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Parent Involvement in K-2 Mathematics Homework

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DEDICATION

I would like to dedicate this thesis to my mom, whose incredible love for teaching and children inspired me to go into education, and to my dad, for his infinite encouragement that anything is possible.

Table of Contents

List of Tables

List of Figures

Introduction

Children's early life experiences, in their intersecting social, cultural, and physical environments, contribute to the unique fabrication of their cognitive development. Early childhood sets a foundation for children to learn and grow, and the malleability of neural networks during this time leads to great variation in cognitive skills and brain structures for each child entering school. All school-entry academic skills influence later achievement, but mathematics specifically, over both literacy and attention, has demonstrated the strongest predictive power on students' achievement trajectory (Duncan et al., 2007; Ten Braak et al., 2022). Continuing past K-12 schooling, mathematics skill development has been shown to predict graduation rates, higher education majors, career choices, base income, and income growth (National Mathematics Advisory Panel, 2008; Susperreguy et al., 2020). Additionally, fields that require strong mathematical competence, such as STEM disciplines, have been identified as the forefront of innovation and problem-solving, and their contribution to the global economy has made them the focus of many U.S. national initiatives (Visioning Report for STEM Education for the Future, 2020). However, as recorded by the latest National Report Card on Mathematics (National Assessment of Educational Progress, 2022), just 36% of fourth graders in the United States demonstrated at or above grade-level math proficiency. Situated just one year after students are introduced to fractions, a predictor of algebraic knowledge and high school math achievement (Bailey et al., 2012; Siegler et al., 2012), these disheartening early achievement levels have the potential to impact students' future

educational and financial success. Thus, the need to support children early on in their mathematics journey is clear, and since pre-kindergarten accessibility and funding varies nationwide across the United States, it is especially critical for students in grades K-2 to be supported in their foundational math competency skill development. The more experiences that engage students with math in various environments, the more mathematical concepts will be woven into their everyday lives. Outside of classroom math instruction, that is often isolated and time-dependent, such math experiences rely on the intentional collaboration of school and home environments alike to have a positive impact on students.

Background Knowledge

Parent Involvement in Education

Overwhelmingly, parental involvement in education has been found to be positively connected to improvements in student academic achievement, youth development, and social and emotional adjustment (Barger et al., 2019; Grolnick & Pomerantz, 2022; Wang, et al., 2014). Parents are the most central relationship in a child's life and given that students spend most of their time outside the classroom environment, parent involvement is a continuous focus for educational policies, schools, programs, and researchers (Barger et al., 2019).

In this study, parent involvement is defined as, "parents' work with schools and with their children to benefit their children's educational outcomes and future success" (Hill et al., 2004, p. 1491). However, parent involvement is a multifaceted concept and its

positive relationship to student success can vary based on circumstance, causing a wide variety of outcomes. For instance, there are many types of involvement in which parents can engage. In the most recent meta-analysis on the relationship between parent involvement in children's school and academic adjustment by Barger et al. (2019), the authors dissected 448 independent data sources to find the most effective forms of involvement and for whom they may benefit the most. The nuances of parent involvement were captured in two broad categories: *school-based and home-based involvement*. *School-based involvement* encompassed parents' interactions and communication with the school specifically referring to (1) *participation* in parent-teacher conferences, engagement with teachers, attendance at events or classroom field trips, and volunteering, and (2) *governance* which included making decisions within the school (e.g., participation in a Parent-Teacher-Association (PTA) or a school board). *Home-based involvement* pointed towards activities occurring outside of school, where the authors uncovered three distinct forms of involvement: (1) *discussion and encouragement* about school and academics, (2) *cognitive-intellectual involvement* where parents engaged with students in activities or environments that were "cognitively stimulating" (e.g., reading with a child, going to the science museum…etc.), and (3) *involvement in homework* which included practices around homework (e.g., routine building, assisting in homework, or giving the child a quiet space to complete homework).

There are multiple perspectives, evidenced by research, on the mechanisms behind student success in each category of involvement (Pomerantz et al., 2012). Within the home environment, studies have shown that parents can support student skill acquisition by scaffolding activities to be developmentally appropriate (Pomerantz et al., 2012), assisting in positive cognitive development (Barger et al., 2019; Romeo et al., 2018; Rowe et al., 2016), and optimizing their assistance for enhanced skill acquisition (Barger et al., 2019). Additionally, parents can grow students' motivational resources (Grolnick & Pomerantz, 2022; Pomerantz et al., 2012) by promoting the value of school and supporting practices of student autonomy in learning (i.e., student control over their learning and motivation) (Grolnick & Slowiaczek, 1994). Involvement that encourages motivation has been shown to diminish delinquency and positively impact not only academic achievement, but also social and emotional behaviors (Barger et al., 2019; Pomerantz et al., 2012). By studying involvement within the school environment, sociologists have pointed to how families can accrue social capital; giving them resources, information, and networks to best support their student in academic goals (Barger et al., 2019; Coleman, 1998; Lareau, 1996).

In all types of involvement, the success of an applied method is dependent on the quality of interaction between a parent and their child (Grolnick & Pomerantz, 2022). To understand the importance of quality when interacting with children, one can look at the analysis of the "30-million-word gap". A breakthrough study by Hart and Risley (1995) revealed a difference in brain structure between students of higher- and lower-socioeconomic status (SES) by the time they were 3 years old. The variation was based

on what they coined as the “30-million-word gap”, concluding that children from lower-SES households heard approximately 30 million fewer words than children from higher-SES households. This study drove educational programs and policies to emphasize both the importance of early childhood experiences and literacy (Klein, 2004). More recently however, in an extension of the research, Romeo et al. (2019) sought to explore the neural mechanisms behind what type of language exposure was most influential to linguistic skill development. The fMRI neuroimaging results showed significant activation along the bilateral superior temporal sulci (STS) with leftward lateralization, extending from the whole left hemisphere STS to the anterior portion of the right STS. However, within these results, neither number of adult words nor child utterances were significantly correlated with the activation during high-level language processing observed while children comprehended stories. It was instead the number of conversational turns, back and forth related comments between parents and their child, that had a single cluster positively correlated. These results were found independent of parent IQ and family SES, signifying that neural language development is based on conversational interactions over and above the quantity of words heard and family SES. This example shows how focusing on the types of interactions between students and parents has the potential to influence the outcome of a child’s development, as well as their academic success, over and above other influences.

Interactions between parents and their students in academic settings vary greatly. Changes in student motivation, engagement, behaviors, and achievement levels in academics are often called academic adjustments (Barger et al., 2019) and can be, either

positively or negatively, influenced by parents own attitudes, emotions and beliefs around material or subjects (Grolnick & Pomerantz, 2022). Driven by self-determination theory, parents may engage in positive interactions that cultivate student autonomy, or in opposition, they may engage in negative interactions that work to control students, effectively undermining student autonomy. Understanding how interactions between parents and students in an academic setting influence outcomes is crucial for analyzing the varying effects of parental involvement in education.

Both *home-based* and *school-based* involvement have generated positive associations with student adjustments, and the most current analysis (Barger et al., 2019) found that *home-based involvement* had overall stronger effects. To analyze who benefited the most from the different forms of involvement, the authors compared results based on developmental phases and family socioeconomic status. Outcomes varied based on developmental phase showcasing that different forms of parent involvement were more effective for students based on their grade-level and age. Of relevance in this study, and consistent with prior research (Jeynes et al, 2005), the association between parent involvement and student school adjustments for elementary school aged children was positive. Elementary school parental *home-based involvement* forms: *cognitive intellectual,* and *discussion/encouragement* were found to be positively and most strongly associated with academic adjustments, while *Homework* had a slightly negative relationship (discussed below). When analyzing outcomes based on family SES, the authors found no significant differences in effects for students who came from low SES families and for students who came from families from other SES backgrounds (working,

middle, and upper-middle or high status) (Barger et al., 2019) signifying that parent involvement in education benefits all students in the same way. Nevertheless, as parents, families and students are all unique in practices and characteristics, variability in the results for involvement are inevitable.

Homework

Harris Cooper (1989) defined homework as the assignment of tasks by teachers that are intended for students to complete during non-school hours. To master any skill, it is well known that repetition and practice are imperative for success and thus the purpose of homework is to function as the extension of a classroom by providing continuous practice of lessons learned at school in the home environment. Extra practice and more time spent with subject content provides students with more time to engage in the subject and deepen understanding. This repetition is intended to improve achievement, and research has reported academic achievement gains for students with higher homework completion rates (Patall et al., 2008). However, in the reality of classrooms, there are more factors that must be considered when deciding whether homework is beneficial to students grasping academic concepts and wielding higher achievement levels (Watkins & Stevens, 2013; Xu, 2024). As a result, the implementation of homework as a pedagogical tool of significance remains tenuous and the topic of homework is highly debated amongst educators, students, parents, and policymakers alike.

Opponents and proponents of homework offer a range of attitudes through dedicated research that has provided literature concentrated on who contributes to the outcome (parents, teachers, students) and if the outcome benefits anyone (Watkins &

Stevens, 2013). In further complication, US educational policy and the national agenda for education has continuously held value for homework, without clear expectations around implementation practices, its purpose, and its influence on student learning (Watkins & Stevens, 2013). In response to lower achievement scores on internationally equated assessments, the National Commission on Excellence in Education 1983 publicly declared in *A Nation at Risk* report that in the U.S., "the educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a Nation and a people" (as cited in Park, 2004). With the state of education being framed as a threat to national security and as a push for global advancement and economic prosperity, national educational policy was reformed. Homework was one of the "notable deficiencies" addressed in the report, under the analysis on expectations in schools. The report stated that the majority of high school seniors spent less than an hour a night doing homework and while grades were higher, student achievement on average was lower (Garder et al., 1983). In 2002, the next wave of reform by the George W. Bush administration restructured the Elementary and Secondary Education Act (ESEA) with the No Child Left Behind (NCLB) Act guided by *A Nation at Risk*. The NCLB Act (2002) implemented accountability measures to uncover disparities in achievement for students who are systemically underserved and upheld the belief that homework is both beneficial and expected, but did not give guidance (Watkins & Stevens, 2013). Finally, the most recent educational reform was enacted by the Obama administration with Every Student Succeeds Act (ESSA), replacing the NCLB Act in 2015 and reaching schools in 2017/2018. The reform worked to further equitable practices, better school and classroom

practices and focused on student's long-term trajectory of success in college and careers. The act didn't outline any specific policies for homework but rather left flexibility for the state and school district jurisdiction to implement best practices (ESSA, n.d.). Given that the weight falls on teachers, parents, and students without clear expectations, it is no wonder that homework continues to be a misunderstood practice and a debated topic. Understanding how to maximize the benefits of homework in a way that is meaningful for the student, developmentally appropriate, and impactful for school achievement has potential to be an important step forward in research clarifying the impacts of homework.

Parent Involvement and Homework

Though the practice of homework is complex, it continues to be an expectation for most classrooms in the United States, and as students are presumed to work on concepts in the home environment there has been an additional growing interest in the role of parents. Home learning environments impact general cognitive development (Gashaj et al., 2023), and even though prior research on the intersection of the two topics has not garnered much clarity, it has continued to identify areas for concern and growth. Akin to parent involvement in school, parent involvement with homework is an intricate intersection. Research examining the two variables mainly shows a slightly negative association between parent involvement in homework and academic achievement with some studies revealing small, yet significant, associations for engagement (Barger et al., 2019). These results differ depending on numerous factors and therefore garner multiple explanations for how and when homework can benefit from parent involvement.

The act of building a routine around homework, the assistance with homework content, and the emotions when engaging with a student while doing homework are all different types of involvement that can have either positive or negative impacts depending on the interaction. Within routine building, establishing and imposing rules around homework (deciding when and where students' complete homework…etc.) has been found to be positively associated with academic achievement (Patall et al., 2008), while monitoring students (checking completion or supervising focus on the task) reported negative effects (Patall et al., 2008). When assisting students with the actual subject material, studies have shown negative effects on student academic achievement (Barger et al., 2019; Fernandez-Alonso et al., 2022; Patall et al., 2008). These negative associations may be dictated by parents' emotions when engaging with the student. When children are low achieving or having difficulties in a subject, parents are more likely to become involved in their homework, therefore, engagement with homework may be driven by frustration and anxiety (negative emotions) around student performance rather than joy or excitement (positive emotions) for learning (Grolnick & Pomerantz, 2022). These negative emotions can be expressed and interpreted as negativity towards the subject or the child's abilities, which in turn can lead students to internalize those feelings about themselves or the material. Positive emotions can have a similar impact in a supportive way, which may lead students towards different forms of engagement and motivation with subject material both outside and inside school. Additionally, if parents are feeling pressure for students to have higher achievement, they are more likely to take a controlling approach when involved in homework, rather than an autonomy supporting

approach. If parents support autonomy, they render positive behaviors surrounding homework engagement by providing choice, routine and fostering student input (Grolnick & Pomerantz, 2022). When controlling and negating student input or choice, interactions provoke disengagement and negative student behaviors. Furthermore, positive, and negative interactions, along with their corresponding outcomes, may also be dictated by whether the parent feels efficacious in the homework subject. High parent self-efficacy in a subject, how capable a parent feels in supporting their student on homework in a particular subject, has been found to be associated with more constructive involvement that facilitates both student-autonomy and positive interactions (Wu et al., 2022). Low parent self-efficacy in a subject is associated with negative interactions with students and negative attitudes towards the subject. This is especially salient in mathematics, as parents often feel less efficacious in math and may experience high levels of math anxiety (DiStefano et al., 2020).

In all, the utility of parent involvement in homework is dictated by a multitude of variables that are unique to each individual and scenario. Training sessions designed for parents around how to best support their students with homework have been shown to improve student experience and homework completion rates (Patall et al., 2008), providing hopeful outcomes. Research on how to strengthen positive parent involvement is highly valuable and will contribute to when and how parent involvement may be most beneficial for student success.

Parent Involvement in Mathematics Homework

Early numerical development, in cohesion with general cognitive development, is influenced by home learning environments (Gashaj et al., 2023). It is especially important to understand how parent involvement in numeracy can impact students' achievement and motivation (Pomerantz et al., 2012; Wu et al., 2022), seeing that early math skills are predictive of later achievement (Elliott & Bachman, 2018). There has been a wealth of research on the positive effects of home literacy environments on early language development, contributing to a culture of literacy forward home activities and parents reading with children (Elliot & Bachman, 2018). Particularly for early childhood, such as Kindergarten, parents have reported spending more time on students' literacy skills rather than numeracy skills (Tudge & Doucet, 2004; Zippert & Rittle, 2020). This may be because in contrast to the strong connection found between home literacy environments and early language skills (Elliot & Bachman, 2018), research on the impacts of student's home numeracy environment and their early numerical skill development is more complex.

The influence of a home learning environment on mathematical development is often measured by standardized math achievement assessments. Their role in early numeracy development is further emphasized as early math achievement scores have been identified as strong predictors of longitudinal academic achievement and career trajectory. Elementary math achievement can be predicted by early childhood symbolic numerical comparison, the discrimination of quantity using numeric symbols (Emerson & Cantlon, 2015; Merkley & Ansari, 2016). To further understand brain regions recruited

for symbolic numerical comparison, functional neuroimaging studies have examined the neural representation of numbers across varying stages of development to locate deviations and their dependencies. Even before developing language or symbolic skills, infants as young as six-months are able to discriminate quantities using non-symbolic magnitude approximation. Research around infants responding to stimuli changes based on numerical properties versus other properties, like shape or color, has shown through electroencephalogram (EEG) data that there is a strong neural response in the right parietal cortex specific to approximation in numeracy tasks (Emerson & Cantlon, 2015). The right intraparietal sulcus (IPS) neural representation is a stable source for numerical processing that has been observed throughout development, and functional damage within it has been associated with early developing math impairments (Emerson & Cantlon, 2015). However, when comparing neuroimaging results from adults and children during numeracy tasks, adults showed more bilateral activation than children, incorporating the left IPS as well. The magnitude of left IPS neural activity in adults increased in tasks on symbolic numerical comparison, and activation was found to be positively related to age (Emerson & Cantlon, 2015; Merkley & Ansari, 2016). During numerical processing tasks in children approximately 4 to 9 years old, whole-brain longitudinal analyses confirmed that the right IPS neural response amplitude was steady and could reliably predict the response amplitude of the next timepoint, usually 1-2 years later (Emerson & Cantlon, 2015; Emerson & Cantlon, 2012; Merkley & Ansari, 2016). This is in contrast with discontinuity found in the left IPS, where number-response amplitudes were not time dependent and neural responses at one timepoint were not

associated with future response magnitude. Alternatively, left IPS activation development was found dependent on children's numerical performance and the acuity of their numerical discrimination (Emerson & Cantlon, 2015). Bilateral representation in adults is henceforth contextualized with more experience in symbolic numerical comparison. Thus, when looking to increase math achievement scores, the emphasis of numerical symbols is essential and requires children to have additional experience and practice outside the classroom environment.

When discussing the efficacy of parent involvement in mathematics outside of school, there is a common distinction made between *formal* and *informal* learning in the home environment (Elliot & Bachman, 2018; Gashaj et al., 2023). Both learning types can either foster student learning through *motivational resources* or *cognitive skill development* (Wu, 2022). Formal home practices are categorized as targeting numeracy skills in structured activities such as using flash cards or practicing writing numerals, and most typically contain math homework. These formal activities are found to be predicative of children's symbolic number knowledge and math skill development (Gashaj et al., 2023; Skwarchuk et al., 2014). Informal math activities are specific to events, such as playing games or cooking, that may require numerical processing or strategies (Elliott & Bachman, 2018) but are not limited to structured activities focused on mathematical concepts. Exposure to informal math activities has been shown to predict children's non-symbolic arithmetic, fluency and math-specific attitudes and achievement in kindergarten through second grade (Gashaje et al., 2023; Skwarchuk et al., 2014).

Informal activities often serve as a less direct mechanism for learning and can potentially relieve students and parents from the pressure they may feel when completing assigned formal activities, such as homework (Wu et al., 2022). Because informal math activities frequently have more flexibility than formal activities, they can be more easily adapted to meet students' needs. In this scenario, parents may have the opportunity to adjust an activity and remove some of the struggle the student may have otherwise experienced in formal settings, exposing students to rigorous content while also supporting their success and engagement. Participating in math activities and games without pressure may also empower parents to be more constructive in their interactions and release control of the task and its outcome (Wu et al., 2022). While the benefits of informal learning activities are important for fostering positive interactions, their relationship to math achievement has been found to be mediated through students' symbolic numerical knowledge cultivated in formal tasks (Emerson & Cantlon, 2015). That being said, the association between formal numeracy tasks in home learning environments, often manifested in homework, and students' math achievement is conflicted due to parents' influential role.

Unfortunately, parent involvement and math homework have a grim relationship, frequently resulting in negative associations (Barger et al., 2019; Grolnick & Pomerantz, 2022; Wu et al., 2022). To change that connection in future practices, it is vital to consider the various factors that render such results. Parents' self-efficacy, anxiety and expectations in math are predictive of the type of support (autonomous vs. controlling) they give when working with students on their homework. These factors also influence

both students' math achievement and math self-concept (DiStefano et al., 2020; Elliott & Bachman, 2018; Wu et al., 2022,). Parental self-efficacy in math is positively associated with the amount of time spent on math in the home environment, as well as autonomy-supporting and positive interactions with children when working on math homework or math activities. This implies that if parents have low self-efficacy in math, they are more likely to spend less time engaging students in math outside of the classroom, and their interactions will reflect negatively on mathematics and homework practices. Such cycles can further the development of low self-efficacy in mathematics for the students as well. However, strengthening parents' self-efficacy in math can only be one piece of the solution. Research shows that in studies controlling for parent self-efficacy, the influence of parent involvement in math homework is still negatively related to student achievement, indicating there are more variables (Wu et al., 2022). Math anxiety, which increasingly plagues students across the U.S., is also correlated to parent math anxiety (DiStefano et al., 2020). When working on math homework with students, parents with math anxiety perceive their interactions as more negative, despite their own math competency and general anxiety levels. These interactions have been shown to result in lower student achievement gains during the school year and higher chances of students developing math anxiety as well (DiStefano et al., 2020). Furthermore, starting from early childhood, parents academic expectations, whether based on student prior achievement or personal ideals, have been shown to predict student achievement and personal expectations through the 8th grade (Froiland et al., 2013; Wang & Sheikh-Khalil, 2014).When parents relationship with math is negative, their expectations for children to

do well in math is low and their beliefs surrounding the subject are imparted to the student, resulting in the student engaging less in math, having low expectations for themselves, and believing that they are not good at math (Wu et al., 2022). Negative involvement is especially impactful as students develop their math identity because of its longitudinal effect. When looking at qualitative research of young elementary school students, parents' negative involvement was the only significant predictor for children's math motivation and achievement even just one year later (Wu et al., 2022).

Due to the influence of parents' expectations and beliefs about math on student math achievement in elementary school (Sheldon & Epstein, 2005; Wu et al., 2022), there have been studies examining the impact of interventions that target the quality of interaction between students and parents when completing math homework. One intervention implemented by Berkowitz and colleagues (2015) had structured numerical story problems built into stories for parents to read with their children. The math stories were reported to increase student math achievement, especially for children whose parents reported elevated levels of math anxiety. The quality of interaction, as well as strategies for parents to mitigate the heavy responsibility of overcoming personal beliefs and experiences with regards to math are important for student success. To further solidify this idea, a recent analysis of student perception of parent and teacher involvement in mathematics homework found that when students perceived parents/teachers to be more involved, their effort levels, homework completion rate and math achievement were all improved, while levels of procrastination were reduced (Xu, 2024). There are ways in which parent involvement in math homework can elicit positive

results, and with guided structure on how to best support students, their involvement can be instrumental to student success.

PowerMyLearning: Family Playlists Program

PowerMyLearning is a nonprofit in the United States that has worked with school districts across the nation for 25 years to implement evidence-based programs that support "each student, particularly those from historically marginalized communities, to thrive academically, socially, and emotionally by working hand-in-hand with educators to foster equitable learning environments" (PowerMyLearning, n.d.). Housed within their *Accelerate Learning for the Early Grades (K-2)* program, *Family Playlists* are an evidence-based mathematics tool designed to be a play-based engagement between families and students. The program permits teachers to send a weekly scheduled text or email to a trusted adult in the student's home environment with instructions on how to play a designated math learning game. Since the activity is sent to each family individually by the teacher, the content can be differentiated on a student-to-student basis depending on what concepts the teacher has identified as needing more practice. The activities are specific to grade-level content, aligned with district math curriculum and standards, and serve as an extension of classroom learning. Instructions sent by the teacher via text or email are available in over 100 languages based on preference of the family and there are also instructional videos that are currently available in both English and Spanish. There are three main components for completion after learning partners receive the instructions; (1) assist the student with the activity, (2) record either an audio or video of the student answering prompted questions, and (3) complete a short feedback

questionnaire about the experience to send back to the teacher. The teacher can then utilize the submissions to adapt their instruction.

According to research conducted by PowerMyLearning, there is evidence supporting the positive impacts of *Family Playlists* on K-2 students' math achievement, academic skills, and social-emotional competencies (PowerMyLearning, 2023). The most current study (James et al., 2023) highlights a statistically significant increase in K-2 students meeting or surpassing grade-level iReady math achievement benchmarks in the academic year 2022-23 after participating in the Family Playlists and SEL program. Additionally, there was proof of the program being especially effective in reaching students from historically marginalized communities (James et al., 2023). The program works to support the positive involvement of parents in students' math homework at an early age.

Theoretical Framework

Constructivism

Constructing knowledge is unique to each person. Due to our individualized experiences in our own socially constructed worlds, we weave new knowledge into past experiences in different ways. Constructivist learning theory refers to how each person constructs knowledge and meaning depending on their interactions with the world, developmental stage, and interest. Directly in cohesion with Jean Piaget's cognitive development theory, for constructivism to be meaningful, active learning must be developmentally appropriate. Piaget asserts that children progress through distinct stages

of life, each of which are separated by perspective on how to understand the world and cognitive structures (Ondog & Kilag, 2023). The four stages that Piaget outlines as being milestones for individual cognitive development growth are sensorimotor, preoperational, concrete operational and formal operational. Each stage is driven by necessity and, according to Piaget, humans flow through the developmental stages in tandem with emerging behavioral and emotional attributes to reach eventual autonomy (Powell & Kalina, 2009).

Originally studying biology, Piaget used observations of how organisms survive by constantly adapting to their environment in pursuit of equilibrium, to inform his human cognitive development theory (Atta et al., 2023). There are three main developmental processes for integrating new information into one's schematic composition to actively grow and adapt a knowledge base. *Accommodation* refers to modifying prior knowledge to match and build upon new knowledge through the formation of new cognitive structures, *assimilation* refers to transforming new incoming information to match and build upon prior knowledge (Powell & Kalina, 2009) and *equilibration* refers to the whole conceptual understanding made up of individual pieces of knowledge that, when not in equilibrium, lead to a cognitive change and support the shift from one stage to another. In both instances the integration of prior knowledge and experience is vital to the development of new knowledge. This cognitive development theory reaffirms constructivism learning theory, as it explains that for adaptive learning to occur, students will construct their knowledge based on prior experiences and will then independently adjust meaning. In using Piaget's learning theory to inform a constructivist

approach, a student's cognitive capabilities, developmental needs and interests need to be in the forefront for learning new concepts. Active participation in learning feeds all these factors by positioning individuals as creators of their own knowledge (Olusegun, 2015). In this role, learners oversee what information gets incorporated, what is irrelevant, what is brand new and what can be connected to prior beliefs, knowledge, or understandings. To do this, active participation in asking questions, manipulating information, exploring, reflecting, and assessing are all vital components to creating a complete conceptual understanding. Meaningful engagement and participation come when learning is relevant to the learner, resonates with their current knowledge and the process is active. For early elementary students, this requires the use of manipulatives, real-life problem-solving and play-based learning tasks that facilitate exploration, collaboration, and critical thinking practices (Ondog & Kilag, 2023). These skills further develop conceptual understanding and positive attitudes in mathematics and utilize connections to students' prior knowledge and interest.

Constructivism and Family Playlists

Constructivist principles are used to inform the *Family Playlists* program because students are positioned to construct meaning of mathematical concepts when they build on content knowledge outside of the classroom by actively participating in assigned activities. To best support K-2 students' developmental stage, the informal games allow for exploration of content in active and collaborative ways, where students are learning by engaging with the material both physically and mentally. As students are expected to play the games as homework, outside the classroom environment and with a trusted adult,

parent involvement becomes crucial to the success of the student. The materials, activities and active engagement all support students' construction of knowledge, and the involvement of parents can aid in students understanding, cognitive development and skill acquisition.

Sociocultural Theory of Development

Each individual learner, when situated outside of the classroom environment, has their own distinct skillset gleaned from the socially and culturally constructed worlds in which they participate. Theorist Lev Vygotsky was a leader in Sociocultural theory of development in acknowledging the social aspects of learning and emphasizing assisted-discovery learning (Givi et al., 2020). He believed that social and physical interactions with one's environment cannot be disentangled from a learners' construction of knowledge, and learners look towards *More Knowledgeable Others (MKO's)* to help approach and solve everyday problems. Rather than solely observational, Vygotsky highlighted the importance of interactive experiences in which the *MKO* is helping to guide the learner in their discovery, and thus consequently assisting in the development of higher psychological processes effectively. How guardians interact with children at home differs based on unique practices of each family influenced by cultural norms, social practices, and physical surrounding context. Sociocultural theory of development attributes developmental change to the acquisition of knowledge gained from interpersonal social interactions with those around the learner, and the internalization of that knowledge through intrapersonal interactions within the learner themself (Givi et al., 2020). Within an organized community that has shared cultural norms, understanding is

passed down through shared, mutual attention and communication (Atit, 2023). There is great variety in social interactions, expectations and activities in which children engage, even within a community, and these all contribute to a child's inimitable foundation for learning.

Sociocultural Theory and Family Playlists:

Family Playlists are structured to foster positive social interactions between learning partners and their students, providing space for quality parent involvement. Parents and students engage in social learning together while playing a game, and parents are positioned as a *MKO* when working with the student, leading to a partnership between themselves and the school and/or teacher as an educator. In providing feedback on the games, and their students' engagement, the learning partner is connected to the educational aspects of learning and the school. Additionally, the game structure enables developmentally appropriate scaffolding, and autonomy for students to uphold their role as a player in the game. Students' autonomy is further extended, as they are expected to explain their learning at the end, grappling with their understanding through both interpersonal and intrapersonal interaction. In organizing the games to be student centered and supportive of autonomy, students are expected to construct their learning through social interaction and support. These routines are shown to be most effective when working with students on homework (Powell & Kalina, 2009).

Current Study

Math skills are predictive of social mobility, cognitive development, and academic trajectory (Duncan et al., 2007; Susperreguy et al., 2020; Ten Braak et al., 2022), thus understanding how to best support students from an early age is of the utmost importance. It has been proven that parent involvement in early elementary grades is beneficial to students' academic experience and development when intentionally applied (Barger et al., 2019). Similarly, homework has the potential to be a very constructive pedagogical practice in elementary school, when routines are positive, active and promote autonomy (Grolnick & Pomerantz, 2022). So, then the question becomes how can schools capitalize on each of these factors to best support students and parents alike?

The research presented in this paper aims to address the discourse around homework, parent involvement and mathematics education in early elementary school (K-2) by analyzing the impact of teacher-initiated and structured parent[1] involvement in play-based mathematics homework. To evaluate these variables, the current study will compare family responses from two schools who have implemented *Family Playlists* to two closely matched schools who did not implement the program through a secondary analysis of the New York City (NYC) School Survey (Family edition, 2022-2023) public data. The schools were chosen because they provide the most recent account on the implementation of the *Family Playlist* program. PowerMyLearning had analyzed internal iReady math data to measure the impact of the program on student achievement,

[1] Within the context of *Family Playlists,* the terms "parent" and "parent involvement" include adults within the home environment who are involved with students and most frequently support them with their homework. I recognize that based on circumstance, there are various situated figures in a student's home life that may be most influential in providing support *and Family Playlists* are not limited to solely parents being involved.

however, there was not yet an analysis conducted on external data examining the impact on parent involvement in education. Since parent involvement in homework varies greatly, depending on the interaction and connection between parents and their students, this study uses family reported responses to capture families' opinions and perceptions around their role and involvement in the student's education. *Family Playlists* have already proved effective in supporting students' academic achievement, however, whether the practices support families in their relationship with the school and students' education to further positive routines involving both math homework and parent involvement remains unseen. The analysis will seek to answer the following research questions:

1. What is the impact of *Family Playlists* interactive mathematics homework on K-2 families' reported involvement in students' education, as measured by the NYC School Survey (*Family ed., 2021/2022 & 2022/2023*)?
2. Does K-2 families' reported involvement in students' education differ between schools who have and have not implemented *Family Playlists*?
3. Are there differences between math and reading in K-2 families' reported involvement, and is there a relationship between the implementation of *Family Playlists* and the results?

    3.1 Is there a difference between K-2 families' reported involvement in math and reading?

    3.2 Do the responses for K-2 families' reported involvement in math and reading depend on the implementation of *Family Playlists*?

Methods

Participants

To measure the impact of *Family Playlists* on family reported involvement in students' education, I examined data from two New York City schools that have implemented the program and demographically best matched them to two other New York City schools who have not implemented the program. Information on which schools implemented *Family Playlists* during the 2022/2023 school year was collected based on PowerMyLearning reports, and schools were coded Family Playlist School 1 (FPS 1) and Family Playlist School 2 (FPS 2). FPS 1 implemented *Family Playlists* during Spring 2021/2022 and throughout the entirety of the 2022/2023 school year, and FPS 2 carried out *Family Playlists* throughout the entire 2022/202 3 school year.

All schools involved in the study are in large city locale and recipients of Title 1 funding. The demographic data presented in Table 1 was found on the U.S. Department of Education's Institute of Education Sciences (IES) website through the National Center for Education Statistics (NCES) 2022/2023 public school reports.

Matching School Methodology

To begin the matching process, I utilized the U.S. News & World Report's *K-12 School Search engine* to view all 2,960 identified NYC public K-8 schools. My initial search for schools to match the *Family Playlist* school demographics looked at the general school directory information and school details: *public school type, grade levels served, locale, total student population* and *student-teacher ratio.* From this primary

search, I narrowed the possible matches to 15 schools. There is extensive literature providing evidence that family socioeconomic status (SES) is related to disparities in achievement and educational barriers for students in the U.S. (Bacic & Zheng, 2024; Domina et al., 2018; Hanushek et al., 2020; Harwell & LeBeau, 2010). Therefore, I next used NCES data (2022/2023) on the number of students eligible to receive either *free or reduced-price lunch* from the National School Lunch Program (NSLP) to match schools, as it was the only publicly available demographic information related to family SES. After matching for free/reduced lunch price, I looked at the NCES student population demographic, *Enrollment by Race and Ethnicity* as an additional variable to reduce the possible matches for FPS 2 to one school, and FPS 1 to two schools. Finally, as the last matching measure, I collected the average family response rate for grades K-2 to find the best matching schools represented in Table 1 below.

Table 1: School Demographics

School Code	FPS 1	C1	FPS 2	C2
School Demographics				
Public School Type NCES	Regular	Regular	Regular	Regular
Public School Type US News	Traditional Public	Traditional Public	Magnet	Magnet
Grade-level	PK-5	PK-5	PK-5	PK-5
Locale	City: Large	City: Large	City: Large	City: Large
Student Population	404	470	793	707
Classroom Teachers (FTE)	29.99	31.6	48	42
T-S Ratio	13.47	14.87	16.52	16.91
Student Demographics				
NLP				
Free lunch	313	365	580	501
Reduced-price lunch	4	0	22	15
Total	317	365	602	516
% of Student Population with Free/Reduced-price lunch	78%	78%	76%	73%
Race/Ethnicity				
Indian/Alaska Native	2	1	7	2
Asian	11	1	89	196
Black	283	395	22	13
Hispanic	90	61	314	183
Hawaiian/Pacific	1	1	0	1
White	5	8	341	308
Two of More Races	12	3	20	4
Gender				
Male	197	216	414	375
Female	207	254	379	332
Response Rate K-2				
K	23%	14%	15%	9%
1	12%	17%	16%	16%
2	12%	18%	14%	13%
K-2	**16%**	**16%**	**15%**	**13%**

Table 1: Demographic information for all four schools. Data presented above was found in the U.S. News & World Report (2022) and National Center for Educational Statistics (2022/2023).

Measures

Survey

To measure family reported involvement in student's education, I used the *2023 NYC School Survey: Families, Family* public data, collected and reported annually through the New York City Department of Education. The NYC School Survey is one of several tools used by the *School Quality Report* to inform school performance ratings. The survey is administered to students in grades 6 to 12 and both families and teachers of students in grades 3-K through 12 (Technical Guide, 2023). For quality assurance, the NYC School Survey is aligned to a research-based framework that encompasses six elements: *Rigorous Instruction, Collaborative Teachers, Supportive Environment, Effective School Leadership, Strong Family-Community Ties, and Trust*. These elements play a crucial role in fostering student achievement and school improvement (Technical Guide, 2023). The survey is structured with sets of questions corresponding to specific measures, and clusters of measures associated with each of the six elements.

Element

For this study I will use the questions and measures housed in element, *Family-Community Ties*, to evaluate family reported involvement in students' education. The Framework & School Survey Scoring Technical Guide (2023) states, "this section [*Family-Community Ties*] looks at whether the school forms effective partnerships with families to improve the school". Through facilitating communication and providing structure for evidence-based parent involvement, *Family Playlists* directly impact the

partnership between families and schools and would subsequently support both student and school success and improvement. Element *Family-Community Ties* consists of six measures: *Building Families' Capacity as their Child's Primary Teacher, Building Families' Capacity as their Child's Primary Advocate, Outreach to Parents, Parent Involvement in School*, *Strong Relationships* and *Two-Way Communication*.

Measure

The *Parent Involvement in School* measure describes whether the school "creates opportunities for parents to be involved in school activities and in their child's learning" (Technical Guide, 2023). Congruent with prior research (discussed above) on the positive impact that parent's involvement in both school-based and home-based activities has on student achievement and other student adjustments, this measure is used as an overall rating for parent involvement in students' education. Additionally, based on the definition and title, it is the NYC Survey score for parent involvement at each school.

School-based involvement questions

The following questions may be impacted by the *Family Playlists* program because they highlight the importance of communication between schools and families around best practices when supporting student learning. Informed by existing research on school-based participation (Barger et al., 2019), quality of interaction during homework (Grolnick & Pomerantz, 2022), scaffolding materials to support skill acquisition and the social nature of learning (Powell & Kalina, 2020), *Family Playlists* include questions that

elicit interaction between both family partners and students and family partners and teachers when completing assigned math activities. Corresponding with the structure of *Family Playlists*, the following questions seek to understand if the program impacts family's perception on communication and involvement within the school environment.

(A) Question 1: School staff regularly communicate with me about how I can help my child learn. (scale: 1 = Strongly disagree, 2 = Disagree, 3 = Agree, 4 = Strongly agree)

(B) Question 12: Since the beginning of the school year, how often have you…communicated with your child's teacher about your child's performance? (scale: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often)

(C) Question 40: During the school year, have you…attended a school meeting, school event, or parent-teacher conference (virtually or in-person)? (scale: 1 = Yes, 2 = No)

Home-based involvement questions

The following questions directly target involvement at the home-based level and have potential to be impacted by the *Family Playlist* program due to the initiated involvement of parents in homework/content-specific activities and in social learning activities. Consistent with prior research, student achievement and school adjustments can be supported by home-based activities, home environments (Daucourt et al., 2021) and by recognizing the crucial role of a *MKO* in the learning process (Givi et al., 2020).

As *Family Playlists* posit an opportunity for parents to be involved in students' homework and learning trajectories through direct communication with the teacher on content-specific activities, these questions aim to gauge family perspectives on how these activities foster their relationship to the student's education, when outside of school.

(D) Question 13: Since the beginning of the school year, how often have you…seen your child's projects, artwork, homework, tests, or quizzes? (scale: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often)

(E) Question 14: My child's teacher treats me as a partner in educating my child. (scale: 1 = Strongly disagree, 2 = Disagree, 3 = Agree, 4 = Strongly agree, 5 = I don't know)

Subject-based involvement questions

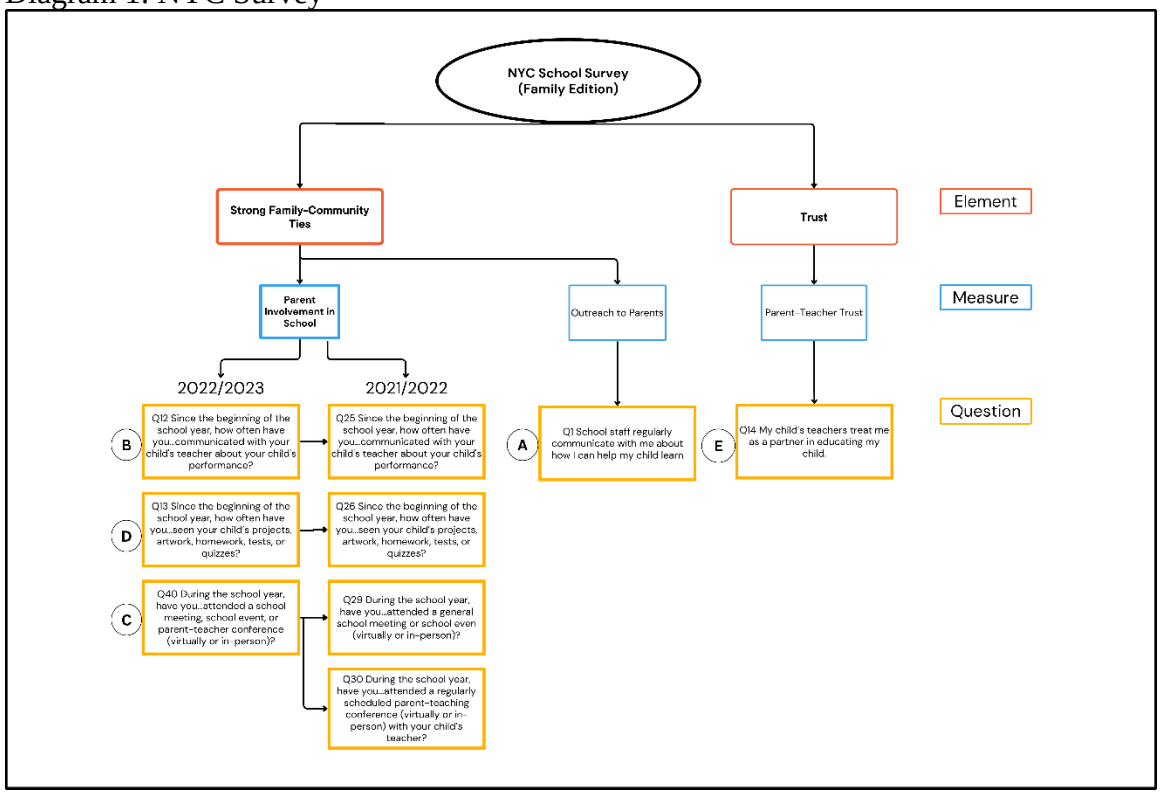
Family Playlists directly target parent involvement in math-specific activities. Thus, the following questions were selected to explicitly uncover any differences between parent involvement in math versus parent involvement in reading. These are the only two questions on the survey related to specific content areas, and though expectations can be influenced by both outer and inner factors (Grolnick & Pomerantz, 2022) there is research that shows a positive relationship between parent involvement and realistic academic expectations based on student ability. When parents are more involved in the learning process, it can be assumed that expectations are more likely to be founded

on experience, observation, and school reports, rather than peer influence or personal ideologies.

(F) Question 33: My child is progressing in reading the way I would expect. (scale: 1 = Strongly disagree, 2 = Disagree, 3 = Agree, 4 = Strongly agree, 5 = I don't know)

(G) Question 34: My child is progressing in math the way I would expect. (scale: 1 = Strongly disagree, 2 = Disagree, 3 = Agree, 4 = Strongly agree, 5 = I don't know)

Diagram 1: NYC Survey



*This diagram shows the different levels of the survey data used in this study and how they relate to one another. Element (red), Measure (blue) and Questions (yellow) are in a **bolded** rectangle if the data was recorded for analysis. Black arrows show the relation between 2022/2023 and 2021/2022 questions (B-D), and questions (A & E) were the same for both years. Questions (F & G) were not situated in an Element/Measure, and therefore are not included above.*

Analyses

All data descriptives were calculated and examined to address the research questions using Microsoft Excel.

Question Scores

All relevant questions and measures outlined above in the NYC School Family Survey data were collected for the four schools identified and compiled for analysis. The measure and question level ratings reported through the NYC Survey data are based on a "percent positive" calculation. For each survey question, half of the response options (e.g., two of the four, one of two) were defined as favorable and accordingly counted towards the final scoring. The final scores excluded responses ("I don't know" or any missing data). As *Family Playlists* is designed for students in grades K-2, I compiled and averaged the percentage of positive ratings for each question only for grades K through 2.

Question K-2 % Favorable Average Rating:

$$\frac{\%\ favorable\ average\ for\ (Grade\ K{+}Grade\ 1{+}Grade\ 2)}{(\#\ of\ grades\ (N{=}3))}$$

Measure Score

Parent Involvement (2022/2023 school) was computed based on the average of the percent positives for all the questions included within that measure and reported in the public data set for each grade level. I averaged the scores for grades K-2 for the final favorable response rate. For the 2021/2022 school year, the measure was a different composition of questions and the measure response rate per grade level was not reported in the archived dataset. Therefore, to be consistent with the previous year, favorable

response rates for each of the questions included in the measure for grades K-2 (questions 25, 26, 29 & 30) were first collected and averaged by grade, and then K-2 rates were averaged for the final measure score.

$$\text{Measure (2022): } \frac{K{-}2\ \%\ Favorable\ Average\ Rating\ for\ (Q25{+}Q26{+}Q29{+}\ Q30)}{(\#\ of\ questions\ (N{=}4))}$$

Element Score

The element rating was not reported for either the 2021-2022 or 2022-2023 school year due to COVID-19, therefore it was not included in any analysis.

Comparison Analyses

There were four comparisons that took place to address the research questions. First, to measure the impact of the *Family Playlists* program (RQ1), data was collected from FPS 1 and FPS 2 for a comparison on both the measure and questions A-E data from years: 2021-2022 & 2022-2023. The analysis aimed to locate any differences in family reported responses between when the program was and was not put into practice. Next, to address differences between matched-schools and *Family Playlist* schools (RQ2), 2022-2023 family response data from C1, C2, FPS 1 and FPS 2 was collected for comparison in questions A-E and the *Parent Involvement* measure. Finally, to measure any discrepancy in parent involvement based on subject (RQ3), data from questions F & G was first compared for just FPS 1 & 2 to see any differences within the schools for family reported involvement (RQ3.1) and then for all four schools to reveal any differences between schools who did and did not implement the program (RQ3.2).

RQ3.1

$$(K-2\ \%\ Favorable\ Average\ Math\ Rating)-(K-2\ \%\ Favorable\ Average\ Reading\ Rating)$$

$$=\%\ Difference\ between\ subjects$$

RQ3.2

$$\left(K-2\ \%\ Favorable\ Average\ Math\ Rating\ \frac{C1+C2}{N=2}\right)$$

$$-\left(K-2\ \%\ Favorable\ Average\ Reading\ Rating\ \frac{FPS1+FPS2}{N=2}\right)$$

$$=\%\ Difference\ between\ subjects$$

$$\frac{\%\ Average\ difference\ between\ subjects\ (C1+C2)}{\#\ of\ schools\ N=2}=\%\ Average\ difference\ between\ subjects$$

$$\frac{\%\ Average\ difference\ between\ subjects\ (FPS\ 1+FPS\ 2)}{\#\ of\ schools\ N=2}$$

$$=\%\ Average\ difference\ between\ subjects$$

Results

Table 2: NYC Survey Results

School Code:	FPS 1	C 1	FPS 2	C 2
Question:				
A: School staff regularly communicate with me about how I can help my child learn.				
2022 K-2 %	93.00%	93.33%	90.67%	93.00%
2023 K-2 %	93.67%	94.33%	94.67%	96.00%
Difference:	0.67%	1.00%	4.00%	3.00%
B: Since the beginning of the school year, how often have you…communicated with your child's teacher about your child's performance?				
K-2 % Favorable 2022	95.00%	94.67%	94.33%	90.67%
K-2 % Favorable 2023	100.00%	97.67%	94.00%	96.67%
Difference:	5.00%	3.00%	-0.33%	6.00%
C: During the school year, have you…attended a school meeting, school event, or parent-teacher conference (virtually or in-person)?				
2022: Q29/30	84.17%	83.17%	87.17%	83.83%
2023: Q40	94.67%	95.67%	93.33%	86.33%
Difference:	10.50%	12.50%	6.17%	2.50%
D: Since the beginning of the school year, how often have you…seen your child's projects, artwork, homework, tests, or quizzes?				
K-2 % 2022	93.00%	94.00%	95.67%	96.67%
K-2 % 2023	97.33%	98.00%	98.00%	97.67%
Difference:	4.33%	4.00%	2.33%	1.00%
E: My child's teacher treats me as a partner in educating my child.				
K-2 % 2022	94.67%	94.67%	96.00%	96.67%
K-2 % 2023	93.33%	100.00%	100.00%	95.67%
Difference:	-1.33%	5.33%	4.00%	-1.00%
F: My child is progressing in reading the way I would expect.				
K-2 % 2023	90.67%	87.00%	94.33%	89.67%
G: My child is progressing in math the way I would expect.				
K-2 % 2023	94.33%	91.33%	96.33%	90.33%
Difference between F & G:	3.67%	4.33%	2.00%	0.67%
Measure: Parent Involvement				
2022	89.08%	88.75%	91.08%	88.75%
2023	98.00%	100.00%	94.67%	94.33%
Difference:	8.92%	11.25%	3.58%	5.58%

Table 2: NYC Survey results from all four schools. Favorable average ratings are presented for the measure each question (A-G).

Research Question Results

RQ1: What is the impact of Family Playlists interactive mathematics homework on K-2 families' reported involvement in students' education, as measured by the NYC School Survey (Family ed., 2021/2022 & 2022/2023)?

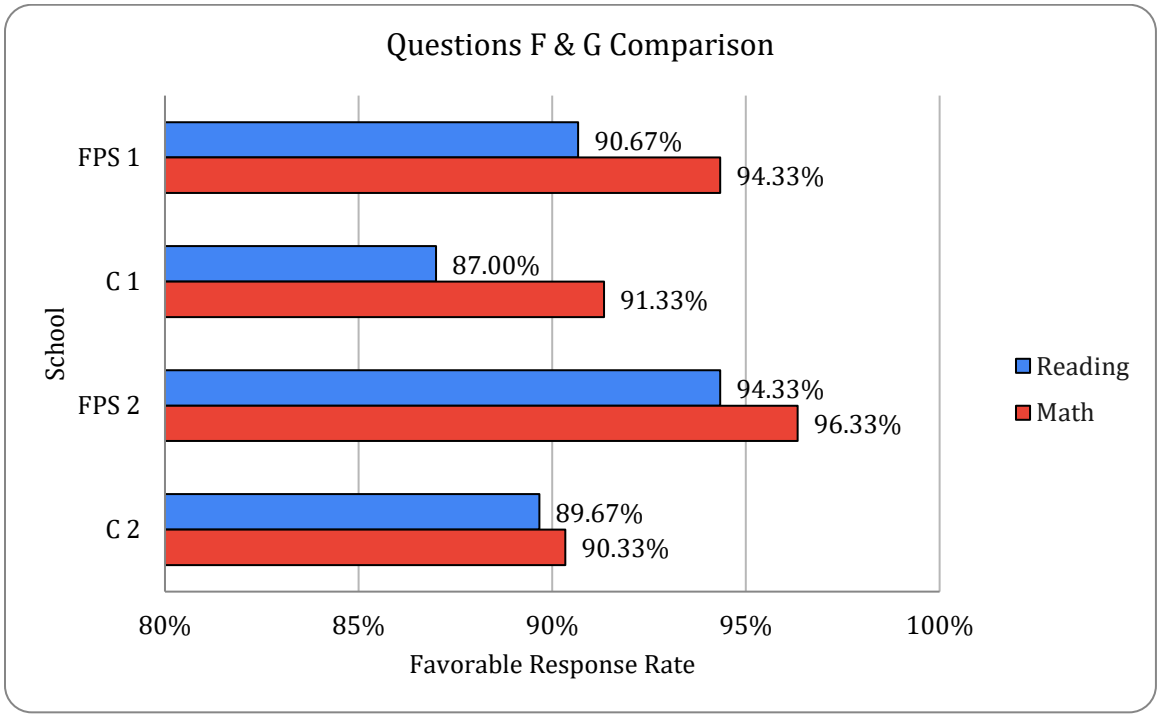
In looking at favorable response rates for schools that implemented *Family Playlists*, family reported involvement in students' education, as determined by responses to questions A-E and the *Parent Involvement* measure, showed an overall positive increase in favorable response rates between school years 2021/2022 and 2022/2023 for both FPS 1 and FPS 2. Exceptions found were for question B, where FPS 2 (2022/2023) was .66% lower than the previous year and for question E, where FPS 1 (2022/2023) was 1.33% lower than the previous year, however these were not influential to the overall positive outcome. Therefore, in response to RQ1, there was an increase in family reported involvement during the years *Family Playlists* were implemented, as measured by the NYC School Survey (*Family ed., 2021/2022 & 2022/2023*).

RQ2: Does K-2 family reported involvement in students' education differ between schools who have and have not implemented Family Playlists?

According to Table 2, there are no significant differences or trends between schools that implemented *Family Playlists* and those that did not when looking at the favorable response rates for questions A-E or for *Parent Involvement* as a measure. Largely, favorable response rates per question and measure were higher for the 2022/2023 school year in comparison to the previous year for all schools, except for

question E where FPS 1 and C 2 were slightly lower. Therefore, in response to RQ2, there was no difference in family reported involvement, as measured by the NYC School Survey (*Family ed., 2021/2022 & 2022/2023*), in students' education for grades K-2 based on whether *Family Playlists* were implemented at the school or not.

RQ3: Are there differences between math and reading K-2 family reported involvement, and is there a relationship between the implementation of Family Playlists and the results?



Graph 1 (above): Favorable response rates (x-axis) to questions F (reading -blue) and question G (math - red) for all four schools.

3.1 Is there a difference between K-2 families' reported involvement in math and reading?

All schools reported higher favorable response rates for expected student progression in math than for reading. Therefore, there is a difference between K-2 family reported involvement in math and reading for schools that did and did not implement the *Family Playlist* program.

3.2 Do the responses for K-2 families' reported involvement in math and reading depend on the implementation of Family Playlists?

The K-2 favorable response rates for family reported involvement in math was higher than reading for both matched schools, as well as both *Family Playlist* schools. Broken down by subject, FPS 1 family reported involvement was 3.00% higher in math and 3.67% higher in reading than C 1 and FPS 2 family reported involvement was 6.00% higher for math and 4.67% higher in reading than C 2. Together, the average difference between FPS1 and C1 and FPS2 and C2 was slightly higher for math (4.5%) than for reading (4.17%). When looking at *Family Playlist* schools versus matched schools, the average difference between reading and math scores were slightly higher for FPS 1 & 2 (2.83%) than C 1 & 2 (2.50%). Thus, overall, the responses for K-2 family reported involvement in math and reading did marginally vary depending on whether the school implemented *Family Playlists* or not.

Conclusion

Discussion

There was an overall positive increase in family reported involvement scores between the 21/22 and 22/23 school years, which is hopeful for the general movement of education. Aligned with research outlined above, parent involvement in school has a positive impact on students' academic trajectory, and to have families report that they feel involved and in a partnership with the school is a significant step towards building strong relationships. The current analysis found that growth in family reported parent involvement was not dependent on the *Family Playlist* program, as both FPS and Control schools showed the same trend between school years. The increase in parent involvement for FPS 1 & 2 implies that the *Family Playlist* program did not negatively impact parent involvement, however without information on the fidelity of implementation there isn't a way to gauge if greater gains are associated with more time spent engaging in the program. Given that the survey is from the public domain and is meant to provide a grand scheme snapshot of the school, it is exciting to see even the slightest bit of elevation for parent involvement, especially in mathematics. The more time families and students engage with math in a fun and positive way, the more likely it is that discouraging stigmas surrounding math will change.

Contextually, parent involvement has shown a positive association with learning through math activities while involvement in math homework has exposed negative associations (Wu et al., 2022). Having a program that is structured to facilitate the interaction between family partners and students with play-based homework has the

ability to mitigate these results and emphasize the benefits. Combining the positive interactions found in engaging with math activities and positive influences of math homework completion, formal symbolic numerical practice and active learning, *Family Playlists* provide a new modality for extended learning outside the classroom. In offering clear instructions, guiding questions, and a channel for communication with the school, the program supports positive engagement with math activities by reducing variability due to stress and/or anxiety around how to engage students effectively in math homework. Additionally, with students taking ownership of the final product being sent to the teacher, parents have the opportunity to facilitate student autonomy in meeting learning objectives and completion. The math parent involvement scores were higher in schools that implemented *Family Playlists* than the control schools. This finding is preliminary and requires more longitudinal research into whether that was influenced by the program itself but is optimistic either way.

Additionally, the high positive response ratings for all four schools can be seen as consistent with research stating that teachers reach out to parents more frequently in elementary school than in middle or high school (Seitsinger, 2008), making parent involvement greater for younger grades. Students are more reliant on family resources in early elementary school, and therefore family engagement is pursued more as a resource to support student learning than higher grade levels. Similarly, parents may feel more comfortable and competent in the subject materials for early grades, which could lead to further involvement in homework and school.

Limitations

First, one of the major drawbacks of using a public data source is that the questions are predesigned to inform an effect separate from this research. Though specific questions and measures were chosen to target parent involvement with the hope of understanding the impact of *Family Playlists* specifically, the ratings speak to the entire school environment, district agendas, grade-level action plans and teacher practices, and the program is just one factor for the classrooms in which it was implemented. Therefore, the findings are correlational rather than causational, and further research would be needed to truly understand the weight of the program in families' responses. Additionally, not all students' families responded to the survey, and so there may be important feedback not included within the response data. There is also no way of knowing if the family member who completed the survey is also one who engaged with the student in completing the *Family Playlists* program activities. Second, there was no information accounting for the fidelity of *Family Playlists* implementation in the classrooms. Information on how many times teachers assigned the learning games during the year, how they were incorporated into the fabric of the class content design and the feedback from parents was not publicly available, and so the results may vary by classroom or school depending on how the program was adapted. Without fidelity measures, there is no reliable information on whether the amount of time students and families spent engaging in the programs activities is correlated to greater parent involvement. Third, matched schools were determined by school demographics without information about what curriculums or practices the schools employed for teaching

mathematics in K-2. There is always a possibility that the control schools had a school curriculum or school goals incorporating parent involvement, which would prompt family responses to be similar to those in schools that had *Family Playlists.* Fourth, the study is relatively small, and specific to large-city urban schools located in New York City in the United States. The findings are not generalizable to the public, and the study would need to be recreated on a larger scale with more students from diverse backgrounds to fully gain insight to the power of teacher-initiated learning games on family's relationship with the school. Lastly, since FPS 1 had implemented the program the year before, it would have been interesting to go further back in the archival survey data for comparison, however, due to the COVID-19 pandemic, it would not have been a fair representation of the school data. Even reports from 2021/2022 are considered to be heavily impacted by the pandemic and need to be analyzed through that lens.

Next Steps

Informal math activities and games, as outlined above, have numerous benefits on students' math self-concept, and parent-student interactions surrounding math. Informal non-symbolic relationship to achievement is mediated through formal symbolic numerical ability and *Family Playlists* present a promising bridge between the two home learning environment types. In capitalizing on the benefits of using games to motivate students and release pressure for parents, while also structuring the activities to promote formal mathematical concepts, the program can intentionally foster positive interactions and important skills to best support students and families.

Though the difference in favorable response rates between schools that have and have not implemented *Family Playlists* cannot be directly attributed to the program without proper measures of fidelity, it is noteworthy that FPS 1 and FPS 2 had higher rates in both subjects when compared to C1 and C2 (See *Graph 1*). This has the potential for promising results in analyzing more program focused data and the impact these programs may have on parents' expectations for students and parent involvement. Furthermore, there was a larger difference between reading and math observed at FPS 1 than FPS 2, which could be a result of the *Family Playlist* program being implemented at FPS 1 in Spring of the year prior as well. This has potential to be an uplifting trend for if schools continue with the program. If starting in kindergarten the program is consistent through 2nd grade, the practice of involvement can become more of a routine and has capability to be carried into other grade levels and subjects as well. Longitudinal research on the impact of *Family Playlists* on family reported involvement could provide evidence for greater results. Additionally, as research has shown the importance of conversational turns to early cognitive development, reforming the questions within each game to be exploratory could benefit students developmentally not only in math, but in language and executive functioning as well.

Research that ties family involvement (qualitatively or quantitatively) either through internal teacher/family surveys or number of communications shared throughout the year to the completion of activities within *Family Playlists,* could also provide a mechanism for measuring transferability of practices. Understanding the mechanisms behind student achievement growth can drive future research and programs connecting

parent involvement and homework practices in mathematics to be positively associated and better understood. Math competency opens a variety of doors for students' future careers, academic trajectories, cognitive development, and social mobility (National Mathematics Advisory Panel, 2008; Susperreguy et al., 2020). As a guide for many U.S. national agendas with STEM education (Visioning Report for STEM Education for the Future, 2020), and an evidenced predictor of income, students' mathematics skill acquisition deserves to be at the forefront of our educational initiatives. Promoting early development of mathematical concepts has the potential to contribute to a more equitable future in math education and careers, where math trajectories are determined by interest and excitement rather than negative experiences. Students' perceptions and expectations are formed early on and have the capability to influence their future endeavors. Therefore, if perceived math competency can be influenced by positive experiences in math facilitated by intentionally guided parent involvement in math homework, then it is worthy of further research and development to best support student success.

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