials will be returned. Also, many families do not own computers or laptops; rental programs are available through school district programs, but many families are not always aware of such opportunities. Therefore, parents with limited means do not always have access to classroom materials or school-issued devices to learn for, from, or with their children.

Latino families face similar but distinct challenges. For parents who recently immigrated to the United States and learned mathematics in non-U.S. schools, the "conventional algorithms," strategies, and procedures that their children use are seen as inefficient.[11] Yet, mathematics methods based in Latino families' home culture are often rejected by their children in place of the school-based strategies. Additionally, language-related policies that mediate the availability of

[7] See note 2.

[8] Greene, Stuart. Race, community, and urban schools: Partnering with African American families. Teachers College Press, 2015.

[9] See note 1.

[10] Remillard, Janine T., and Kara Jackson. "Old math, new math: Parents' experiences with standards-based reform." Mathematical thinking and Learning 8, no. 3 (2006): 231-259.

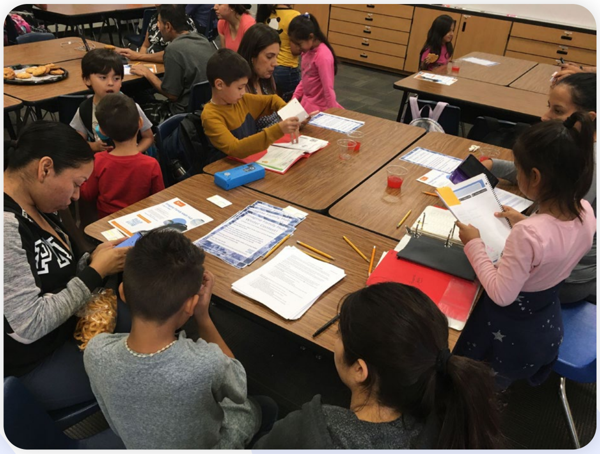
[11] Quintos, Beatriz, Marta Civil, and Jill Bratton. "Promoting change through a formative intervention: contradictions in mathematics education parental engagement." Mind, Culture, and Activity 26, no. 2 (2019): 171-186.

Spanish-language mathematical resources are not always available to families (to the extent they are shared). With English-only materials, children are positioned in the translator's role for their parents seeking to support their mathematics learning.

Fundamentally, family involvement is not necessarily a question of whether low-income Black and Latino families support their children's mathematics learning and development. Rather, family engagement seems to be a matter of how families support their children's mathematical success and the extent to which support is recognized and aligned with classroom goals and practices.

Family Engagement as a Design Problem

As previously mentioned, family engagement, particularly in mathematics education, has been largely construed as a social problem that locates deficits in individuals and, in this case, families. However, there is great potential in conceptualizing family engagement as a design problem—a problem that is solved through the rearrangement of the relationships between people and tools. The Imagine Learning Family Engagement Program is an innovative project that used web-based tools associated with a mathematics curriculum to rearrange the relationships between teachers, parents, family members, and children to align mathematics learning in school with families' needs and practices out of school.



Chapter 1
Background of the Family Engagement Program

The first chapter describes the beginnings of the Family Engagement Program and provides key ideas and context for the project's development.

In 2018, Imagine Learning proposed a mobile tool to support family engagement in children's math education with funding from the Gates Foundation, under the Foundation's Bright Spots in Middle Years Math: Learning from the Field program. The Gates Foundation's research and development program for middle years mathematics (approximately grades 3-9) was initiated to "dramatically improve" middle years mathematics for Black and Latino children, as well as children whose families and communities have been placed at an economic disadvantage. This funding initiative intentionally targets children based on their racial, ethnic, economic, and linguistic backgrounds to counter enduring systems of inequity, so previously underserved or mis-served children are well-positioned to engage in ambitious mathematics course-taking through high school. Acknowledging that the sorting of children by purported mathematics ability begins early (e.g., circa third grade) and mathematics success is a collective (not individual) endeavor, Imagine Learning proposed a Family Engagement Program to support families in a structured, content-specific way around their children's mathematics learning and development.

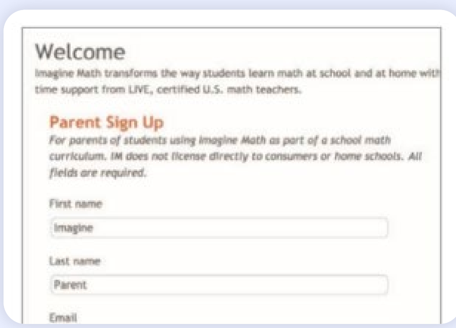
Building on Imagine Math Suite

The tools for family engagement were conceptualized with an existing mathematics curriculum offered by Imagine Learning, known as Imagine Math. Imagine Math3+, part of the comprehensive digital supplemental Imagine Math solution suite, focuses on third-grade children's conceptual understanding of mathematics and problem-solving skills. The Family Engagement Program started with Imagine Math 3+. This standards-based supplemental mathematics curriculum includes interactive lessons and activities, administers formative and benchmark assessments, and provides live, on-demand individualized instruction from certified bilingual math teachers. The program consists of animated and interactive learning elements and a reward system for students as they progress through the lessons and activities. The Family Engagement Program was designed to extend children's mathematics learning at home in a structured way and aligned with the classroom curriculum. To build tools for family engagement that were responsive to low-income and working-class families and families of various racial, ethnic, and linguistic backgrounds, a key component of tool design was partnering with school communities.

Family-Responsive Tools

Two different tools emerged within the development of the Family Engagement Program—the Family Math Portal and the Family Math Hub. The Family Math Portal was at the center of the initial conceptualization of the Family Engagement Program. The purpose of the Family Math Portal was to provide families with the ability to monitor their children's participation with the Imagine Math 3+ curriculum, including progress within the activities, assessment results, and resources for informal teaching. The Family Math Portal was designed behind a log-in screen to secure children's personal information per FERPA regulations.

Through the collaborative design process, a new resource was developed in addition to the Family Math Portal and framed as the Family Math Hub. In contrast to the Portal, the Family Math Hub was accessible without log-in credentials or a password. This Hub was focused less on monitoring and more on informal teaching supports. Accordingly, the Family Math Hub included easily accessible instructional videos and activity guides, competitive activities, and live chats with certified bilingual teachers. This embodiment of the family-responsive tool after co-developed with families was subsequently tested at a larger scale.



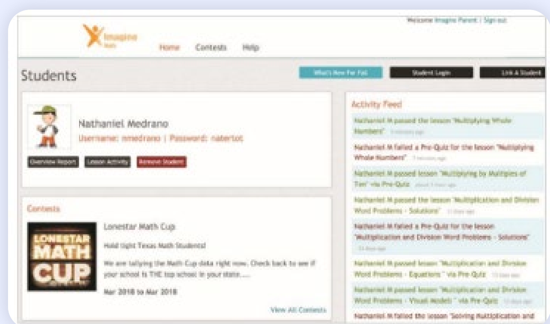


Figure 1: Family Math Portal (in Imagine Math) log-in screen vs the open-access Family Math Hub

Sustained Partnership with School Communities as Fundamental to Design

Imagine Learning partnered with the school community to understand the demands that families experience when seeking to support their children's math education. These included the interactional and pedagogical demands of informally teaching their children mathematics. For Imagine Learning, communication—the frequency and substance of messages—was a critical design consideration. Therefore, Imagine Learning sought to partner with a community with characteristics aligned with the Bright Spots in Middle Year Math target population—low-income and working-class communities of color with linguistic diversity. Accordingly, Imagine Learning partnered with elementary schools in a large urban school district in California (the District). The partnership began with the implementation of Imagine Math 3+ in two schools within the District, which serves students who are predominantly Latino (77%), Black (12%), English Language Learners (23%), and qualify under federal guidelines for free and reduced lunch (87%). During the 2018-19 school year, the average proficiency in ELA for 3rd graders was 40%, and the average proficiency in mathematics was only 26%. This 18-month partnership spanning 2018-2020 was impacted by the coronavirus pandemic, starting in February 2020.

Research-based Design & Evaluation Methods

Through these 18 months, the Imagine Learning team was engaged in an iterative design process that incorporated research-based methods. A typical design process includes six phases of work: empathize or understand a design problem from the user's perspective (phase 1). In this case, the users are Black and Latino low-income, working-class families. After empathizing, the key design issues are identified (phase 2), and possibilities for addressing those design issues are explored (phase 3). The possibilities are then rendered as a prototype (phase 4), which is then tested (phase 5) and refined as necessary before being implemented (phase 6). A design process is generally cyclic, i.e., includes multiple iterations and can potentially have many starting points.

The starting point for the Imagine Learning team was a prototype of the Family Math Portal designed by Imagine Learning. The Portal was based on a theoretical model of family engagement and offered to families to learn about their perspectives and daily practices for supporting their children's mathematics learning. The Imagine Learning team sought to understand the design issues for families. Various research methods were used to gather information from families. This information was later used to re-define the design issues, moving away from the theoretical model toward the empirical reality of families. The design team explored possibilities for addressing the needs of the families. A new prototype, the Family Math Hub, was co-developed with families and tested, using various research methods (focus groups, surveys, and quasi-experimental designs) to determine the tool's efficacy. Throughout this process, there were additional points to re-engage the design process as new issues emerged.

Timeline: From Concept to a Family-responsive Tool

The project was organized into two stages. The first stage (2018-19) focused on co-development and an initial pilot rollout of the Family Engagement Program to identify and respond to the key design issues. The second stage (2019-20) of the project focused on the program's efficacy, including usage of the tools and any early signs of impact on children's achievement. The coronavirus pandemic disrupted the testing of the Family Engagement Program.

Stage 1: Family Engagement Program Co-Development

During the co-development phase, the Imagine Learning team focused on collaborating with families concerning four themes, which were formulated as follows. Four questions related to design issues, i.e., the function of the tool, and three questions sought to collect baseline data for parent and student participation.

GUIDING QUESTION IN STAGE 1

Design Questions

Demands that Families Face in Informally Teaching Mathematics

- What are the demands that might limit families' ability to communicate about and informally teach their children?

Most Promising Approach to Communicating with Families

- What is the most promising approach to communicating with families given the demands of community and home contexts?

Family Feedback on Family Portal

- Do families find the Family Portal intuitive and easy to use?
- How frequently do families who have access to an early version of the Family Engagement Program log on to the Family Portal?

Baseline Questions

Parent and Student Participation

- How frequently do families who have an early version of the Family Engagement Program report communicating with their children about math?
- How frequently do families who have access to an early version of the Family Engagement Program report doing math with their children related to the curriculum?
- How frequently do students engage with the Imagine Math intervention (including the activities, assessment, and the live instruction with the virtual teacher)?

Stage 2: Family Engagement Program Evaluation

During the 2019-2020 school year, the efficacy of the Family Math Hub was evaluated with respect to usage and usability, and impact. The project was expanded from two to ten elementary schools and included approximately 1,000 third-grade students across the District in Stage 2. This stage of the project was focused on five evaluation questions. Three of the evaluation questions focused on families, and two of the evaluation questions focused on students. The questions oriented to families focused on usage and usability. In contrast, the student questions sought to establish whether the Family Math Hub impacted overall achievement scores in mathematics and engagement in the Imagine Math 3+ curriculum.

GUIDING QUESTION IN STAGE 2

Family Questions

- Do families find the Imagine Family Math Hub easy to use and useful?
- What proportion of families engage with the Imagine Family Math Hub at least once?
- How much time do families spend on the Imagine Family Math Hub?

Student Questions

- Does the use of the Family Math Hub show signs of an increase in students' math achievement?
- Do students whose families use the Family Math Hub spend more time engaging in the Imagine Math 3+ curriculum?

Stages 1 and 2 and the results of the design and evaluation questions are described in detail in the following chapters. Specifically, the important work with families is documented in Stage 1, and greater context is provided regarding the disruption of the pandemic to the evaluation work in Stage 2.

Chapter 2
Inside the Work of Developing the Family Engagement Program (Stage 1)

This second chapter focuses on the families, team members, and ideas through which the Family Engagement Program was designed.

The Beginning Concept

To support learning at home, Imagine Learning initially adopted the Hoover-Dempsey & Sandler multi-level model of family engagement. This model is premised on the assumption that parent involvement is a determinant of school success and relates to a range of activities out of school, such as reviewing and supporting homework, monitoring progress, discussing school experiences, offering enrichment activities, and communicating with the classroom teacher. Additionally, parental involvement extends to extra-curricular engagement, such as attending field trips, volunteering for school events, attending school conferences, and serving on school boards or as a member of parent-teacher groups. The Hoover-Dempsey & Sandler model focuses on psychological processes, i.e., decision-making, in relation to three key areas: (1) parents' beliefs about their role in children's education, (2) parents' sense of self-efficacy in supporting their children, and (3) parents' perceptions of whether the school community desires their involvement. Fundamentally, this model situates parent involvement inside of individual parents' dispositions and beliefs.

Imagine Learning, through this initial conception, sought to formulate the Family Engagement Program around these key areas. To address the conception of the caregiver's or parent's role, family sessions were designed to explicitly frame the importance of adult support in children's education. Text messages were also used to prompt families to engage with the children about mathematics, and the Family Math Portal was provided to actively monitor children's progress. The family sessions also served to support parents' sense of self-efficacy, specifically related to mathematics, by working on high-leverage mathematics content in the third grade (e.g., multiplication and division strategies within 100, developing an understanding of fractions, and analyzing and describing two-dimensional shapes).

The Hoover-Dempsey & Sandler multi-level model exclusively focuses on so-called process variables (i.e., what parents think and believe) instead of variables like socio-economic status. The researchers argued this is due to the process variables being purportedly "within the purview of school-initiated influence," whereas socio-economic status is not readily alterable. Such a stance intentionally neglects socio-economic, socio-political, and socio-cultural factors that may influence families' engagement with teachers and schools, in addition to the polarizing school subject of mathematics. The Imagine Learning team found, through Stage 1 co-development with families, this model underestimated families' desire for engagement, specifically in the subject of mathematics.

While family engagement can be improved by a robust communication system that invites parents into participation as suggested by the theoretical model, families did not need to reframe their beliefs about their role as parents per se. Families also did not need to be trained to simply use a tool, like the Family Math Portal. The Imagine Learning team learned that the accessibility of pedagogical resources and tools designed for families' day-to-day experiences was key to promoting families' engagement in middle-years mathematics. Establishing principles of collaboration with families allowed for empathizing with them and a redefinition of the design problem (not the social problem) of family engagement.

Connecting and Co-designing with Families

The Stage 1 co-design process started with the Family Math Portal, based on the Hoover-Dempsey & Sandler model. This process began in January 2019 and continued until June 2019. The primary focus of this stage of the project was modifying the Family Math Portal to align with low-income, working-class Black and Latino families' needs as supporters of their children's mathematics learning.

Starting with School Community and Imagine Learning Staff

As previously mentioned, the Imagine Learning team started working with two public elementary schools in a large urban school district in California (the District). Table 1 describes the demographics of each school versus the district average.

Table 1: Demographics of the partnership district and schools

Characteristics		District	School 1	School 2
School	Grades served	K–12	K–6	K–6
	School type	Public, magnet, charter	Public	Public, magnet
	Number of students enrolled	53,000	730	550
	Setting	Urban	Urban	Urban
Student Population	% Black	12	13	6
	% Latino	77	75	83
	% FRPL	87	91	83
	% Girls	50	51	50
	% English Language Learners	23	41	39
Achievement	ELA achievement	40	----	----
	Math achievement	26	----	----
Policy context and other factors of the school community			60 minutes of math instruction in Grade 3	120 minutes of math instruction in Grade 3

There were three key constituencies at the center of this design work: the children as learners, the family participants who volunteered their time to attend meetings with Imagine Learning, participating in various research activities, and teachers who taught and supported the children in the classroom.

Over 200 low-income families participated in the co-development phase. Demographically, the families were primarily Latino. Additionally, there was a range of diversity, including Black, Asian, and White families, as well as a deaf mother. The family participants at the two schools largely reflect the demographics of the District at large.

Each school volunteered a Teacher Champion to communicate information about the project to the other teaching team members. Nine teachers participated in the program through class contests, meeting attendance, and Imagine Math 3+ program use. The teaching team was reflective of the student population in terms of diversity. In addition to the third-grade teachers, the principal at each school encouraged family member participation and met with Imagine Learning to understand how to increase family engagement in mathematics.

Finally, with respect to the Imagine Learning staff, over 40 team members worked on the Family Engagement Project across various areas, including the research team, the design team, and the fieldbased team (who worked closely with families). The work of these teams was highly integrated. For example, the field-based team shared information from working with families with the research and design teams. Similarly, the design teams worked with the research team to draft targeted questions to assess the utility and usability of the Family Math Portal.

Principles for Collaboration with Families

The co-design process was accomplished through family-centered principles and structured activities during family sessions. These principles and activities were crafted to answer specific design and baseline questions to elicit families' feedback and improve the Family Math Portal. The principles of collaboration were grounded on six elements that have been revised in this report as follows.

- **Communication:** Using consistent and accessible communication (often by text) from teach-ers to parents in the home language
- **Math Competence:** Given the reluctance of most people in the United States to identify positively with mathematics, any design must account for parents' various experiences and expertise with school-based mathematics.
- **Messaging and Activities:** Providing easy-to-use activities and resources that lower the de-mands for enriching engagement.
- **Interactions with Math:** Helping parents develop informal teaching strategies by sharing ped-agogical content knowledge.

- **Community Engagement:** Engaging a broader community of champions and advocates who have earned the trust of families.

- **Personal Beliefs and Experience:** Honoring parents' conceptualization of their role and offering tools that align with their beliefs and experiences.

Enacting these principles occurred through structured, in-person sessions with families. More detailed descriptions of the family sessions are discussed in the following section.

Engaging the Community: Family Sessions

During Stage 1, families participated in family sessions facilitated by the Imagine Learning field team at the local schools. The first family session launched the program and was well-attended by families. Subsequent sessions were facilitated to collect information and answer the key design questions around three themes (i.e., families' needs and demands, preferences for communication, and the usability of the Family Math Portal). Attendance during the family sessions fluctuated between five and 55 families over the 6-month rapid cycle. The co-design sessions included a variety of research-based activities, such as surveys and focus groups, as well as informal data collection activities, like reviewing materials and observing families' experiences logging into the Family Math Portal. The design questions were answered through the family sessions and set a new path for the Family Math Portal.

Figure 2: Photographs of family sessions in Stage 1

Families Contributing their Time and Knowledge to the Design Project

Families also played a pivotal role in developing the project by sharing their time and knowledge to curate Spanish-language resources that families requested during the co-design sessions. Several different family members contributed to this work. One of the fathers who worked at a local neighborhood store served as a translator of different activity materials. Given his position at the store, he saw many neighborhood families and enthusiastically shared information about the resources being developed to support families doing mathematics at home. The translation work created an opportunity to connect with his son on their daily mathematics routine.

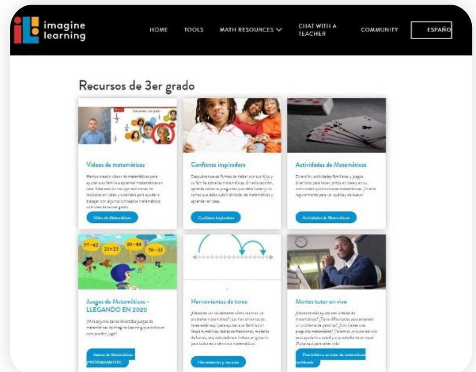


Figure 3: Spanish-language version of Family Math Hub

HIGHLIGHTS OF FAMILY PARTICIPANTS IN STAGE 1

A Devoted Big Brother

A broad conceptualization of family was important in the co-design sessions. One family member was a big brother of a third-grader who was the main caretaker of his sibling after school. This high schooler loved mathematics and was desirous of helping his little brother enjoy mathematics as well. This Big Brother actively provided feedback. In particular, he wished that he had similar resources available when he was younger.

A Father in the Construction Trade

At one afternoon session, a father arrived at a co-design session for his son wearing his paint clothes. This father shared that he worked in the trades as a painter. Through discussions with the Imagine Learning staff, this father shared the importance of mathematics to his daily work practice. He noted that he was not fully communicating the importance of mathematics to his son—describing the mathematics in measurement, proportions, and estimation. The depictions of school mathematics as abstract and austere often situate parents with a variety of mathematical expertise and understanding as lacking mathematical competence. However, a brief interaction during a co-design session seems to enliven this father and impact how he assessed his value to his son’s mathematical education.

Learning from Families' Experiences: Issues of Design

As previously mentioned, the co-design process sought to answer four design questions around three themes. A detailed discussion of the findings, a summary in Table 2, key data sources, the timeline for data collection, and the key findings are all provided below.

Table 2: Summary of the Findings to Design Questions

Design Themes	Data Sources	Timeline	Summary of the Findings
Demands that Families Face in Informally Teaching Mathematics (Research Question 1)	Family surveys and focus groups	January 2019 Focus groups: 45% response rate Survey 1: 41% response rate	• The pedagogical demands of teaching children reform-based mathematics without tools and resources related to classroom curriculum. • Family members reported having limited time to engage with their children about math because of their long, busy days. • Family members did not recognize and devalued their day-to-day engagement with their children as mathematical. • Family members described the communication demands in interacting with children about mathematics.
Most Promising Approach to Communicating with Families (Research Questions 2)	Family surveys and focus groups	February 2019 Focus groups: 18% response rate Survey 2: 15% response rate	• Families stated they were open to communications ranging from multiple times a day to once a month. Imagine Learning did not inquire about preferred day or time. • Text messages are families' preferred mode of communication. • Families requested math conversation starters and activities to use with their children. This frequency of communication is often enough to remind families to engage with their children regularly, but not so often that the families become overwhelmed.
Family Feedback on the Family Portal (Research Questions 3 and 4)	Focus groups Imagine Math Family Portal log-in information	March 2019 Focus groups: 15% response rate January – May 2019 Log data from 8% of families	Early in the pilot project, Imagine Learning introduced the original online math website, known as the Family Portal, to parents. It became apparent that the website was extremely challenging for families to use. Specifically, based on interactions with 15% of the participating families during an in-person meeting, Imagine Learning found that parents had: • Difficulties creating accounts as they had to log in to their child's account • Log-in challenges as to URL was complex and challenging to type • Problems accessing the site via their mobile phones as it was not formatted for that use.

Theme 1: Demands that Families Face in Informally Teaching Mathematics

DESIGN QUESTION 1:

What are the demands that might limit families' ability to communicate about and informally teach their children?

Families encountered intersecting demands when attempting to communicate with their children about mathematics related to their socio-economic status, conceptions on what it means to know math, and children's reluctance to engage in mathematics.

Families described facing several well-known challenges documented by mathematics education research. For example, standards-based mathematics create pedagogical demands on parents that affect families of various racial and ethnic backgrounds and socio-economic circumstance.

Of course, these demands are exacerbated by low-income and working-class families' schedules, which include long, busy days.

Families also face unique challenges in supporting their children in mathematics because mathematics is often treated as purely abstract and disconnected from the "real world." Families have difficulty locating their everyday routines, practices, and interactions as having mathematical value. Thus, family members felt they did not know how to integrate mathematics into their daily interactions or routines with their children. Mathematical self-efficacy (or confidence in their ability to do mathematics) is often diminished for children and adults uniformly. It follows that conversations were difficult for many families, given some children stated they did not like mathematics or want to talk about mathematics. For some families, this reluctance and resistance by children resulted in frustration and caregivers arguing with their children. Therefore, communication demands are not merely a matter of time and mathematics content knowledge but also children's (and caregivers') relationships to and around mathematics.

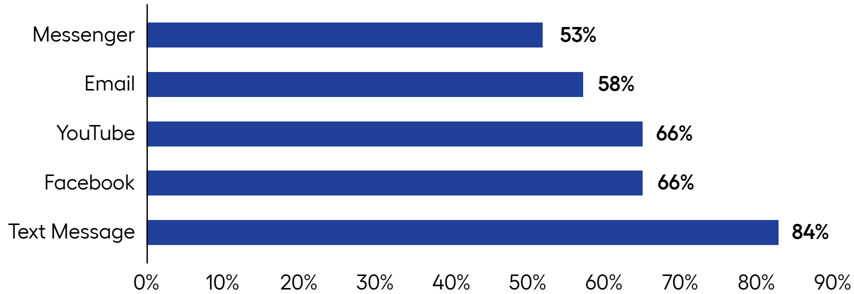
Theme 2: Most Promising Approach to Communicating with Families

DESIGN QUESTION 2:
What is the most promising approach to communicating with families given the demands of community and home contexts?

Families desired communication every two weeks through text messages that contained math conversation starters and activities to use with their children.

Promising approaches to communication given the demands of community and home contexts entailed understanding three key issues: frequency of communication, modes of communication, and content of the communication. Concerning frequency, families provided a range of responses from multiple times a day to once a month. Given this wide variance, the Imagine Learning research team turned to the research literature. However, only two rigorous studies with successful educational interventions on family engagement, family behavior, and student outcomes used text messages, which ranged from once a week or once a month. The Imagine Learning team settled on sending families text messages once every two weeks. This frequency of communication was thought to be often enough to remind families to engage with their children regularly, but not so often that the families become overwhelmed. Among a variety of modes of communication, family members preferred text messages as the mode of communication.

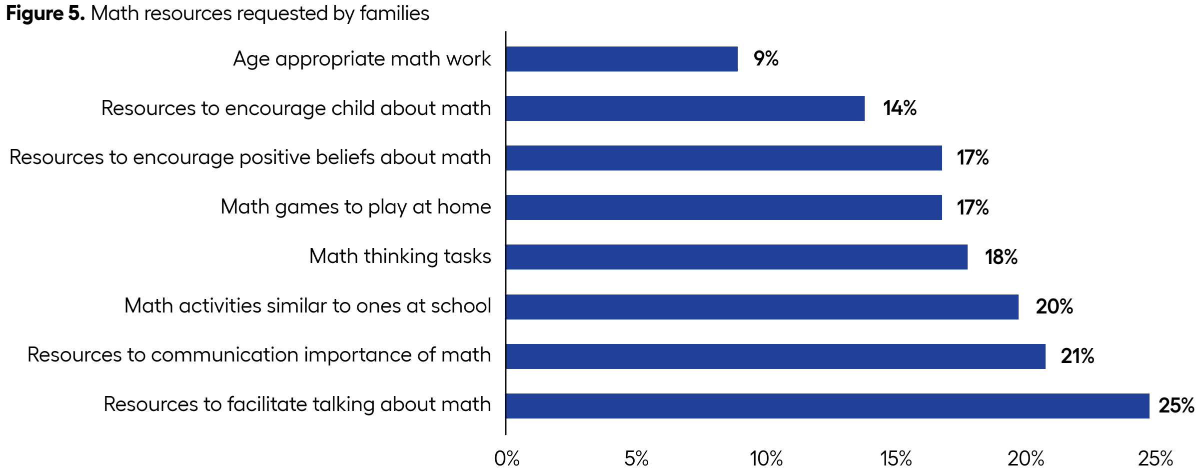
Figure 4. Modes of communication families most often selected as their preferred mode



Note: 38 families (or 17%) responded to this question. Only the modes of communication that more than 50% of families selected are presented in the figure. The other modes of communication families were asked about were text message communications using Imagine Learning systems (45%), Class Dojo (39%), Instagram (37%), WhatsApp (29%), Google+ (26%), Snapchat (24%), Remind (13%), Twitter (5%), LinkedIn (3%), and Skype (0%).

The primary content desired by families included resources to facilitate talking about math (25%), resources to communicate about the importance of math (21%), and math activities like those offered at school (20%). Families also desired knowledge-building resources, such as guidance and tutorials. The desire for knowledge-building resources was also supported by feedback shared by families in Design Question 1. Families expressed an interest in instructional tools that would build their standards-based math knowledge and skills. Importantly, these materials would be easily accessible and include conversation starters, in addition to math activities that could be incorporated into daily activities and encourage fun (as opposed to strenuous) math interactions with their children.

Figure 5. Math resources requested by families



Note: Results are based on the 99 families who participated in the in-person focus groups. In Stage 1, Imagine Learning sent families text messages approximately every two weeks between February and May 2019. The text messages included math conversation starters, example math activities, and reminders for families to attend family engagement program meetings. Appendix D presents sample text messages that Imagine Learning sent to families.

Theme 3: Family Feedback on the Family Portal

DESIGN QUESTION 3:
Do families find the Family Math Portal intuitive and easy to use?

Families did not find the Imagine Math Family Portal to be intuitive or easy to use.

First, families needed to have a valid email address to create an account. Families found the creation of accounts difficult. For family members to create an account, they needed to first link their account to their child's by obtaining their child's log-in information and logging into their child's account. Even with in-person support from Imagine Learning and instructional guides, family members found it challenging to create their accounts.

Once accounts were created, logging in also posed challenges to families. The Family Math Portal is a school-specific, secure site and has a long URL address consisting of letters and numbers. Family members who primarily use mobile devices found it difficult to type in this long URL address accurately. Moreover, the Family Math Portal was not mobile-friendly. It was formatted for use on computers, laptops, or tablets due to the Imagine Math software program's infrastructure. While families reported that they did want an online resource, they preferred one that was mobile-friendly, easy to use and accessible, and featured instructional tools, engaging math activities, and games.

DESIGN QUESTION 4:
How frequently do families who have access to an early version of the Family Engagement Program log on to the Family Portal?

Only a small number of families (8%) used the Family Portal.

Due to the challenges described above that families faced using the Family Math Portal (Design Question 3), only 8% of families created Family Math Portal accounts. These family members logged on to the Family Portal an average of three times.

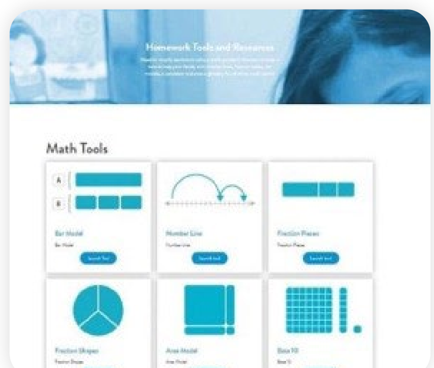
The Family Math Hub

As a result of these findings, Imagine Learning responded by developing the Imagine Math Family Hub as a free and open-access website allowing families to have 24/7 access to a robust suite of math instructional resources. It is designed to be user-friendly on both computers and mobile devices as it does not require log-in credentials. Table 3 connect the design themes, issues, findings, proposed solution, and emergent design.

Table 3: Summary of design themes, issues, findings, proposed solution, and new design

Design Theme	Design Issue	Findings	Proposed Solution	New Design
Demands that Families Face in Informally Teaching Mathematics (Research Question 1)	Portal Content	Pedagogical Supports	Provide families with instructional tools, such as online tutors who are certified math teacher, instructional videos, and math tools that can build families' Common Core math knowledge and skills.	Family Math Hub
		Family day is busy and long	Provide easily accessible resources and ways to integrate math engagement into their existing routines.	
		Daily mathematical practices		
		Communication demands around mathematics	Provide conversation starters and math activities families can incorporate into their daily routines	
		Negative experiences with mathematics	Provide ways to engage with their children through math games and other fun math activities	
Family Feedback on the Family Portal (Research Questions 3 and 4)	Accessibility	Creating and account	Provide an open-access online resource, i.e., does not require account creations or log-in	
		Portal log-in		
		Not mobile-friendly	Mobile-friendly	
Most Promising Approach to Communicating with Families (Research Questions 2)	Communications	Frequency	Families stated they were open to communications ranging from multiple times a day to once a month. Imagine Learning did not inquire about preferred day or time	Maintain Communication System
		Modes of Communication	Text messages are families' preferred mode of communication	
		Types of communication	Families requested math conversation starters and activities to use with their children.	
		Content of communication		

The Math Hub provides one-stop shopping for a wide range of math tools and instructional resources that encourage families to engage with their children around math and build their own math skills. The website is available in English and native Spanish and offers support via live certified bilingual math teachers. Specifically, Imagine Learning identified five key elements that would serve as the foundation for the first iterations of the Family Math Hub.



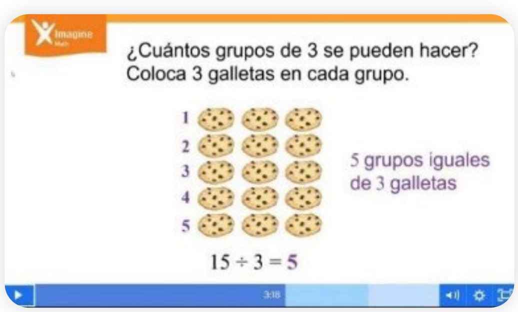


Table 6: Features of the Family Math Hub

- Instructional videos and activity guides
- At-home family math challenges and school-based Imagine Math contests
- Games
- Tools to help families visualize math concepts
- Live bilingual, certified math teachers (including homework chats and on-demand support from Imagine Math teachers in English and Spanish)

Although the Math Hub was designed using families' input during Stage 1, it was not tested with families during the 2018-19 academic year. Stage Two of the project (2019-20 academic year) focused on determining if families found the new Imagine Family Math Hub (with enhanced features and resources) easy to use and useful, if they access the site, and how much time they are spending on the site.

Establishing Baselines during Stage 1

Despite the demands identified in the first design question, families reported wanting to be engaged in and take action to support their child's math learning. Families who participated in the Family Engagement program indicated high involvement in their children's math learning. Imagine Math also tracked student usage data from January to May 2019 and found that the majority of students frequently engaged with Imagine Math. Table 4 provides an overview of the baseline questions, methods, and findings.

Table 4: Summary of baseline questions, methods, findings, and evaluation questions

	Baseline Questions	Methods	Findings	Evaluation Questions
Parent and Student Participation	How frequently do families who have an early version of the Family Engagement Program report communicating with their children about math?	Focus Group, Family Survey Imagine Math Family Portal log-in information May 2019 Survey 3: 90% response rate	Nearly all (95%) communicated with their children about math once a week or more frequently.	Do students whose families use the Family Math Hub engage more in the Imagine Math 3+ Curriculum?
	How frequently do families who have access to an early version of the Family Engegement Program rorprot ding math with their children related to the curriculum?		Nearly all (92%) did math with their children once a week or more frequently.	
	How frequently do students engage with the Imagine Math intervention (including the activities, assessment, and the live instruction with the virtual teacher)?	January–May 2019 Usage data from 100% of students	The majority of their third-grade students (85%) frequently engaged with Imagine Math above the recommended usage time during the 2018–2019 academic year.	What proportion of families engage with the Imagine Family Math Hub at least once? How much time do families spend on the Imagine Fmaily Math Hub?
Achievement	No baseline data collected			Does the use of the Family Math Hub show signs of increase in students' math achievement?
Design				Do families find the Imagine Family Math Hub easy to use and useful?

BASELINE QUESTION 5:
How frequently do families who have an early version of the Family Engagement Program report communicating with their children about math?

Nearly all the families (95%) communicated with their children about math once a week or more frequently.

The majority of families regularly communicated with their children about math on at least one of six topics that focused on math homework, math beliefs, and the importance of math for the child's future. Because the finding is not from an experimental design study, it is impossible to attribute the frequency with which families communicated about math with their children to the Family Engagement Program. However, this finding indicates that these families—who reported facing several challenges, such as time and limited math knowledge—regularly communicated with their children about math.

BASELINE QUESTION 6:
How frequently do families who have an early version of the Family Engagement Program report doing math with their children related to the curriculum?

Nearly all families (92%) did math with their children once a week or more frequently.

The majority of families regularly did math with their children using one of seven activities that involved math calculations. Similar to the finding above (Baseline Question 5), it is not possible to attribute this finding to the influence of the Family Engagement Program because it is not based on an experimental design study.

BASELINE QUESTION 7:
How frequently do students engage with Imagine Math intervention (including the activities, assessments, and the live instruction with the virtual teacher)?

On average, students used Imagine Math 20 minutes a day across nine weeks.

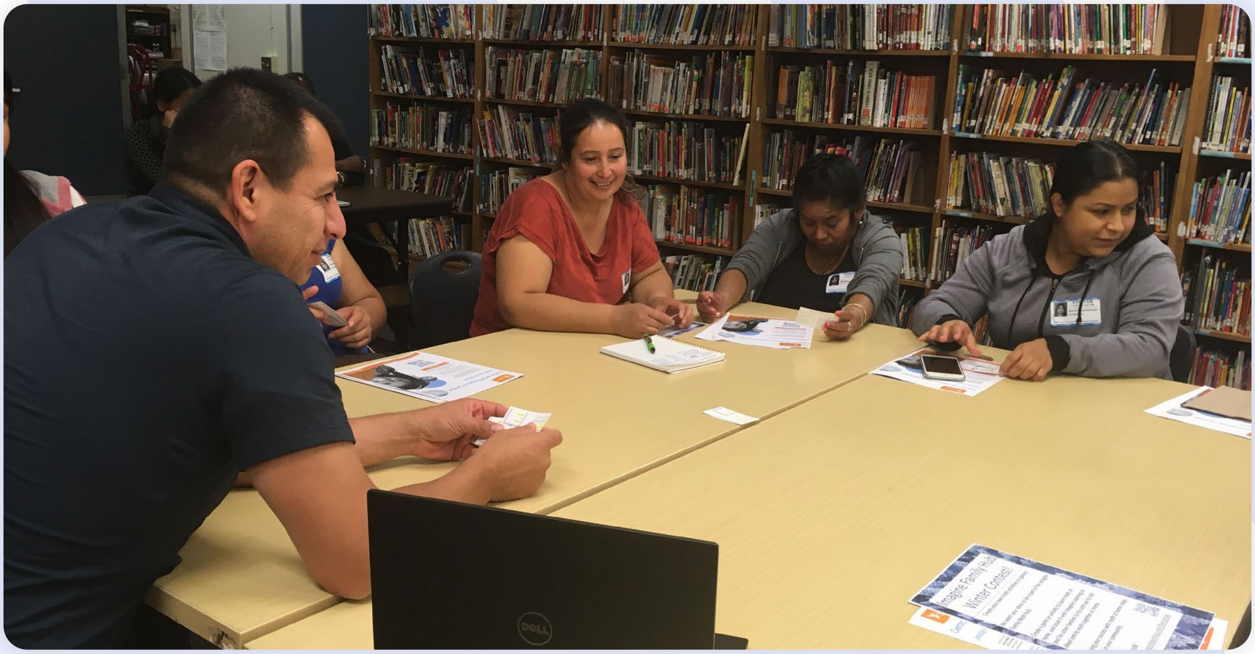
When measuring students' usage data, on average, students used Imagine Math for 20 minutes a day (or 15 hours across nine weeks). When considering all 220 third-grade students (who had a range of usage patterns of Imagine Math +3), students worked for approximately 20 minutes a day. Most of the students (85%) used Imagine Math for about eight minutes a day from January to June 2019, and a majority of students (61%) maintained this pattern for approximately ten additional weeks (for a total of about 20 weeks into the summer).

Preparing for Testing in Stage 2

The findings from the baseline questions raise new questions regarding the efficacy of the Family Engagement Program as outlined below.

- Does access to the Family Engagement Program increase the frequency of communication within families about mathematics or broaden the range of mathematics topics families discussed over the academic year?
- Does the Family Engagement Program increase the frequency with which families do mathematics together throughout the academic year?
- Does the average of eight minutes a day across nine weeks result in the growth of mathematics knowledge?

These questions of the efficacy of the Family Engagement Program were not answerable in Stage 1. However, a quasi-experimental research design was developed in Stage 2 to explore the differences between families who were provided access to the Family Engagement Program (i.e., what will be referred to as the Family Math Hub group) and families who were not given access (i.e., typically referred to as the control or reference group). The results from the testing phase are detailed next in Chapter 3.



Chapter 3

From Design to Evaluation: Testing the Family Engagement Program (Stage 2)

This third chapter evaluates the Family Math Hub in the following academic year and the key findings from the evaluation questions.

The questions pursued in Stage 1 were largely exploratory and crafted to elicit feedback from families to inform the design of the Family Math Portal. The findings in Stage 1 were used to develop an entirely new design for families, namely the Family Math Hub. In Stage 2, the Family Math Hub was tested to determine its impact in mediating family engagement and improving outcomes for children and whether these effects varied by gender, socio-economic status, or ethnicity.

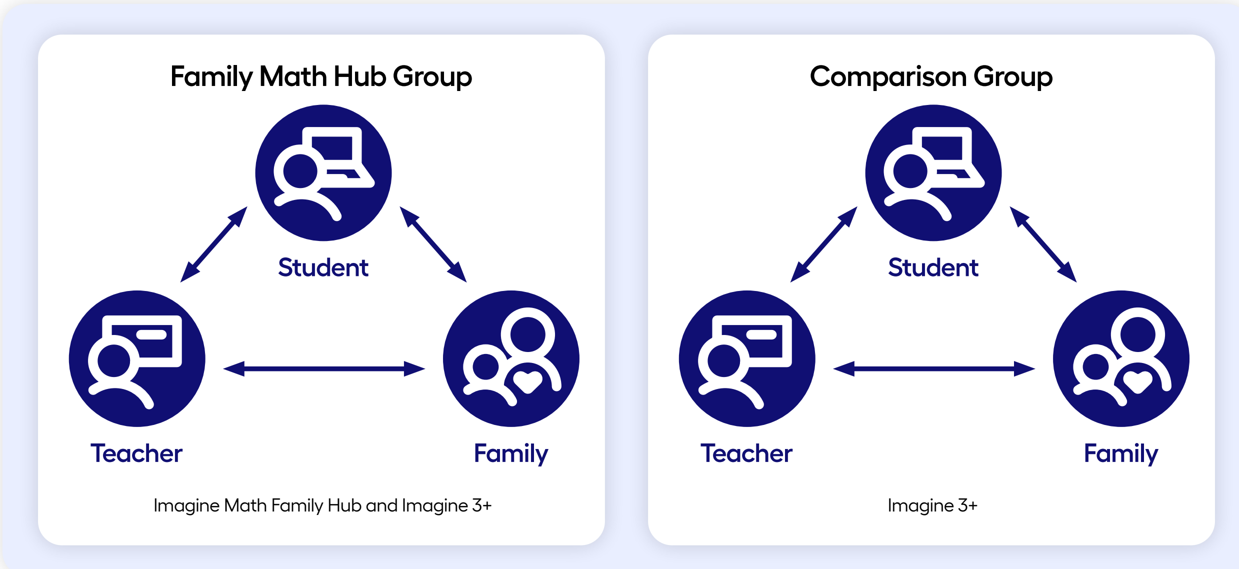
The Broader Context of Evaluation

During the 2019-2020 academic year, Imagine Learning broadened the participation in the study across several third-grade classrooms in ten schools in the District. In total, there were 982 students included in the evaluation process. About 82% of third-graders in the study identify as Latino and 10% as Black. The other 8% of students identified as Native American, Hawaiian, Pacific Islander, multi-ethnic, or declined to report their race (collectively denoted as the “other” category). In addition, 94% of the students are experiencing poverty.

A quasi-experimental design was set up across the ten schools to test the efficacy of the Family Math Hub. Two different groups were designated as the Family Hub Group (or the treatment group) and the other as the reference group (or comparison group). The Family Hub Group included 487 students, whereas the comparison group included 495 students. As part of the conditions of the evaluation process, Imagine Learning asked teachers of all 987 students to use

Imagine Math3+ with their students for at least 40 minutes a week from October 2019 to May 2020. While the families of both groups are certainly implicated in the evaluation study, only the treatment group was provided access to the Family Math Hub.

Figure 7: Organization of the quasi-experimental design in Stage 2



Accordingly, about 487 families were treated as participants in the evaluation study. In Stage 2, a robust communication system was also developed. Parents received invitations from teachers and Imagine Learning through formal networks, such as text message reminders, and from Teacher and Parent Champions through informal networks (i.e., word of mouth). Across the academic year, no more than 23% of Family Hub Group families attended in-person meetings where the feedback forms were collected: There were approximately 115 respondents that fully engaged in the evaluation process. It is important to note that the relatively small, self-selected set of families that participated and completed these forms likely differs from the overall set of families offered the family engagement program. As a result, these findings may not reflect the experience of the full population of treatment school families.

A Family Champion Mom

Family Champions were an innovation stemming from Stage 1, which spoke to the relationships fostered between the Imagine Learning field team and families that attended the co-design sessions. One mother, in particular, was a strong advocate for her family, actively serving to stay visibly involved in her children's lives. Her commitments stemmed from her own learning experiences, where she did not have the opportunities in her youth and wanted more for her children. During Stage 2, this Family Champion Mom attended all sessions, and her school had some of the highest attendance (15–20 families) per session. The Family Math Hub, particularly the messaging features, provided this mother with supports to make connections to everyday examples with her daughter.

Findings from the Evaluation of the Family Math Hub

Findings from the evaluation questions are discussed in detail below. Table 5 provides a summary of the evaluation questions, data sources, timeline, and findings.

Table 5: Findings of Evaluation Questions and Data Sources and Timeline

Evaluation Questions	Data Sources	Timeline	Findings
1. Do families fine the Imagine Family Math Hub easy to use and useful?	Family feedback forms	October 2019 and January 2020	The majority of families that responded were able to access the website (93%), found it easy-to-use (88%), and classified it as useful (20%) or very useful (71%).
2. What proportion of families engage with the Imagine Family Math Hub at least once?	Math Hub website metrics	October 2019 and February 2020 Supplemental analysis will look at usage after school closures (March to June 2020)	Approximately 40% of families engaged with the Math Hub at least once from October 2019 to February 2020. By June 2020, we estimate 50% of families engaged. After February, the Imagine Family Math Hub was made widely available, and we cannot verify whether all visitors to the Imagine Family Math Hub were associated with treatment schools.
3. How much time do families spend on the Imagine Family Math Hub?	Math Hub website metrics	The main analysis will look at usage throughout the study (October 2019 to February 2020) The supplemental analysis will look at usage after school closures (March to June 2020).	On average, users who visited the Imagine Family Hub for the first time from October 2019 to February 2020 spent about 12 minutes on the site throughout the study. On average, users who visited the Imagine Family Math Hub for the first time from October to June spent 11 minutes on the site.
4. Do Imagine Math 3+ and the family engagement program increase students' math knowledge compared to Imagine Math 3+ only? Does the effect on math knowledge vary by race/ethnicity, gender, or other demographic characteristics?	MetaMetrics® assessment	October 2019 and February 2020	There is a 32% probability that students who use Imagine Math 3+ and the family engagement program increase their math knowledge by 3.5 quantile measures compared to students using only Imagine Math 3+ (an increase roughly equivalent to being in school for an additional week). There was not enough variation in the sample to examine differences by ethnicity or socio-economic status, and there was no strong evidence of variation by gender identity.
5. To what extent do students in schools assigned to receive Imagine Math 3+ and the family engagement program use Image Math 3+ compared to students in schools assigned to use only Imagine Math 3+? Does the effect on utilization vary by race/ethnicity, gender, or other demographic characteristics?	Imagine Math 3+ student log-in, use, and activity progress data	October 2019 and February 2020	There is a 50% probability that students who use Imagine Math 3+ and the family engagement program used Imagine Math 3+ five minutes a week more than students who do not use the family engagement program There was not enough variation in the sample to examine differences by ethnicity or socio-economic status, and there was no strong evidence of variation by gender identity.

EVALUATION QUESTION 1:

Do families find the Imagine Family Math Hub easy to use and useful?

Based on responding families, 88% describe the Imagine Family Math Hub as easy to use.

As shown in Table 6, a majority of respondents were able to access the Family Math Hub on their devices (93%), found the Imagine Family Math Hub easy to use (88%), and described the Family Math Hub as useful (20%) or very useful (71%). Out of the families that used the Spanish version of the website, 94% found the Spanish in the Imagine Family Math Hub easy to understand. The responses to open-ended questions provided additional positive and productive feedback, as shown in Table 7.

Table 6: Usability and utility of Family Math Hub

Questions	Percentage of families that answered in the affirmative
Were you able to access the Math Hub on your device?	93
Do you think the Math Hub was easy to use?	88
If you used the Math Hub in Spanish, was the Spanish easy to understand?	94
Overall, how useful do you find the Math Hub[a]	91

Source: Family feedback forms collected from attendees at the first and second quarterly meetings.
[a] Includes responses in which families indicated the options useful or very useful. Other options included a little useful and not useful.

Table 7: Family responses to open-ended questions

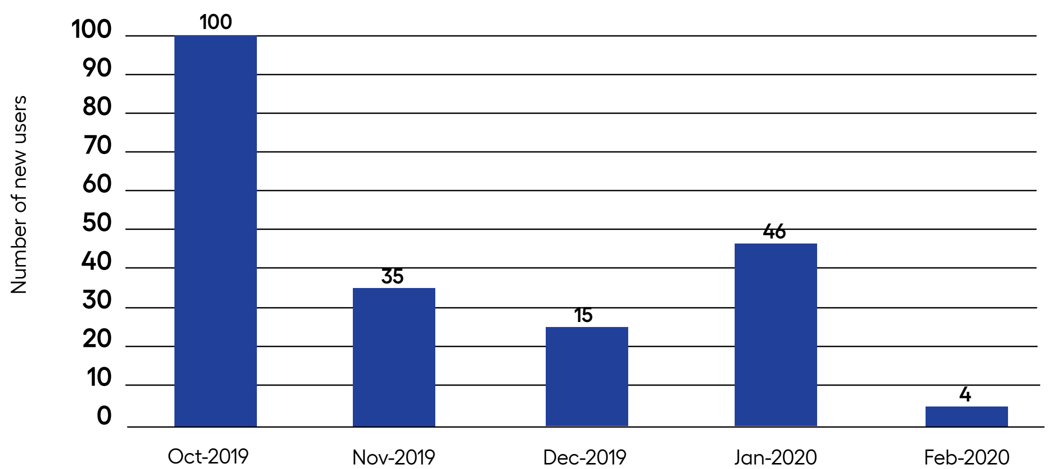
Questions	Responses
Improving usability	• "Everything is very good. It is easy to use, and the program is very clear." • It is very easy for the students and the family members. I liked how it was in English and Spanish (English for the kids, and Spanish for family members)."
Improving accessibility and content	• Create or make the Math Hub work like a mobile app (eight responses) • Improve the [site or its content] loading times (two responses) • Resolve technical glitches to access and load the Spanish-language version of the site (three responses) • Add more content, such as videos, games, activities, and homework tools (four responses) • Include more instructions on using the content and brief explanations or directions for activities (three responses)
Most useful parts	• "All of the Math Hub is useful. When talking about math with my child, using Math Hub based on the part of math she is working on." • "Videos explain well, and just visualizing the problem helps." • "I love the encouraging part. Sometimes it gets a little hard for me as a parent to find the perfect strategy to help him with math problems."

EVALUATION QUESTION 2:
What proportion of families engage with Imagine Family Hub at least once?

Forty percent of approximately 500 families accessed the Imagine Family Math Hub between October 2019 and February 2020.

Two hundred unique visitors accessed the Imagine Family Math Hub across five months (i.e., October 2019 and February 2020). Visitors were measured as the number of unique IP addresses that accessed the site since its inception, representing 40% of approximately 500 families served by the family engagement program.

Figure 8: Number of new users of Imagine Family Math Hub near the participating school district in the pre-COVID period



COVID-19 Disruption

From March 2020 to June 2020, after COVID-19 necessitated the shutdown of public schools, an additional 51 new users visited the Imagine Family Math Hub from cities and counties in and around the geography of the participating schools. The Imagine Family Math Hub was made publicly available in March. It is possible that some of the users from March 2020 to June 2020 were members of the public who were not recipients of the family engagement program. However, if all of these additional new users were families of treatment school students, then the combined 251 users would represent 50% of families in the engagement program. It is not possible to distinguish specific users of the Family Math Hub.

EVALUATION QUESTION 3:
How much time do families spend on the Imagine Family Math Hub?

On average, families spent 10 minutes on the Imagine Family Hub between October 2019 and February 2020.

From October 2019 to February 2020, 200 unique family users spent about 2,000 minutes on the Math Hub, establishing an average of 10 minutes per family user over those five months. In this case, family user refers to a unique IP address when considering all visitors to the Imagine Family Math Hub as of October 2019. With respect to visits (i.e., the average time spent using the Family Math Hub in one sitting), each visit was 4.6 minutes in duration. The web analytics data collected by Imagine Learning do not measure individual family users' frequency of engagement. They provide insights into the overall amount of time all family users spent on the Imagine Family Math Hub.

EVALUATION QUESTION 4:
Does Imagine Math 3+ and the Family Engagement Program increase students' "math knowledge" compared to Imagine Math 3+ only? Does the effect on "math knowledge" vary by race, ethnicity, gender, or other demographics characteristics?

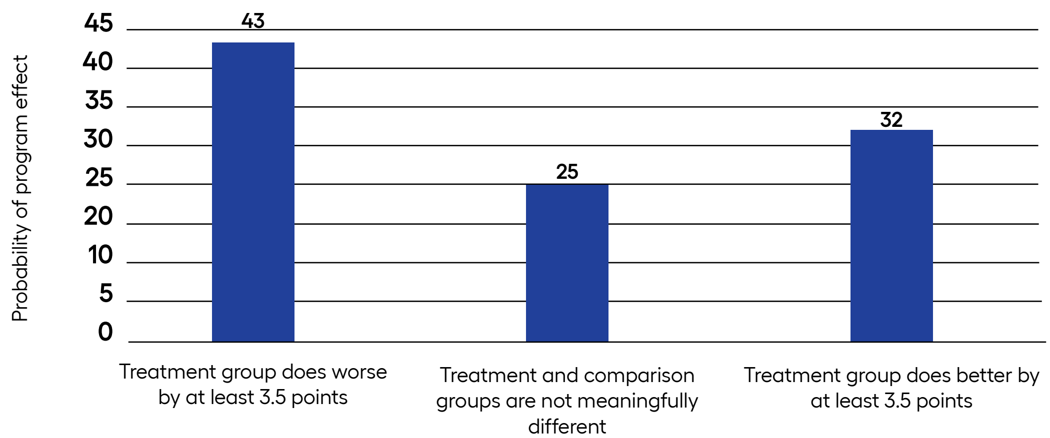
The results were inconclusive regarding an increase in students' "math knowledge." Further, there was no statistically significant difference in students' "math knowledge" between race, ethnicity, gender, or other demographic characteristics.

Students completed a baseline assessment in October 2019 and a middle-of-year assessment in February 2020, which can gauge the extent of progress that was evident after five months. The assessments were developed by MetaMetrics® and use the Quantile® Measure Framework. Quantile measures represent a general math skill level and are aligned with state and Common Core standards. They range from 0 to 1400 and are meant to capture a student's math skill progression from kindergarten through high school. A Quantile Measure from 305 to 555 is considered "typical" for a third-grade student.

On average, students in the treatment schools (who had access to the Family Math Hub) scored 259.1 quantile measures, and students in comparison schools scored 261.5 quantile measures. However, the 2.4-point difference was not statistically significant. Because the treatment schools indicated declines in math growth, additional tests were conducted to determine the probability of the Family Math Hub as a driver of the decline. That is, three cases were tested to determine whether the Family Math Hub was likely to improve students' scores by 3.5 quantile measures or more, lower students' scores by 3.5 quantile measures or more, or produce scores between -3.5 and

3.5 quantile measures. A probability of 50% or greater would suggest conclusive results regarding the Family Math Hub's impact. As shown in Figure 9, there was only a 32 % chance of improving students' scores by a 3.5 quantile or more. Because none of these probabilities shown is greater than 50%, the results are inconclusive regarding the impact of the Family Math Hub. This is not surprising, given only four months had passed between test administrations. An end-of-year exam would likely have produced more useful results. (See COVID-19 Disruption note below.)

Figure 9: Probability that the difference in use and increase in mathematics assessment scores for students assigned to the family engagement program was greater than, less than, or within 3.5 quantile measures of the comparison students



For students' scores, the demographic characteristics of the student population did not provide sufficient variation to examine differential effects based on racial and ethnic categories related to students' scores and whether these effects varied by gender or socio-economic status. While girl students scored 2.9 quantile measures more than boy students, the difference in these scores is not statistically significant.

COVID-19 Disruption

Due to the COVID-19 pandemic, Imagine Learning could not administer the end-of-year Imagine Math 3+ benchmark assessment scheduled for May 2020. As such, gains across the academic year are not reported.

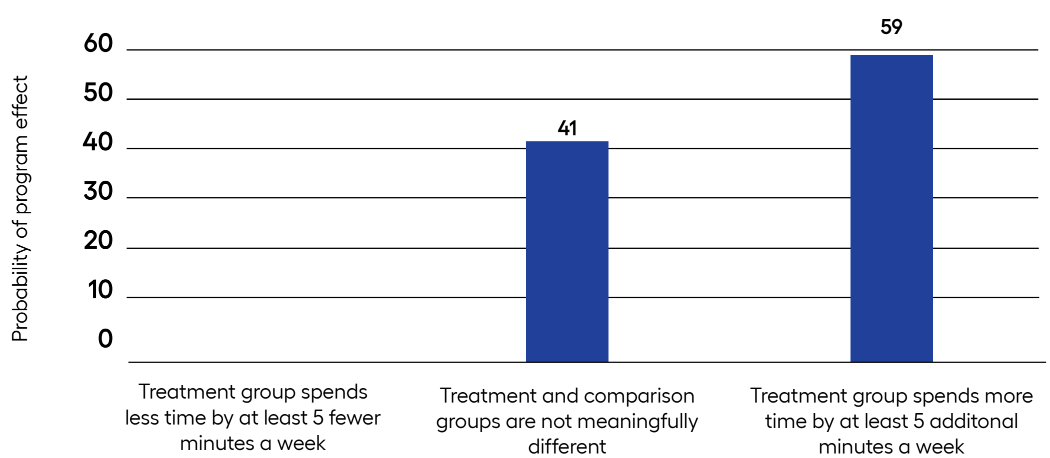
EVALUATION QUESTION 5:
To what extent do students in schools assigned to receive Imagine Math 3+ and the Family Engagement Program use Imagine Math 3+ compared to students in schools assigned to use only Imagine Math 3+? Does the effect on utilization vary by race, ethnicity, gender, or other demographic characteristics?

There is a 96% probability that students whose families participated in the Family Engagement Program spent more time using the Imagine Math 3+ than students whose families did not participate in the Program.

Based on Imagine Math 3+ usage data from October 2019 to February 2020, there was a 96% probability that students in schools with the Family Engagement Program used Imagine Math 3+ more than students whose families did not participate in the program. This case was tested to determine whether students whose families participated in the Family Engagement Program spent five minutes or more on Imagine Math 3+. There was only a 59% probability that the difference was five minutes per week or more (Figure 10). The overall increase in time spent on Imagine Math 3+ came from time spent inside and outside school hours. There was a 95% probability that students whose families had access to the Family Engagement program spent more time during school hours. Outside of school hours, there is an 85% probability that these same students assigned to the Family Hub group spent more minutes on Imagine Math 3+.

The student population's demographic characteristics did not provide sufficient variation to examine differential effects based on racial and ethnic categories related to students' time spent on Imagine Math 3+ and whether these effects varied by gender or socio-economic status.

Figure 10: Probability that the difference in time spent on Imagine Math 3+ for students assigned to the family engagement program was greater than, less than, or within five minutes a week relative to the comparison students



Conclusion

The Future of Family Engagement for Imagine Learning

This chapter provides a retrospective look at the design and evaluation process for the Family Engagement Program, specifically the Family Math Hub, and the potential of retooling the Family Math Portal.

Organizational Learning with Families: Lessons to Design By

Through the co-development process, Imagine Learning synthesized its organizational learning during Stage 1. These lessons related to the importance of communication, establishing trusting relationships between schools and families, and inviting families to be partners and collaborators in supporting their child's learning. These lessons were integral to the project, and the Imagine Learning teams moving forward in designing with families as five key lessons.

Lesson 1: Importance of Invitations to Families

Parents and families do not always feel that teachers and schools welcome their involvement as educational partners. This can be a particular issue for low-income families and families of color. Research overwhelmingly shows that ethnic-racial minority families have disparate experiences in parent-teacher relationships and communication compared to White parents. Families of color are more likely to receive disrespectful and condescending messages from schools, making them less likely to engage. Helping families feel welcome and as equal partners in their child's learning is an important contextual factor that needs to be considered.

Lesson 2: Importance of Family-Teacher Trust

Parents and families trust teachers as the primary source of information regarding their child's learning. For families to engage with online supports or other resources, messaging about their value and importance needs to come from the teacher. Parents and families, particularly those who are Black, Latino, and/or low-income, are not generally asked for their input or opinions, so building relationships of trust in which they can share their concerns is an essential precondition to a successful design. Research finds that low-income families of color and families of varying linguistic backgrounds are often underrepresented in school-level decision- making and family involvement activities. This phenomenon speaks to differing needs, values, and levels of trust rather than families' lack of interest or unwillingness to get involved.

Lesson 3: Importance of Family-Teacher Collaboration

In general, teachers are frequently only in touch with families when school discipline issues arise. Hence, there is value in establishing collaborative relationships and proactively communicating with positive and learning-related news early and often. Families value invitations to discuss their child's learning as an equal to educators. Although they respect educators, families demonstrated that they sometimes do not feel like equals in decision-making relative to their child's education, which supports the notion of empowering parents as partners in supporting student learning. Parents and families benefit from having the opportunity to voice their desires and concerns about what their students are learning and how they can or cannot help. Not all parents know where to look for help, and some may not come to the school for assistance when they are not sure how to help their child.

Lesson 4: Honoring Family Experience Over Theoretical Models

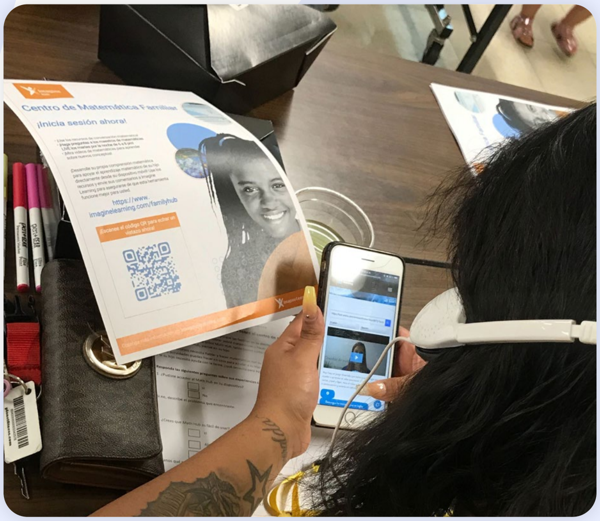
The Hoover-Dempsey & Sandler model for family engagement was a helpful starting place but had limitations. To fully engage in community work with restricted resources, challenges with poverty, public trust, and language barriers require significantly more energy, attention, and nuance than is contemplated in the model. This is particularly true in math, as this is a subject in which parents and families tend to have less confidence in their content knowledge and skills and are therefore more reluctant to get involved in their child's learning at home.

Lesson 5: Community-Based Work with Families in Resource-Intensive

Related to Lesson 4, Imagine Learning found that implementing Stage 1 of this project was resource-intensive work. During the pilot, Imagine Learning dedicated multiple team members to facilitate implementation and collect feedback from families at the two participating schools. Given that the pilot project proved to be quite resource-intensive, there is a need to identify additional strategies that are more cost-effective in building math efficacy. Given the need to develop community-specific, family-responsive designs, there is a real question regarding the replicability and feasibility of this design process at a greater scale across schools. One potential solution provides coaching and support to families at the community level instead of individual schools.

The Imagine Family Math Portal: New Possibilities for the Original Concept

In addition to the lessons learned over 2018-2020, Imagine Learning is assessing the possibilities of reconfiguring the Family Math Portal featured in Imagine Math 3+ to be mobile-friendly. In keeping with the recommendations from Stage 1, the mobile-friendly version would include simplified login requirements (while ensuring student data are protected), language translations, accessibility features, and other features based on feedback and needs of families across the country. Additionally, Imagine Learning is exploring single sign-on providers, such as Clever, to assess the feasibility of integrating and embedding the Family Math Portal app into their platforms. Such integration would allow families to easily register and access an account by using their student's district-issued student ID. Imagine Learning continues to seek design solutions to support the relationship between teachers, families, children, and the mathematics content that honors families as the greatest asset in children's mathematics learning and development.



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