How Does Parental Attitude Toward Mathematics Prompt Student Achievement?

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Parents, K-8 teachers, and 4th-8th grade children partnered as learners in math-focused parental involvement through the Math and Parent Partners (MAPPS) program. We hypothesize that participation in MAPPS improved parent attitudes towards mathematics motivating children to learn at school.

Keywords: Informal Education, Attitudes

Background and Research Questions

Low parental involvement in disadvantaged schools has been related to a gap in mathematics achievement (Jackson & Remillard, 2005) while strong parent-child communications and parents' aspirations for their children's mathematics education have been found beneficial for student achievement (Aldous, 2006; Robinson & Harris, 2014). A school district and university in the Southeast partnered to boost student achievement in Title I schools through the Math and Parent Partners (MAPPS) Program. Knapp, Jefferson, and Landers (2013) found standardized test scores to rise significantly over a three year period for those participants attending regularly for at least one Minicourse. To build on this result, we ask, *How might improvement in student understanding and achievement occur within a standards-based mathematics PI program such as MAPPS? In particular, do parents' attitudes related to mathematics improve?*

Theoretical Framework: Funds of Knowledge

From its inception, MAPPS has been grounded in the socio cultural theory of Funds of Knowledge/Communities of learners (Rogoff 1994; Allexsaht-Snider & Bernier 2003). The assumption that families possess bodies of knowledge used for daily living, "is critical in terms of reconceptualizing households, not as the source of barriers to educational attainment, but as repositories of resources that can be strategically tapped" (González 1996, p. 3). Civil (2007) refers to these resources as "Funds of Knowledge". According to Civil, Funds of Knowledge build on students' and parents' knowledge and experiences as a resource for schooling and values community-based teaching as well. Such Funds involve pedagogically mathematizing household knowledge such as carpentry, repair, or folk medicine for classroom use.

Participants and Context

In this vein, the Math and Parent Partners (MAPPS) program engages parents in mathematical tasks to equip them as mathematical resources for children and schools. The five-part MAPPS curriculum was developed with National Science Foundation project ESI-9901275 funding K-8 parents to collaboratively explore mathematics learning at school as well as connecting to parents' existing Funds of Knowledge. A particular MAPPS program located in the Southeast invited all parents, instructional staff, administrators, and children from certain schools to participate in the study (Knapp et al., 2013). Children in 4^{th}-8^{th} grade accompanied their parents for Mini-courses comprised of eight weeks in two hour sessions while young children participated in childcare with mathematical activities and games. Eight separate Mini-courses on number, geometry, algebra, and data were offered over the course of three years. Instructors were practicing teachers studying mathematics education. MAPPS Mini-course structure followed the National Council of Teachers of Mathematics (2000) process standards by engaging participants in content and pedagogy through learning communities of parents, children, and teachers to solve tasks, use manipulatives, and present solutions to the entire group

(Knapp et al., 2013). In total, 59 parents, 33 teachers, and 115 children from four main Title I elementary schools attended at least one Mini-course on a regular basis. About double attended less regularly. Most attendees were single mothers and held low-income jobs. They were approximately 40% Caucasian, 40% African-American, and 20% Hispanic.

Methods, Data Analysis, and Coding Tallies

Impacts of the MAPPS Mini-courses were ascertained through pre/post attitude inventories taken by parents and teachers. A focus group of parents, teachers, and children also participated in 95 pre/post interviews lasting approximately 15 minutes probing for improvement in mathematical knowledge and on parents' ability to assist their children in mathematics. Interviews were coded for factors that might affect their mathematics achievement, including aspects of the home environment related to Funds of Knowledge. Code identification examples are given in bold in the results section. After coding the interviews and pre/post surveys, we tallied the 59 codes to identify areas of participant growth as well as factors prompting that growth. For quantitative attitude analysis, the researchers administered a modified version of the Attitudes Toward Mathematics Inventory (ATMI) (Tapia & Marsh, 2004) to parents and teachers before and after each Mini-course. The inventory consisted of 25 items to reflect five affective mathematics dimensions (confidence, anxiety, value, enjoyment, and motivation). The ATMI was found to be reliable (alpha = .948) for parents and teachers. Parents were asked to rate statements such as "Mathematics is a very interesting subject" on a Likert scale (Tapia, 1996). Attitude surveys were analyzed using paired samples *t*-tests. This mixed methods study was of quasi-experimental design as parents self-selected to the program.

Results and Discussion

Question #1 How might improvement in student understanding and achievement occur?

The MAPPS **learning community** environment yielded many benefits. First parents, teachers, and children assisted one another in learning mathematics. At times**, children helped parents** figure out problems, which became a source of pride and motivation for the children, especially when they could present their solutions to the group. **Enjoyment** of mathematics was the second product of the learning community. "Before you leave, you're laughing because you've learned. The average 8 and 78-year-old learning together," said one parent. She explained that people come to MAPPS for the enjoyment of learning. Children also expressed enjoyment such as in seeing their teacher and parent interact. The third product of the learning community included **motivation**. The learning community motivated parents to increase parent-child interaction around mathematics as they observed other parents engage with their children . As one parent put it, she was motivated to explicitly budget time at home for helping her child with mathematics. Motivational factors for children included 1) parental presence at MAPPS, 2) parental interest in what the children were doing, 3) a non-traditional, ungraded learning environment at the university, and 4) a location that they found exciting. Seeing their parents **value mathematics** also motivated children to value it. The MAPPS-fostered learning community among parents, teachers, and children motivated children not just to learn mathematics at MAPPS and at home, but in school as well. One teacher reported:

> I think as they [children] saw things that we did outside of class [at MAPPS] in our class, it motivated them because they could share their experience with their peers. They could say, 'I understand this because I've seen it before.' It built their confidence because when they knew how to do something, people [MAPPS participants] looked to them for help.

A child expressed her gained mathematical confidence and motivation by saying, "You would get smarter and feel more confident. You would just have fun with that". Thus, parental

involvement in mathematics along with the MAPPS learning community appeared to spawn increased motivation and confidence for children to learn in the school setting. Analysis of the qualitative data appears to show that the MAPPS environment improved classroom learning for children, an improvement which may have impacted student achievement over time.

Research Question #2: Do Parents' Attitudes Related to Mathematics Improve?

The quantitative attitude survey supports the qualitative evidence gathered about improved **confidence** and **motivation** of parents with respect to their own mathematics learning and teaching of their children. Mean **attitude** scores improved during most sessions (See Table 1).

Table 1

Parent and Teacher Attitude Surveys- Mean Scores out of 125

	n	Pre	Post	Change
2008-2009 Session1	18	100.5	101.6	1.1
2008-2009 Session 2	32	97.2	98.6	1.4
2009-2010 Session 1	24	90.7	85.5	-5.2
2009-2010 Session 2	20	92.6	98.3	5.7
2010-2011 Session 1	4	90.8	95.0	4.2
All years 1st Mini-course taken	65	93.0	94.2	1.2
All years 1st-Last Mini-course	65	93.6	96.2	2.6

Parents showed improved attitude toward mathematics when comparing the first time the inventory was taken to the last (some participants took several Mini-courses and thus took the survey multiple times) (p = 0.101, d = 0.160). Adults (parents and teachers) analyzed together improved significantly when comparing the first time they took the inventory to the last (p = 0.084, d = 0.125). We chose *alpha* = 0.1 as the limit level due to the small sample size. Thus for the p-value of 0.101, we have moderate evidence to say it is significant and the p-value of 0.084 is considered significant (Borenstein, 2012). An increase in parent attitude toward mathematics may have contributed to the improved motivation of children to learn mathematics (See Table 2).

Table 2. *Parent and Teacher Attitude Scores- 125 points possible.*

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	n	Pre	Post	Change	Result
1st-Last Mini-course Parents	46	93.6	96.2	2.6	p=.101
		sd	sd		d=.160
		14.1	11.3		
1st-Last Mini-course Parents & Teachers	65	93.1	95.2	2.1	p = 0.084
		sd	sd		d = 0.125
		17.7	16.0		

Conclusions

In conclusion, parents' improved attitudes toward mathematics and their confidence in explaining it appeared to impact **parent-child interactions** and thereby impacting student achievement. Parent-teacher relationships forged through the MAPPS learning community also impacted student motivation and consequently sustained mathematics learning. *Children's interactions with parents fueled by the MAPPS learning community prompted children's motivation and confidence to learn mathematics at school, possibly leading to student achievement gains.* The *familial bond* to and with the child may channel motivation to learn mathematics. Indeed, top codes from data analysis revealed improved parent-child interaction

around mathematics and parent enjoyment and valuation of MAPPS; certainly children would have picked up on these cues. Through mixed methods, this mid-sized quasi-experiment points to parental attitude toward mathematics as a possible predictor of student achievement. Other possible factors in the study may have been changes in parent and teacher knowledge and parent-child interaction among other factors (See Knapp et al., 2013; Knapp & Landers, 2012). Further quantitative study is needed on larger scale and in multiple contexts relating parent attitude and student achievement. Additionally, a correlation study is needed to compare parental attitude towards mathematics and student attitude toward mathematics.

References

Aldous, J. (2006). Family, ethnicity, and immigrant youths' educational achievements. *Journal of Family Issues, 27*(12), 1633-1667.

Allexsaht-Snider, M., & Bernier, E. (April , 2003). *Schools as the unit of change: Principal roles in the support of parental involvement in mathematics reform*. Paper presented at the NCTM Research Presession. Retrieved from http://mathandparents.math.arizona.edu/research.html

Borenstein, M. (2012) Statistical hypothesis tests. In J. Arthur, M. Waring, R. Coe, & L. Hedges (Eds.), *Research methods and methodologies in education* (pp. 330-337). London: Sage

Civil, M. (2007). Building on community knowledge: An avenue to equity in mathematics education. In N. Nasir & P. Cobb (Eds.), *Improving access to mathematics: Diversity and equity in the classroom* (pp. 105-117). New York, NY: Teachers College Press.

González, N. (1996). *Applied anthropology as educational innovation: Learning from households.* In Final Report: Funds of knowledge for teaching. Principal investigators, L.Moll, N. González, M. Civil.

Hong, S., & Ho, H.-Z. (2005). Direct and Indirect Longitudinal Effects of Parental Involvement on Student Achievement: Second-Order Latent Growth Modeling Across Ethnic Groups. *Journal of Educational Psychology, 97*(1), 32-42. doi:10.103710122-0663.97.1.32

Jackson, K., and J. Remillard. (2005). Rethinking parent involvement: African American mothers construct their roles in the mathematics education of their children." *School Community Journal, 15(1),* 51-73.

Knapp, A. K., Jefferson, V., & Landers, R. (2013). Learning together. *Teaching Children Mathematics, 19*(7) 432-439.

Knapp, A.K. & Landers, R. (2012). Prompting mathematical knowledge for teaching through parent-teacher learning communities. *Proceedings of the 34th annual meeting of the North American chapter of the International Group for the Psychology of Mathematics Education* (pp. 453-460). Kalamazoo, MI.

Robinson, K., & Harris, A. (2014). *The Broken Compass: Parental Involvement with Children's Education*. Cambridge, MA: Harvard University Press.

Rogoff, B. (1994). Developing understanding of the idea of communities of learners. *Mind, Culture, and Activity*: *An International Journal, 1*, 209-229.

Tapia, M. (1996). *Attitudes Toward Mathematics Inventory.* Retrived 27 May 2016 from http://www.une.edu/sites/default/files/Attitudes-Toward-Mathematics-Inventory.pdf

Tapia, M., & Marsh, G. E. (2004). Instrument to measure mathematics attitudes. *Academic Exchange Quarterly, 8* (2).

Citation for final version at www.pmena/2016:

Knapp, A.K., Landers, R., & Liang, S. (2016). How does parental attitude toward mathematics impact student achievement? In M. Wood, E. Turner, M. Civil & J. Eli (Eds.). *Proceedings*

of the 38th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education. (pp. 1107-1110), Tucson, AZ: The University of Arizona.