

## THE BARRIERS TO PREPAREDNESS FOR ALGEBRA 1 IN LOW SES AND MINORITY INNER CITY DISTRICTS

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### **Math Achievement in the U. S.**

Algebra 1 has often been described as “*the gateway*” because doing well in algebra is thought to be a predictor for life’s future successes. Unfortunately, success post taking algebra for some, especially minority and low socioeconomic status students (SES), can be elusive. Minority and low SES students are underrepresented in Algebra 1 courses and of those that are attending the course many do not achieve passing grades (Domina, 2014; Stein et al., 2011; Stone, 1998; Walston & McCarroll, 2010). Though the problem is more pronounced in low SES and minority environments, large numbers of students in schools across the United States are reaching middle school, where Algebra 1 is most commonly taken, without having grasped proper grade-level math skills in previous math experiences to facilitate needed success in Algebra 1 (Rhymer, Dittmer, Skinner & Jackson, 2000). The United States has watched its international standing for mathematic achievement continue to fall behind other nations. The National Assessment of Education Progress (NAEP) reports that the overall mathematical achievements in the United States has suffered with a mere 39% of all students (independent of race, gender or culture consideration) classified as at or above the “proficient” category in mathematics when reaching Grade 8. The challenge of math proficiency does not appear to improve by Grade 12 with the gap widening to only 23% of United States students reported on grade level in mathematics (U. S. Department of Education 2005, 2007). Yet, of our nations shortcomings, minorities and low SES students are overrepresented in the number of student failing to reach grade level preparation by Algebra 1.

Yet, as recently as 2012, the Program for International Student Assessment reported that United States ranked at approximately 26, far below average, when compared among a total of 34 countries in mathematics. Socio-economic

backgrounds contributed to 15% of the United States shortcoming when compared to other countries (Schleicher, 2012). Due to deficient learning experiences beginning early in life, both at home and in school, students classified as holding low socioeconomic status (SES) and minority students are not reaching proficiency in the core subject of mathematics (specifically preparation for algebra 1) that lead to proper achievement (Kilpatrick, Swafford, & Findell, 2001). Further focus will show that systematic inadequacies in the quality of learning delivered in classrooms predominately populated by minority and low economic status children from early learning until the timeframe to meet minimum requirements for higher math (algebra 1) contribute to the inadequacies in higher math readiness.

There are numerous variables that contribute to this cyclical shortcoming. The low SES of many minority students is thought to be a contributor. Students not being properly prepared for Algebra 1 is another, as well as the substandard quality of exposure to math in poor quality schools. There is also an absence of math “talk” traced back as far as a student’s kindergarten experience (Mulligan, Hastedt, & McCarroll, 2012). The lack of math “talk” is considered significant because algebra not only approaches math with symbolic representation but also poses an opportunity to use word problems in algebraic equations. Thus, low SES and minority students who are more likely to attend poor quality schools and are in home environments that are also not likely to expose them to sufficient word and vocabulary engagement are facing home and school inadequacies that directly impact their subject matter preparedness (Hattie, 2009). The gaps in math proficiency for minority and low SES students has been shown to surface as early as in kindergarten and that gap widens as school grades progress (Jencks & Phillips, 1998; Taylor & Graham, 2007; U.S. Commission on Civil Rights, 2004)

There are various reasons why failure to be on the proper math grade level is important but the core course of Algebra is considered critical because doing well within this subject impacts (1) additional advanced math classes such as calculus and trigonometry in secondary schools, (2) High-school graduation in some states, (3) College entry into sought higher learning institutions, and (4) Science, Technology, Engineering and Mathematics (STEM) related careers.

The United States, recognizing that the achievement of its children in areas of mathematics and reading lagged when compared to other countries, sought to intervene with the intent to improve what was increasingly seen as an issue that impacted the socio-economically disadvantaged, of which many attend inner-city public schools. However, in no way are children of “privilege” (for the purposes of this paper, all non-at-risk students) immune to failing algebra in large numbers. In 2014, Forbes reported that in a middle to upper-class suburban area of Montgomery County, Maryland (a school awarded gold, silver and bronze recognition), 82% of children failed their final Algebra 1 exam (Anderson, 2014). The No Child Left Behind Act (NCLB), however, was intended to reach more of the socio-economical classes and turn around a downward spiraling of achievement that plagued many populations. Poor achievement in the core subjects, math and reading, was found to be more pronounced in minority and poor populations. The component of NCLB that was to address teacher quality remains elusive and the inability to place quality core subject teachers for subjects such as math has been more pronounced in areas of poverty and as such the academic achievements of large numbers of such children is consistently abysmal (Boyd, Grossman, Hammerness, Lankford, Loeb, Ronfeldt, & Wyckoff, 2012).

### **Historic Response**

For minorities and the socioeconomically disadvantaged, the experience of poor learning opportunities in the core subjects of math both in home environments and in the classroom systemically build a pathway to underachievement for both academics and adult futures. Such inequity that suggests profound impact in the lives of

innocent and unassuming children suggests a need for closer examination of the problems that exacerbate the gap between low SES/minority students and higher income students. It is painfully apparent that every child is not excelling in the core subjects of mathematics and reading leaving some populations of children consistently lagging in the subject areas that have been identified as predictors for future success. NCLB was the hope for closing a widening gap of academic achievement between whites, minorities and disadvantaged students (Rowley & Wright, 2011). There were three focal points for NCLB: identifying an Adequate Yearly Progress (AYP) for school divisions, pursuing teacher quality, and achieving 100% proficiency in mathematics and English by 2014 (Blank, 2011; Chin, Wong, 2011; Shirvani, n.d). The goals of NCLB were aggressive and though very loosely making change in some states, few urban schools came close to the intended goals of NCLB. Unfortunately, studies that analyzed achievement across the nation consistently found that poor and SES students continue to achieve at much lower level than their white or affluent counterparts (Lagana-Riordan & Aguilar, 2009).

### **Academics Shortcomings**

#### **A Poor Start**

The gap that can separate children of low socioeconomic status (SES) from the achievement of others is thought to be profoundly far reaching and begins early in the lives of such children due to infrequent word exposure. Hart and Risley (2003) found that all children regardless of race and economic background generally start talking at about the same time. Nevertheless, disparate differences begin to show early. By 3 years of age, children of welfare systems were speaking approximately 500 words while children of like age in middle class families were speaking 1,100 words. Such findings are further supported by other research that convey children of low-income and poverty homes experience far less complex conversation and thus their exposure to words is, in fact, limited if limited to home experience (NAECY, 2009). Low exposure to words at home in childhood might infer that fewer minority and low SES students are being read to routinely. This

missing time in reading is significant because studies show that hearing more traditional childhood books like *The Three Billy Goats Gruff* (1973) and *Goldilocks and the Three Bears* (1992) which are filled with imagery, patterns and symbols allow children to develop early quantitative change recognition and isomorphic structure which are fundamental building blocks to prepare for Algebra 1 (Elliott, 2005; Hart, 1983). These differences are partially attributed to middle class children hearing much more conversation and language that serve to grow vocabularies. In short, poor and disadvantaged children are beginning education behind children of more affluence and the gap continues to broaden (NAECY, 2009; Schipper, 2014; Hart & Riley, 2013).

### **Early Learning**

Preschool and head start programs could serve as a catalyst to fill the gaps that result in academic shortcomings observed in some low SES children so that such children can become better equipped to enter kindergarten and start with early lives of academic preparedness. Studies has shown that children who attend preschool programs realize an increase in letter-word recognition, improvements in oral composition, development of early math skills and overall improvements in cognitive skills. Specifically, a study conducted in Tennessee found a 75% improvement in letter-word identification, a 152 percent improvement in oral comprehension and 63 percent improvement in quantitative concepts when compared to children not in preschool programs (Herman, O'Halloran, 2013). The development of such skills may impact a child's opportunity for higher learning as well as career paths. Preschool programs offer yet another benefit in some capacity. There are preschool programs that are public which require immunization of children in adherence to health requirements. This might mean that a child who might not otherwise see the doctor for eyes or teeth might now be encouraged to do so. In addition, many head start programs serve children regular meals, which might not be at home but are a necessary part of their young child's healthy growth and progression. In some cases, the nutrition that preschool programs have provided have met one

and two thirds of required nutritional needs for a child's physical development (Schipper, 2013). Since we know that such young children are always learning and developing, it seems fitting that organized offering of early learning environments such as head start and pre-k for children should be plentiful to close the achievement gaps for mathematics and other core subjects that we know exists in our great country.

### **Availability and Quality in Early Learning**

The lack of formal preschool program availability for minority and low SES students in addition to the inadequacies of the preschool programs that *are* available continue to contribute to a lack of ability to close the gap of academic achievement where it begins. Even when formalized preschool programs are made available some do not contain the quality level that would increase the opportunity for impact in the areas of reading and math especially for minorities. In general, the options that parents select for early learning are varied: (1) Head Start (2) Home based care (relative or trusted friend/companion) (3) Parents (4) Other center-based (5) Multiple arrangements (Barnett, 2013).

The quality for preschool programs is generally determined by the use of two tools, the Early Childhood Environment Rating Scale (ECERS) for center-based programs and the Family Day Care Rating Scale (FDCRS) for home centered programs. In 2005, the National Center for Education Statistics sponsored a national observation of the preschools being attended by 4 year olds. Most startling, this study discovered that more than one half of the home based programs attended by Black (53%) and Hispanic (63%) students were classified as low quality. Though some of the home-based programs attended by minorities were considered of medium quality, 0% percent were found classified to be high quality nation-wide in this 12 state study (Barnett, 2013). As a base requisite, the quality commitment must extend to preschools in such a way that program quality is aligned to support the intended goal of early learning in children. While the social benefit of head start and pre-school programs are well documented, these same programs are not always

equally as strong in building a sound foundation for academic futures nor are such programs equally within the reach of poor and disadvantaged students. Certainly with so much potential to increase learning for lower economic standing populations, minorities and all populations, early learning programs that incorporate quality should become a common place offering where the need is well established (Nores, Barnett (2010); Puma, Bell, Cook, Heid, Broen, Jenkins, Mashburn, Downer, (2012), Barnett, Carolan, Johns (2013).

### **Math Anxiety in Teachers**

The explanations for the missing foundational building blocks for mathematics in some preschool and head start settings, specifically those that serve minority and low SES students, are varied. One such explanation stems from what is now being referred to as the impact of teacher subject anxiety. Some studies reveal that teachers in preschool environments may have an anxiety towards mathematics when mathematics was not a favored subject during the teacher's college experience. In turn, this anxiety towards mathematics can be directly translated into an anxiety for *teaching* mathematical concepts in head start or preschool. Such discomfort in approaching and teaching mathematics is thought to provide an explanation for the low inclusion of mathematics found within preschool classrooms and curriculums. In general, studies as recent as 2009 reveal that preschool teachers were spending less than 7% of class time on math related delivery (Cross, Woods, & Schweingruber, 2009). As such, math anxiety in teachers has been found to be directly transferable to children reducing student's confidence in developmental thinking intended to spark interest and understanding of math value early in life. The practice of employing teachers in early learning settings who are not comfortable in the subject area of math without proper quality built into program delivery may very well be an impediment to the very intention of providing children at risk proper foundations in early math discovery (Cross, Woods & Schweingruber, 2009).

There are further conditions that reduce intended gains of achievement in math proficiency in early learning environments if present. For

example, there are many characteristics that comprise quality and thus adversely impact otherwise effective preschool programs. One of the characteristics that appears to influence the success of a program is the length of time spent by children towards available instructional delivery, specifically half-day or full-day sessions. While there is significant belief that a child that has participated in a full-day session when compared to one that has not has high gains, the difference in gains between half-day and full-day sessions are nominal in some studies while more significant in others. This decision should not be made lightly as students who attend full-time realize do realize larger academic gains than students who do not attend at all or only attend half-time (Copley 2004, Hattie 2009). Additionally the success of such programs, though an entry point for formal learning, are not always coupled with a properly planned or executed curriculum: a curriculum that not only addresses social skills but also targets early math and reading fundamentals. In many case, teachers are just not being given the skills to deliver instructional material that will be impactful to preschoolers in these formative years especially in the area of math (Copley & Padron, 1999). Yet, the incorporation of careful attention to curriculum change that includes math may also require a pedagogical modification of teacher thinking for those that are adverse to the belief that math should be a larger part of the early learning experience as opposed to heavy inclusion socialization skills. Resistance in teacher's base pedagogical beliefs can very well be an impediment to teacher time spent in practices that develop math concepts for children in classrooms. Unfortunately, in minority and disadvantaged populations, the lower quality of early learning programs, coupled with the pedagogical beliefs of some teachers that wish to keep such schooling opportunities as social development grounds contributes directly to the shortcomings of an early learning opportunity intended close the gap of achievement (Geist, 2012; Peker, & Ertekin, 2011; Roberts & Vukovic 2011).

### **Global Implications**

#### **The United States Investment in Children**

If the United States intends to continue being a country known for technology and Science

Technology and Engineering (STEM) related advance, it stands to reason that it must be among the countries whose children grow up to occupy such standing and invest in its children. The United States, when compared to other countries, is investing less in its children, per capita, than other countries. Approximately 69% of 4 year olds in the United States are enrolled in head start programs. Japan was recently ranked 40 points higher in the United States for 4<sup>th</sup> grade math (Herman, 2013). Japan, in contrast to the U.S, follows a conscious practice that allows almost all of its children have access and attend a head start program.

Additionally, Japan is not the only country that has made a conscious effort to invest heavily in early childhood development. In 3<sup>rd</sup> grade, France, Norway and Italy make head start programs available to 90% of its children (Herman, 2013). Debating the question of if the No Child Left Behind Act of 2011 was successful is no longer the question that begs answering for the United States. As a nation, we must consider the impact of our not investing in the human resource of children heavily as our surrounding nations and weigh what impact such failure to invest is causing in the futures of our children. If we are a nation that cares about its weakest and most disadvantaged, now is the time to show it. Otherwise, large numbers of children risk growing into adult lives without the necessary knowledge to enjoy higher economic status.

Science, Technology, Engineering and Math

Our world is becoming far more dependent on technology and the use of such. If students are not engaged to acquire math and reading skills, their opportunities for contribution in such a society may be severely threatened (Committee on Prospering in the Global Economy of the 21st century, 2007). Some research suggests that the number of jobs that will require technology knowledge which are associated with mathematics are more than 80% (Coble, & Allen, 2005). Given the need for math as a base for many technology careers, the failure of minority and low SES students to perform well in mathematics while in grade schools will generally carry over into college environments making preparedness to compete in a STEM workforce much more evasive. The impact of a child's failure

to excel in math not only has immediate impact in the early learning classrooms but may be far reaching into the college and adult lives of such children.

### **Socioeconomic Standing**

#### **Parent Education and Belief Systems**

The impact parents can contribute to the academic advancement of children cannot be understated. There are, however, challenges that can get in the way of parental influence that are often induced by socioeconomic factors. Parents who are not college educated may not have an inward belief that college is attainable for their children because college may have been an elusive goal for them. As such, children can find themselves in a home with parental role models who are not communicating the language of higher achievement and instead learn to settle for lower aspirations. Yet, there is promise in that area because parents that do not have academic backgrounds can and do sincerely encourage or champion their children with high expectations for their achievement (Rubie-Davies, Peterson, Irving, Widdowson, & Dixon, 2010). The importance of parents who believe in and support academic achievement cannot be understated as such resources directly impact a child's belief that success can be achieved (Hattie, 2009). Several factors comprise parental contributions to perceptions of a child's predicated success. These resources are named as parental education, income and occupation. The overall effect size of such resources is .57, quite impactful (Hattie, 2009). Given that many poor and minority parents are themselves undereducated, it may be a challenge to see their offspring go higher in the educational paradigm so the absence of parental encourage for poor children can be silencing for children in need.

#### **Mobility**

The growing lower class has impacted home ownership possibilities for many of our nation's poor or underprivileged/underpaid, requiring many families to rent property. Not only is renting property the only choice for some but also perpetual moves are often characteristic of such groups due to a recurrent inability to meet rental obligations. In the United States, 20% of children

change residence each year. Expectedly, such mobility has a negative impact. Such mobility according to Mehana (1997) has a profoundly negative impact on math and reading ( $d = -.27$ ) that is felt in schools. The negative impact is thought to be more heavily felt when children are in kindergarten, high school or if multiple moves occur (Burkam, Lee, Valarie & Dwyer, 2009). Though certainly challenges at home contribute to the learning process of children, home environments do not have mandated quality measures attached to them but outside of the home learning opportunities can and should adhere to quality. Certainly home environments vary widely and all of the problems outside of schools impact academic achievement. However, studies suggest that effective teachers have far more overall influence on student achievement than perceived in previous years so the contributions of quality teachers cannot be understated (Stronge, 2010).

### **Teachers and Schools**

#### **Still Unequal and Very Separate**

Beyond the surmountable obstacles faced in the home environments of at-risk children, often the very school systems entrusted by parents are failing to provide children with teachers that are considered desirable and effective in the art of instruction. There is a grave difference in the qualifications of teachers that have been recruited to guide poor and minority students than that of schools that serve higher income families. In fact, it is not uncommon to have an absence of the more sought after teacher in inner city schools because such teachers are drawn to better paying opportunities and climates not characteristically common in the inner city (Stronge, 2010). Perhaps due to higher requirements in other school systems, new teachers of less than 3 years appear to cycle through the walls of inner city schools more often bringing with them little experience and untested ability to adjust their teaching styles for the varied needs of children found in the classrooms of low SES and minority students.

The lower quality of teachers that at-risk children face has a significantly negative impact on their academic standing (Hattie, 2009; Darling-Hammond, 2004, 2010; Stronge, 2010).

### **Misplaced Degrees**

NCLB mandated that the employment of quality teachers was to be a requirement for districts across the nation. NCLB defined quality teachers as having a bachelor's degree and full state licensure and certification (Davis, 2009). Since that time much has been researched about the impact of teachers having a degree in the actual subject for which is being taught which NCLB fails to address. For example, teachers that are trained in the field are much more effective than others ( $d = .38$ ) (Spark, 2004). Yet, low-income and minority schools are far more likely to have teachers teaching out of field than most predominately white school populations (Darling-Hammonds and Sykes, 2003) and this is not a state specific issue. Among 39 countries, the U.S was 36<sup>th</sup> in its ability to provide qualified teachers in math classes for low-income and minority students. 67% of higher income students were taught by a qualified teacher when compared to 53.2% of minority and lower income students (Akiba, LeTendre, & Scribner, 2007). Placing effective and qualified teachers in classrooms, while no small effort, does make a difference in the academic achievement of students. In fact, doing so consistently, placing quality, effective teachers with children who might most benefit must be an unwavering focus for children of disadvantage to close the academic gap of achievement.

### **Implication**

Parents in lower income families do not always have access to information that details district, school or teacher historic impact to academic achievement. Having such information, parents are empowered to have open discussions about the adequacy of educational resources, specifically the teachers that are placed with their children to provide instruction. Even then, recruiting and retaining effective teachers in less than optimal settings is a challenge. The value of closer examination into the characteristics of teachers who are successful in preparing children of risk would be to recruit teachers, yes, but more importantly in hopes of there being trainable or measureable qualities that can be duplicated to improve the impact of existing staff members. Further, to have children taught by teachers that fear

math themselves will need to be overcome by promoting an efficacy in children for mathematics but also a self-efficacy in the teachers who will be leading. Efficacy can be a challenge to pinpoint but it will be necessary to determine teacher needs beyond practices, degrees and certifications. While problems of academia are more profound in minority and low SES settings, children of all economic backgrounds might stand to benefit by learning what characteristics follow those instructors successfully able to teach students in the area of mathematics. Open dialogue about inequalities of education may be a very difficult topic for governmental agencies to broadly address given the history of our nation. Yet, open and honest conversations that seek to resolve wrongs should not only be required but necessary for continued growth of our nation and its children.

### **Conclusion**

Post the Separate but Equal doctrine, the United States still operates institutions of education for its young and most vulnerable populations without achieving equity in the quality of education. Much research acknowledges that many issues outside of the classroom start minorities and low SES students on an even path to lower academic achievement in mathematics. However, we now know that teacher quality has a profound impact on the knowledge that children acquire. In knowing so, methods to increase the likelihood of having quality teachers that have proper backgrounds and proper skills to adjust to the many needs of such populations must be a high priority. Districts must do the hard work to identify which characteristics make effective teachers and seek to attract and hire only those that possess the characteristics thought to be successful. No, life at home for children will not likely change as a result but providing children adequate experience in the classroom in the form of effective instruction can have impact on academic standing. For now, for most in the inner city, that impact is not on the caliber required to compete locally or on a global front.

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