



background

Report # 117

Development Of Mathematical Abilities

April 2010

The Troubling Gap in Math Knowledge

Math Deficits Start Early

Poor children tend to fall behind quickly

Children's mathematical abilities begin to form very early in life, several years before they first step into a kindergarten or elementary school classroom, and their exposure to simple math activities can go a long way toward determining how well they grasp mathematics later in school.

Unfortunately, these formative early childhood years also mark the beginning of a troubling knowledge gap in mathematics that is separating America's low-income children from their more affluent peers, who generally enter school with the benefit of having more highly developed mathematical skills and a better understanding of key concepts.

The gap illustrates a trend that has debilitating consequences for low-income children.

Studies show that early deficits in mathematical knowledge have profound implications for future learning. Researchers report, for example, that children's knowledge of mathematics in kindergarten predicts their scores on achievement tests during the elementary grades and on into high school.¹

But there is reason for optimism. The gap separating low-income and more affluent children is widely recognized and researchers are making progress in understanding its roots and are investigating effective ways of narrowing it.

For example, one of the many areas of mathematics that young children from low-income backgrounds struggle with is number sense, a key mathematical ability related to understanding numerical magnitudes. Re-

cent studies suggest there are simple ways to promote the development of number sense during early childhood that could help low-income preschoolers sharpen their overall mathematical knowledge.

Math Gap Seen Early

Throughout the United States, studies show that children from low-income families are more likely to begin their school years with much less knowledge in mathematics than children from middle-class and wealthier backgrounds.

This gap is seen across several fundamental math tasks, including counting from one, counting up or down from numbers other than one, recognizing written numerals, adding, subtracting and comparing the magnitudes of numbers.^{2,3}

Such early deficits in mathematical knowledge can have long-lasting consequences.

Researchers investigating the development of math knowledge and the early deficits that can jeopardize learning suggest there are simple ways to develop number sense and help children improve their overall understanding of math.

See Report 118

In general, a child who starts out behind in learning math stays behind throughout his or her school years. Achievement test scores are one measure that provides evidence of the math achievement gap between low-income students and their more affluent peers in U.S. schools.

In western Pennsylvania, for example, a gap in math achievement between low-income students and those from more affluent families was identified by the 2003 Mayor's Commission on Public Education as one of the challenges facing the Pittsburgh Public Schools.

According to the commission's report, only 39 percent of all Pittsburgh Public School students in grades 5, 8 and 11 were proficient in mathematics during the 2001-2002 school year, based on Pennsylvania System of School Assessment test scores. But among low-income students, only

(Continued on back)

29% earned test scores high enough for them to be considered proficient in math.⁴

Of concern is the fact that students from low-income families account for the majority of students in the Pittsburgh Public Schools. The Pittsburgh commission's report defined low-income students as those whose family income fell below poverty levels, as well as those with family incomes low enough to qualify for the federal free and reduced lunch program. About 60% of the students enrolled in the Pittsburgh Public Schools in 2001-2002 fell into those categories.

The same achievement test scores show that 52% of all students across Pennsylvania were proficient in math during the 2001-2002 school year cited in the Pittsburgh commission's report.

Recent evidence suggests that Pennsylvania's schools are also burdened by a significant gap in math knowledge that divides low-income students from their more affluent peers.

Despite general improvement in statewide academic proficiency scores during the 2007-2008 school year, for example, students who attended school in disadvantaged communities continued to struggle, accounting for 68% of those whose math and verbal scores fell "below basic," which is the lowest category on the Pennsylvania System of School Assessment.⁵

Support Is Critical

Research suggests that the mathematical knowledge gap reflects a difference in the learning support children receive from their parents and others.

Studies have found, for example, that middle-income parents engage in a wider range of math activities with

The math gap that separates low-income children from their more affluent peers is seen across several basic tasks, including counting from one, recognizing written numerals, counting up or down from numbers other than one adding, subtracting and comparing the magnitudes of numbers. These early deficits can have long-lasting consequences.

their children and do so more frequently than do parents in low-income households.^{6, 7}

And studies point out the benefits of such practices in the home. In general, researchers have found that children whose parents engage in more numerical activities generally possess greater math knowledge.

Such findings underscore the value of designing activities to improve the understanding of numbers that can be widely used among low-income preschoolers who are less likely to be exposed to adequate early math support at home.

Researchers investigating such activities have recently reported progress.

A simple board game, for instance, has shown promise in helping young children develop number sense. Not only has it helped children develop their abilities such as approximating numerical magnitudes, it is both simple and inexpensive enough that it could be widely used to help promote the development of mathematical knowledge among a wide population of young low-income children, who studies show desperately need such support.

references

This report is largely based on the following publications.

Siegler, R.S. (2009). Improving the numerical understanding of children from low-income families. *Child Development Perspectives*, 3(2), 118-124.

¹ Duncan, G.J., Dowsett, C.J., Claessens, A., Magnuson, K., Huston, A.C., Klebanov, P., et al. (2007). School readiness and later achievement. *Developmental Psychology*, 43, 1428-1446.

² Ginsberg, H.P., & Russell, R.L. (1981). Social class and racial influences on early mathematical thinking. *Monographs of the Society for Research in Child Development*, 46(6, Serial No. 69).

³ Jordan, N.C., Kaplan, S.C., Olah, L.M., & Locuniak, M.N. (2006). Number sense growth in kindergarten: A longitudinal investigation of children at risk for mathematics difficulties. *Child Development*, 77, 153-175.

⁴ Mayor's Commission on Public Education. (2003). Keeping the Promise: The Case for Reform in the Pittsburgh Public Schools. Full report, September 2003, 24-25. www.aplsschools.org/pdf/KeepingthePromise-Full2.pdf

⁵ Pennsylvania Department of Education. 2008 Student Achievement Fast Facts. http://www.pde.state.pa.us/a_and_t/lib/a_and_t/AYP_PSSA_final_fast_facts_2008.pdf

⁶ Clements, D.H., & Sarama, J. (2007). Effects of a preschool mathematics curriculum: Summative research on the Building Blocks Project. *Journal for Research in Mathematics Education*, 38, 136-163.

⁷ Starkey, P., Klein, A., & Wakeley, A. (2004). Enhancing young children's mathematical knowledge through pre-kindergarten mathematics intervention. *Early Childhood Research Quarterly*, 19, 99-120.

Children, Youth & Families background is published by the University of Pittsburgh Office of Child Development (OCD), a program of the University of Pittsburgh School of Education. These reports are based on available research and are provided as overviews of topics related to children and families.

OCD Co-Directors: Christina J. Groark, Ph.D.; Robert B. McCall, Ph.D.

background writer/editor: Jeffery Fraser; e-mail: jd.fraser@comcast.net

University of Pittsburgh Office of Child Development 400 N. Lexington Ave., Pittsburgh, PA 15208; (412) 244-5447; fax: (412) 244-5440

This report and others can be found on the Internet by visiting: <http://www.education.pitt.edu/ocd/family/backgrounders.aspx>