“I’m No Good in Math.” Student Perspectives on Math Struggles and Dropping Out of School

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Washington Student Oral Histories Project

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March 2014

The Washington Student Oral Histories Project
(http://www.wsohp.org)

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Acknowledgments

The project team would like to acknowledge those who have helped us carry out this research. First, we are indebted to the youth who shared their stories with us and from whom we learned so much. Thank you for making this project possible! In addition, we'd like to thank the *Washington State Partnership Council on Juvenile Justice* (Department of Social and Health Services) for providing the seed funding that helped us launch the research. Finally, we would like to acknowledge the following organizations and individuals who have offered guidance and support to this project in so many ways:

Antioch University Seattle
Patricia Linn

Center for Children & Youth Justice
Gina Cumbo Michael Curtis Leila Curtis Rachelle Nesta

Center for Strong Schools (University of Washington Tacoma)
Greg Benner

Cohen Research & Evaluation, LLC
Carolyn Cohen

College Success Foundation
Hilary Loeb

Educational Service District #113
Mike Hickman Dale McDaniel

Goodlad Institute for Educational Renewal (University of Washington)
Thomas Bellamy Laraine Hong Kellie Holden

New Start High School (Highline School District)
Ann Magyar Mike Sita

Office of Superintendent of Public Instruction
Annie Blackledge Dixie Grunefelder Sue Furth Greg Williamson

Paragon Education Network
Sandy Wilkerson

Puget Sound Educational Service District
Kelly Goodsell Hilary Loeb

REACH Center
Brandon Hambrick Kurt Miller

TeamChild
Anne Lee Caroline Tillier

Washington State Partnership Council on Juvenile Justice
Lisa Wolph

Windward High School (Ferndale School District)
Timothy Keigley Kelsey Simpson

YouthCare
Eric Anderson Zach Selke Melinda Giovengo Marissa Tanimura

Individuals
Joyce Bamberger Davis Patterson Del Young

The findings and opinions in this document are solely those of the authors and do not necessarily reflect the views of funders or supporters of the Washington Student Oral Histories Project. For more information on the project, please visit www.wsohp.org.

Introduction

In recent years educators, policy-makers and business leaders have pressed for greater educational focus on and improvement in STEM (Science, Technology, Engineering and Mathematics) disciplines. The federal government, for example funds a number of research and development efforts designed to promote and increase STEM learning at all educational levels. Funders particularly encourage STEM participation and achievement among under-represented groups, such as girls, low income and minority students. These efforts spring in large measure from concerns about the need to bolster our competitive stance in the emerging global economy and the desire to promote economic opportunity among populations that historically have had low rates of participation in these technical disciplines. At the same time, the new Common Core standards seek to develop a more rigorous k-12 math curriculum, one that raises the bar for math learning and achievement (Common Core State Standards Initiative, 2012). Against this backdrop is the reality that a substantial portion of secondary students struggle with more advanced math and fail to develop basic math understanding and computational skills necessary for other STEM disciplines (National Mathematics Advisory Panel, 2008; National Center for Education Statistics, 2013). Upon graduation from high school, many students find they are ill-prepared for college-level math and reading literacy demands. In one study, community colleges reported that a majority of their students had to take developmental math classes that covered basic early high school math concepts and computational skills; only 20 percent of these developmental math students completed a required college level math course. (Bailey, Jeong & Cho, 2010). Although there is disagreement as to how seriously the U.S. lags behind other countries in math performance (Ravitch, 2013), mastery of what are considered to be essential math skills appears elusive for a sizeable percentage of young people (National Center for Education Statistics, 2013).

These concerns raise the question "What can we discover about math learning from struggling, low-achieving students?" To examine this question, this article focuses on math-related learning experiences as seen through the eyes of youth who have dropped out of school. It is based on a study of 53 youth, ages 16-22, who participated in in-depth interviews about their school lives from early elementary school to the present. All participants had either formally dropped out or had been seriously truant, missing large segments of school prior to the interview. During the interview, investigators explored participants' prior and current beliefs about their math abilities, how their beliefs may have been shaped through learning experiences, and how those beliefs, in turn, influenced academic behaviors and outcomes. In addition, the study explored student perceptions of math instruction and how classroom experiences supported or failed to support their learning.

Study Background

The article serves as a companion piece to an earlier study, *Pathways to Dropping Out*, which explored multiple facets of the dropping out process, again, based on in-depth interviews with participants (Feldman, Smith & Waxman, 2013a-c). In the current study, researchers continued to investigate the dropping out process from the youth's perspective; of particular interest was *the role math difficulties played in students' narratives of their disengagement from school.* The decision to focus inquiry on math-related topics emerged from preliminary interview data: After an initial round of interviews was completed in 2012, analyses revealed that the interview narratives contained abundant content related to students' struggles in math. More specifically, math struggles and math failure appeared to play an outsized role in propelling many of these students on a pathway to dropping out.

Research Context

Two bodies of research informed the current study: Literature on student engagement/disengagement and the research related to math and academic mindsets that influence self-efficacy and achievement.

Student Engagement and Disengagement

In recent years, the literature on student engagement has expanded our understanding of factors contributing to alarmingly high dropout rates nationwide. The antecedents leading to dropping out are complex and intertwined, encompassing a range of factors. Pianta and Allen (2008), for example, stress the importance of *classroom factors* in building teacher-student relationships and positively impacting adolescent engagement and motivation in school. Other factors associated with dropping out include *individual and peer group factors* (Flores-Gonzalez, 2002; Lee & Burkam, 2003; Rumberger & Lin, 2008), *family factors* (Bridgeland, Dilulio & Morrison, 2006; National Research Council, 2004); and *school factors* (Bridges et al., 2008; Croninger & Lee, 2001; Kerr & Letgers, 2004; Lee & Burkam).

While research has explored individual student and school characteristics associated with truancy and dropping out, less attention has been paid to analyzing the complex causal factors influencing these student behaviors (Fredricks, Blumenfeld & Paris, 2004; National Research Council, 2003; Tyler & Lofstrom, 2009). Moreover, relatively little research has been devoted to studying dropout behavior from the student's point of view. The limited research that has tapped student opinion has largely relied on structured surveys and focus group discussion, with the latter approach mostly involving younger students still in school. (See, for example, the studies by Bridgeland et al., 2006; Bridges et al.; 2008; Rotermund, 2007; and Schmakel, 2008).

Definitions of student engagement and disengagement abound (National Center for School Engagement, 2006; Fredericks, Blumenfeld & Paris, 2004, Lawson & Lawson, 2013). Some tend to emphasize cognitive factors relating to the student's motivation, interest and persistence at school. Other definitions focus more on the emotional reaction the student has to learning or being in school. Does the student feel excited, sad, anxious or indifferent? Still others use behavioral measures, such as compliance with school rules, attendance or completing assignments. Fredericks et al. (2004) argue that school engagement should encompass all three dimensions: cognitive, emotional and behavioral, whereas Lawson & Lawson (2013) conceptualize engagement as a dynamic, synergistic process that should consider a youth's behavior within a broader socio-cultural ecology, encompassing school, family and community domains.

Math and Academic Mindsets

Educational researchers and practitioners in the field have long recognized that the student's *academic mindset* is an important factor in student motivation, engagement and achievement (Dweck, 2000, National Mathematics Advisory Panel, 2008). Academic mindset refers to the collection of student beliefs, attitudes and perceptions about learning, their abilities, and about school. A substantial body of research suggests that the student's mindset can have measureable positive or negative effects on their motivation to learn, the intellectual effort they invest in learning tasks and, ultimately, their learning outcomes (Dweck, 2000; Farrington et al., 2012). Here are some examples of contrasting mindsets:

Utility/Importance of learning	
This school work has/will have value.	This school work is meaningless/has no value.
Self efficacy	
I am/can be successful at this task.	I am not/can't be successful at this task.
Beliefs about intelligence (Theory of Intelligence)	
If I put in the effort, I'll increase my abilities.	I'm not smart enough to do this work.

Dweck points to two opposing views of intelligence: *fixed*, where ability is seen as innate and unchanging; and *dynamic*, where ability is viewed as a quality that can change and grow with effort. Dweck argues that students who attribute school success to innate (fixed) intelligence, instead of to effort, are more likely to shrink from new learning challenges (2000, 2006). However, students' concepts of intelligence are malleable; student-teacher interactions can influence students' beliefs about their abilities, including math abilities, in either direction (Dweck, 2006, Rattan, Good & Dweck, 2012).

A closely related concept is *self-efficacy*, which concerns an individual's perceptions of his/her ability to learn and perform (Bandura, 1997, Schunk & Meese, 2006). Research has linked students' math self-efficacy beliefs to motivational levels, effort and academic performance: Those who see themselves as capable learners are more likely to engage in learning challenges, expend more effort and develop the skills necessary to perform well on homework and tests (Kitsantas, Cheema and Ware, 2011, National Mathematics Advisory Panel, 2008). Conversely, those who do not see themselves as capable in a specific task area are less likely to engage in related learning tasks, less likely to persist when facing a challenge and therefore, less likely to develop the skills needed to succeed in academic tasks, including math-related learning tasks. Notions of self-efficacy vary with task area and setting; a student can feel highly capable in language arts and science and still maintain low self-efficacy in math.

Study Methods

In order to maximize the potential for candid conversations with a variety of youth, we recruited and interviewed young people, ages 16-22, at five youth-serving organizations in King, Pierce, Mason and Whatcom Counties.[1] With the assistance of these partnering agencies, our team of three conducted in-depth, face-to-face interviews with a diverse set of 53 youth volunteers who had dropped out or had a history of serious truancy. We used a semi-structured interview protocol that focused on the youth's school experiences and their perceptions of how they came to leave school. This narrative approach allowed us to capture detailed portraits of these struggling students' lives over time—a novel research approach to exploring the student disengagement process. After completing interviews, we used sophisticated data analysis software[2] to code and analyze the digitally recorded and transcribed interviews.

[1] The study utilized a site-based sampling method in which sites offering services to out-of-school youth and young adults assisted in outreach to and recruitment of youth meeting the study criteria. The five sites served youth with diverse characteristics and backgrounds. Please see the separate Technical Appendix for more information on the study's methodology (available from the Washington Student Oral Histories Project www.wsohp.org).

[2] We used Dedoose, a web-based application that allowed for close collaboration among team members.

Study Definition of "Dropped Out"

Since the measurement focus at the national and state levels has shifted to reporting whether a student has graduated "on time," there is relatively little guidance in policy or in the research literature as to how best to define "dropping out." For this study, we considered anyone who elected to stay out of school for more than a month to have "dropped out." This definition allowed us to have a chronological anchor for exploring the dropping out process with different groups of youth, including those who dropped out permanently, as well as those who dropped out and then elected to return to an alternative learning setting after varying lengths of time away from school.

Participants

This is an exploratory study based on a non-random sample of youth who elected to participate when presented with the opportunity. In order to increase participant diversity, we limited the number of interviews at each site to 15. We conducted between 10 and 15 interviews at four of the sites, but only four interviews at a fifth site, due to recruitment issues at the site. Findings presented represent the youth's *perceptions* of their school experiences and are not generalizable to the larger population of dropouts. The sites did not pressure or require youth to participate; only a percentage of youth at each site participated in the study. Almost all seemed genuinely interested in sharing their stories at length with interviewers, but these stories reflected the perceptions and experiences of those who were self-selected into the study, not all youth participants at the site.

Study Questions

In order to explore study participants' sense of self-efficacy and beliefs about intelligence, we asked them to share with us any learning challenges they remembered, how they dealt with those challenges and how they felt about their math and reading abilities at different stages of their schooling. We also investigated whether their ability beliefs had changed over time and how they currently felt about learning math. In addition, we posed a series of open-ended questions designed to elicit perceptions of their *math learning contexts*, particularly in middle and early high school when math achievement typically drops dramatically (National Advisory Panel, 2008; National Center for Education Statistics, 2013). Questions included:

Why did you enjoy/dislike your math class?

What did you do when you didn't understand something in class?

What helped you feel successful in math?

At the time you had these problems with math, what do you think might have helped you?

In response to these inquiries, the overwhelming majority described math as the subject they most disliked and/or felt the most challenged by. They routinely characterized themselves as less successful learners in math (low self-efficacy). Moreover, their comments demonstrated a decidedly *fixed* view of their abilities with regard to math. The sentiment "I'm no good in math" pervaded their reflections on the subject. The lack of confidence in their abilities and the notion that these abilities were immutable led to substantial motivational barriers for struggling students. This lack of motivation and withdrawal of effort often contributed to a disastrous downward spiral in math performance. Disengagement from math tended to accompany an emerging pattern of disengagement from school, in general.

How did students come to develop such a fear and dislike of math and such a static view of their math abilities? How did their learning contexts shape their mindsets? And, finally, how did these mindsets and learning experiences influence their more general attitudes and behaviors related to school? The reflections of struggling students across time - from early elementary to the present – help elucidate the processes that contributed to their disengagement from math, and, ultimately, their more general disengagement from school.

Elementary School Math Experiences

Over two-thirds (68 percent) of youth we interviewed described themselves as having serious learning challenges involving math at some point in their schooling. As illustrated by the excerpts below, many expressed the sentiment that they had "never been good in math," implying that as far back as they could remember, they had not done well in the subject:

> *I remember when I was younger I just didn't think I was good in math. I just didn't think I could do it, you know?*
>
> *I've always sucked at math.*
>
> *Math is my worst subject … It's, it's always been my worst subject. No matter how focused I am or how much I try, I just don't get it.*
>
> *I always had in my head, "I'm not gonna do math. I don't like math. I'm never going to [get] math."*

Interestingly, however, of this group, less than a third recalled any *specific math difficulties* in elementary school. Most characterized elementary school work, in general, as "easy" and some (who would later struggle with math) even recalled enjoying performing basic arithmetic operations during their early school years.

Early Math Mindsets: A Contradictory Picture

From the perspective of participants, a somewhat contradictory picture emerges of early mindsets: On the one hand, many conveyed that they had "always" been terrible in math, yet in elementary school the majority did not portray themselves as incompetent math learners. In response to the question, *"Do you remember how you felt about your abilities to do reading, math and other assignments?"* or "*How were you doing academically at this time?"* most participants, including those with obvious learning challenges, thought their math capabilities during elementary school were at an acceptable level; as a group, they were more likely to recall having specific problems at this stage in reading, writing or spelling, rather than with math. These memories may have been softened by the fact that individual supports often seemed to be available to struggling elementary students, so they did not feel like they were facing their problems alone. In the same breath that they discussed their general learning problems, a number of students also recollected their elementary school teachers or tutors providing one-on-one help in math and reading when they needed this support, which then allowed them to progress.

Another potential explanation is that during elementary school, participants may have developed math-related conceptual gaps and errors or skills deficits, of which they were not fully cognizant at the time. Because so many of those who claimed to do well, or at least adequately, in elementary school subsequently floundered in middle school math classes, we suspect that a higher percentage of participants may have faced some early math difficulties that left them

unprepared for the more advanced math required in secondary schools.

A relatively small number of youth participants (about 20 percent) remembered specific math-related experiences in elementary school that (they felt) shaped their views, both positive and negative, around their math abilities. These experiences revolved primarily around making ability comparisons with their peers regarding the rapidity with which they mastered math facts and operations. Those few with a retrospectively *positive view* tended to recall how they were "always good in math," learning arithmetic operations easily, finishing their work quickly, or helping others with math challenges. This small subgroup who labeled themselves as "pro-math" was comprised almost entirely (but not exclusively) of participants who retained a positive view of math throughout their entire schooling and into the present.

> *[In elementary school] I just liked math because I have always been really good at it. The teacher made it fun by making it hands-on with stuff.*

> *[My favorite subjects were] reading and math. When I got math, I was just so happy I could do it. A lot of people were asking me for help, and I liked that.*

Ability comparison between oneself and one's peers emerges as a common social behavior in early elementary school, but the motivation for making comparisons shifts over time (Dijkstra, Kuyper, Werf, Buunk, & Zee, 2008). In primary years the child's motivation for the comparison is often geared towards gaining information and mastery. (How did she draw that tree so well?) However, by 4th or 5th grade, children are largely interested in making comparisons in order to self-evaluate and make judgments about how well they perform compared to peers. These judgments can then inform their self-concept as a learner (Dijkstra et al.). For the majority of youth we interviewed, the comparisons they made were decidedly unfavorable, and as the next section describes, contributed to the emergence of a negative and fixed mindset about math.

Emergence of Fixed Mindsets

Those with a retrospectively *negative view* of their early math abilities recalled being "slow" to catch on to new concepts. They were mystified by fractions and decimals or stymied by timed tests of multiplication tables. Occasionally, they remembered becoming frustrated, discouraged or angry:

> *I'd get mad and just not do [a math assignment], just throw it away, I would get so mad because I couldn't figure it out because … I'd count too much and lose track or it just wouldn't make sense to me.*

> *I felt like I was working hard [on math], but at the same time it felt like I wasn't fully understanding … [I wasn't] processing things that the other students would get before me, like a week before me. And I'd feel like I just got left behind, and there's no point in continuing.*

Because of their more public and concrete nature, timed multiplication tests, in particular, seemed to invite unwelcome comparisons. As the excerpt below illustrates, those who struggled to develop this skill interpreted the timed tests as clear evidence that they were not as smart or capable as their peers were in this subject—that they were simply "no good in math."

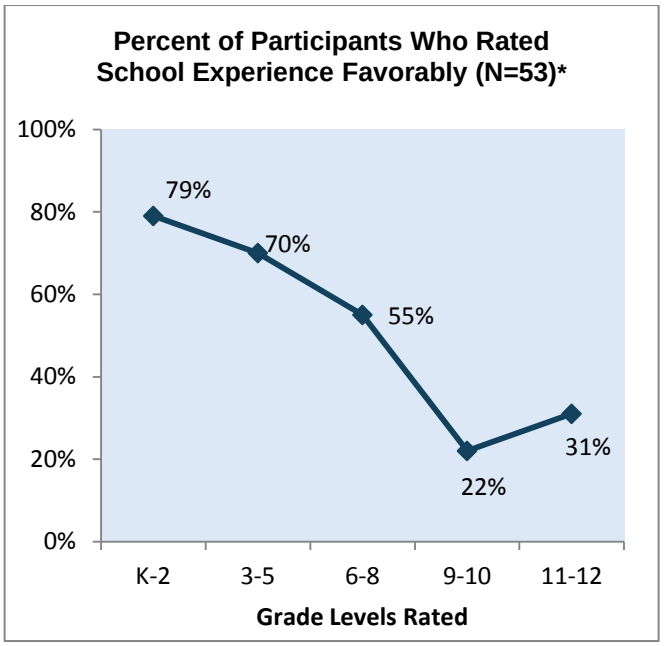
> *…We used to have these time sheets… 1 times 5, 2 times [5], you know, and they used to have this little [competition] where everybody was on a … different times table. I got*

stuck on [the] times table. I was stuck on that a good six, seven months. Everybody went past me, so I knew then that [math] wasn't ... a good fit [for me].

Elementary School Learning Contexts

Compared with middle school, participants recalled few specific learning activities and assignments in elementary school. The experiences they remembered with some specificity mostly related to creative or hands-on activities, such as art or drama projects; they also frequently recalled games and recess time with friends. As mentioned earlier, a few remembered liking or not liking certain aspects of math, but most said they had no memory of what they actually learned or tried to learn across all elementary grades. Thus, their narratives tell us relatively little about how they experienced math instruction in these early years.

While they could not recall many particulars about math or other more academic subjects, participants were able to describe their feelings about elementary school learning contexts, *in general*. These recollections were overwhelmingly positive. For example, using a colorful and easy-to-understand rating chart, we asked youth retrospectively to rate their overall experience of school across different time periods. Youth generally had few problems providing a global rating on a five-point favorability scale for each of the time periods they attended school. About 79 percent of participants assigned a favorable rating (a "4" or a "5") to their early elementary years (k-2nd grade); 70 percent gave favorable ratings to their late elementary years (3rd-5th grade). As the chart below shows, the group's views on middle and high school were decidedly less positive.



* Favorable ratings defined as a "4" or a "5" on five-point scale.

(Note: N=49 for *9th-10th* and 35 for *11th-12th due to youth dropping out*.) [3]

[3] The ratings for high school time periods only include those youth who were still in school; those who said the time period was not applicable to them were excluded from the count. Ratings for grades 11-12 rise due to students who dropped out, then re-entered an alternative program they liked.

Their global attitudes toward early and late elementary school are somewhat surprising, given the general problems with and disaffection towards school that participants experienced later on. The top reasons they cited for their earlier positive feelings included:

- Enjoyment of elementary classroom activities (being in school and learning was "fun").
- Positive interactions with peers inside and outside the classroom
- Positive feelings towards elementary teachers

The importance of having a social connection to teachers surfaced as a central theme in our discussions with youth. When interviewees were encouraged to discuss their classroom learning experiences at the elementary level, they frequently focused on their relationships with teachers, as opposed to instructional methods, instructional styles, or curriculum activities. Positive feelings toward their K-5 teachers abounded; here are some representative responses to our questions about why they liked their elementary teachers:

> *[The teacher] kind of felt like another mom to me, at the time. She was really, like, willing to help a lot with the other students, as well.*
>
> *She was equally just really, really nice to everybody, not just to one student or to a group of students. She really treated everybody the same.*
>
> *[The teachers] were nice; they were positive, like, really positive. They cared about us.*
>
> *She was just so friendly…. She was just a lovable person to be around and you can talk to her about anything. She was really sweet.*

Students who recalled struggling early on in math (or in other subjects) mostly felt supported by their elementary teachers. They especially noted the *one-on-one attention* they received from either teachers or tutors as being helpful when they faced a learning challenge. For example, one student recalled having a very frustrating time understanding math in early elementary school, but then proceeded immediately to describe the fun math games she played with a tutor, an experience which allowed her to progress, she felt.

> ***Interviewer:*** *So, you mentioned you received some assistance or some support for math … what was that like?*
>
> ***Participant:*** *That was fun; I actually enjoyed that because she'd make games out of it when we did the math stuff. It was all math, but, in a way, she made it fun with games and prizes and everything. [The tutoring] seemed to work for the most part, I think.*

These kinds of positive interactions with teachers are significant because they can strongly influence student engagement in learning and commitment to school in a positive direction (Croninger & Lee, 2001; Farrington et al., 2012, Pianta & Allen, 2008). However, as will be illustrated later with regard to participants' middle and early high school math experiences, the reverse corollary is also true: When positive personal connections to teachers are absent, student motivation, engagement and performance in school suffer.

Middle and Early High School Math: The Great Tripwire

Of the more than two-thirds of participants with significant math learning issues, most reported

the full emergence of these issues during middle school, or in a few cases, early high school. Participants frequently portrayed themselves as “unprepared” for the academic demands placed on them as they transitioned into middle or early high school. As described in an earlier analysis of participant interviews, “It got hard” was a common refrain regarding middle school academics, in general (Feldman et al., 2013b). Students who had managed to get through elementary school without experiencing a lot of difficulty suddenly confronted assignments that required more consistent effort, time management skills and independent work. Many admitted that they had not developed the necessary academic behaviors, like paying attention and completing homework that now were required of them. Others felt that they were not academically ready or did not have the requisite skill sets to tackle more advanced coursework.

This current analysis revealed that math, in particular, was the subject that distressed participants the most during middle school and early high school. Of all the skill areas and coursework discussed during the interview, math cropped up as an issue more frequently than all other subject areas combined; from the viewpoint of participants, middle school math (especially algebra) functioned as an academic tripwire over which the majority of interviewees seriously stumbled and frequently never regained their footing. Even a few students who felt they had previously done well in math and had enjoyed math during elementary school now found themselves floundering, falling behind and failing math classes. These later math experiences were often highly aversive, according to participants, and served to solidify a fatalistic view of their intellectual capabilities vis-a-vis math. Running throughout their conversations about math teaching and learning were the thematic threads of low-self efficacy and fixed abilities:

> *I know with math – I didn't really notice math [problems] until probably middle school, maybe. In middle school I just knew that I didn't like it, and I could never do it. ..I was trying to avoid [math] as much as possible. ..With writing and reading and all that other stuff, I could do just fine. It was just math. Just math was really difficult for me.*

What accounts for this surge of negative feelings towards math and accompanying sense of low self-efficacy? Participants’ narratives revealed several explanatory themes, including:

- Relationships with Teachers
- Instructional Practices
- Struggles with Algebra
- A Math Gender Gap

The remainder of this section briefly examines each of these themes.

Relationships with Teachers

Elementary school teachers, for the most part had been perceived as warm, caring and supportive. Middle and high school teachers, by contrast, were commonly perceived to be distant figures who had to contend with too many students and who could not or would not offer more individualized support to those who needed it. When participants entered middle school, they generally experienced a marked decline in positive personal connections with their teachers.

The teachers were not really enthused about their job. They kinda, pretty much – they hated their job… Most teachers I had were kinda mean in middle school.

[In middle school] I did not care because that's how I felt the teachers were. I was like, well, this teacher doesn't care about me learning. Why should I care about myself learning?

The teachers were kinda grumpy… I didn't like most of the teachers at that school.

In math classes, this lack of personal connection to teachers appeared to be particularly problematic for struggling students. The perceived lack of teacher interest and caring led participants to avoid interacting with the teacher because they were uncertain of the teacher's response. If they had not followed the teacher's explanation, would the teacher help them or become irritated with them for their failure to understand? Thus, when students were confused by a math lesson, many were reluctant to ask for help. Here is a participant speaking about doing poorly in Algebra II after previously having done well in Algebra I:

The teacher had his own method and if you didn't understand it, then you just didn't understand it…I didn't want to say anything because he would be like "what don't you get?" And I would be like "everything." I could tell he already had this attitude, so I didn't bother.

The failure to seek help, often combined with other non-productive behaviors (failure to do homework, pay attention, or attend class regularly) predictably resulted in the student falling further and further behind, failing tests and, ultimately, as in the case cited directly above, failing the class and having to repeat it.

Moreover, the lack of positive connections to the teacher may have had the tendency to suppress engagement with learning tasks and increase students' suspicions that the teacher did not value them or feel they were capable enough to do the work. For example, one student who struggled with both math and reading was convinced that teachers did not want to help students like him because he was not a "good" student:

So I felt like the star students in high school got engaged more by the teachers and all the kids like me, you know, [we] sometimes show up late or goof around in class. I just wouldn't get the help that I needed… the kids that really did their work, they got more help.

When students who struggled in math encountered a teacher with whom they had a rapport, the positive connection sometimes made an enormous difference in their sense of self-efficacy and engagement in learning tasks. For example, a participant (who had been a good student through ninth grade) had failed math in 10th grade because, in part, she could not follow the teacher's explanations, but felt too intimidated and embarrassed to ask for help. Upon transferring to an alternative school setting the next year, she found teachers, in general, and the math teacher, in particular, more approachable:

I like all the teachers (here). If you don't understand something, you can just go and ask them for help. [Before, at the old school] I was always like, oh, no, I can't do [math]. It's too hard. But now that I see [I can do it] and I actually try… right now, [math is] not bad.

Instructional Practices

Previous student-centered studies have found that many students who drop out claimed they were "bored" and "turned off" by their classroom experience (Bridges et al., 2006; Bridgeland, Dilulio & Morison, 2008). A similar theme also emerged in our interviews: Upon leaving elementary school, participants no longer found their classes "fun," interesting, or relevant; math frequently popped up in their discussions of negative teaching and learning experiences. To discover more about their math classroom experiences, we asked participants specific questions about their math teachers' instructional approaches and the perceived effectiveness of these approaches. We also probed for any recollections of positive math learning experiences and the instructional activities connected with those experiences. The following trends emerged from our analysis:

- *Math teachers relied too heavily on lecture-style instruction:* Frequently, math classes followed this format: The teacher would demonstrate and talk through an algorithm then assign problems for students to do. There was no "guided practice" or group work, just "I do" and "you do." The teacher went around and individually helped students, usually by re-demonstrating how to do the problem. Rightly or wrongly, students often interpreted this direct instruction approach to mean that they should "get it" the first time around and that if they did not understand they were largely on their own, as captured by the quote below:

  And the other thing was they just teach, like, whatever we're learning, they teach it once and then you just have to do it by yourself or figure it out, how to do it, right? So I didn't like that...

- *Math course content seemed disconnected from students' lives:* Students routinely complained that they could not see the relevance to their lives of many different subjects, not just math. They felt no connection between what they were being asked to learn and why it might be important later. When a task was "boring" or difficult, they therefore could not see a larger purpose that would make it worthwhile to persevere and complete it. With math, the complaint about non-relevance was most narrowly aimed at algebra.

- *A one-size fits all sequence and pace of instruction appeared to leave students behind*: The generic sequencing and pacing of math lessons, in particular, created conditions to discourage engagement. Students who did not have the necessary background knowledge, missed part of an instructional sequence, or simply needed more time to process new learning fell off a moving instructional train that did not stop for them. They might continue to attend class for quite a while, but not really understand the material. Under these conditions, it was easy for students to feel bored, frustrated, or angry. Many also said that they felt "stupid" when they saw that other students seemed to be "getting it" and they did not.

A major issue for students was getting sufficient instructional support in middle and high school levels in order to understand and complete math work in class or at home. Particularly those students who had learning challenges lamented the lack of differentiated teaching and learning opportunities in their classes. They most frequently described their difficulties and subsequent disengagement in conjunction with math. Sometimes students directly connected the size of the class to lack of individual attention. ("*The teacher was too busy to help me."*) But many also portrayed the teacher as unable/unwilling to differentiate or to adapt their standard approaches and explanations in response to the student's individual needs. They would ask a question and the teacher would repeat the same explanation, direct them to reading material, or ask them to

ask another student. The latter was often not an effective approach because a fellow student might not be willing or able to help:

> *The teacher just didn't understand how everybody's not on the same level… I was listening and everything, but I just wanted her to say [the explanation] again or something, just so I could get it into my brain, and she just wouldn't say for nothing. Why wouldn't she say it? I just needed to understand. She's telling me to ask somebody next to me. That person is not telling me.*

When struggling students received more individualized attention, and were allowed to take the time they needed, it sometimes made a huge difference in their sense of self-efficacy, motivation, and effort. Here is one student's description of a favorite teacher and class in middle school, in which she did well, in contrast to her other classes:

> *The teacher actually, like, took her time. You know, she wasn't one of the teachers that got irritated by your hand being raised or by questions and stuff. Like, she didn't mind repeating herself.*

Another seriously truant student described the enormous difference it made in her academic performance when she transferred to an alternative educational setting where she received individual attention. She had previously had particular difficulties passing math and science classes

> *Then I came here and the smaller class sizes were more attentive. It just made me focus and made me realize I have potential, and I can use it [to pass geometry]...So, I started to [do the work] and I've done things that I thought I'd never be able to do. I've passed all my classes almost every single session I've been here. That's something that I've never ever been able to do.*

Struggles with Algebra

Across middle and early high school years, algebra, in particular, posed problems for participants; many were challenged by its more abstract nature and often questioned the relevance of the subject to their future lives. A substantial number recalled failing algebra and having to repeat the class. Below are some illustrative interview excerpts:

> *[In seventh grade] starting to learn algebra…it was like I was thrown into a whole other dimension of math. I had to do a study group. I had to get all this extra help from my mom and my brother and I was still [struggling]… I was getting B's and C's on tests…And I was getting upset because I couldn't try any harder.*

> *Math was easy for me. It didn't get hard till I hit high school. That's when I got introduced to algebra.*

Other interviewees, now in their late teens or early twenties recalled their sense of puzzlement as young teens over the presence of letters within an algebraic expression or equation:

> *I would say algebra [in 9th grade] was really where it [became a problem for me] because it would be like, "Y [equals] this and this," and I'm just, like, "Whoa, like, what is <u>that</u>?"*

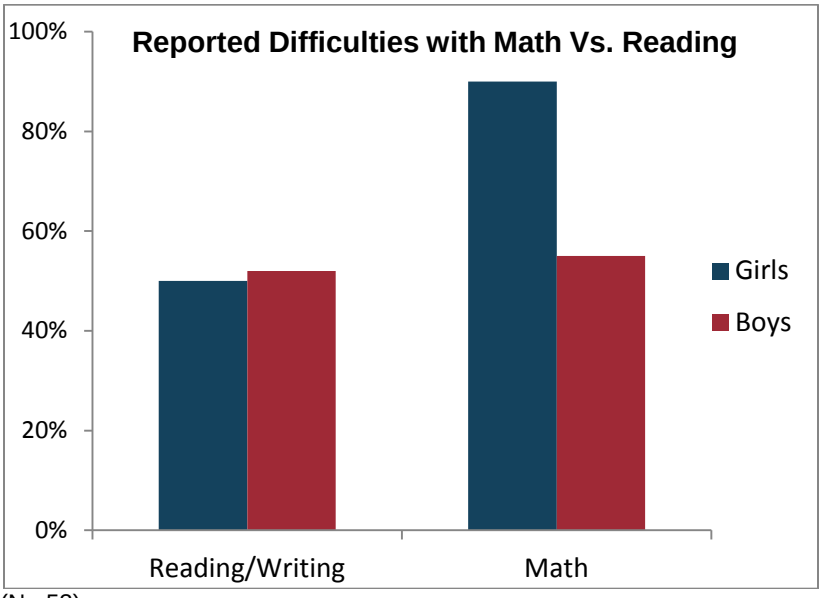
The material [in 7th grade math] got a lot harder because it went from multiplication to, "Oh, now you [the student] have [to learn] x… x times three equals…" You know?

I can't do algebra, but you give me geometry and I [can] do that… I don't know what it is [about algebra]. It's just the letters that mess me up. I was, like, "Screw it. I don't need that."

The fact that so many of these students struggled with and failed algebra is not surprising. Others have noted the difficulties this particular course poses to a broad swath of students nationwide, and have recommended both curriculum and instructional reforms (National Mathematics Advisory Panel, 2008; Kilpatrick & Quinn, 2009).

Math Gender Gap

A larger portion of participants associated serious learning difficulties with math (68 percent) than with reading and/or writing (51 percent). However, as shown below, reported learning problems in math were not equally distributed across male and female participants. Gender comparisons reveal that *90 percent of female participants* described having serious problems with math. In comparison, only 55 percent of male participants discussed serious math issues.



(N= 53)

No such gender difference emerged among participants with regard to reading/writing problems. Research has found that for the student population as a whole, girls generally present a lower self-efficacy profile than boys. However, girls' actual math performance on achievement tests generally matches that of boys (Kitsantas, Cheema and Ware, 2011; National Center for Education Statistics, 2013). In other words, the gender differences are largely one of mindset, not ability. Such differences in mindset might explain the enormous "gender gap" evidenced in this study of out-of–school youth, as well, given that a number of female participants indicated that they later developed improved math capabilities after dropping out and returning to a new educational setting.

Math Homework Issues

In middle and high school, homework becomes an increasingly important element of the curriculum; regularly nightly homework assignments are common, particularly in math. Failing to complete and turn in homework assignments typically results in a lowered grade. One purpose of regular homework assignments is to help students learn and expand self-regulatory skills in pursing academic tasks independently (Zimmerman & Kitsantas, 2005). Another purpose is to provide students with opportunities to practice what they have learned in class in order to solidify their understanding and increase their problem-solving skills (National Mathematics Advisory Panel, 2008).

As reported elsewhere, one of the early behavioral signed of disengagement from school is failure to complete and turn in assignments (Balfanz, Herzog & Mac Iver, 2007). Among study participants, an unwillingness or inability to do homework was a common theme. As first reported in the *Pathways* study, some participants described their problems completing assignments as a long-standing issue. They felt they had developed poor homework habits early in elementary school when their incomplete work seemed to carry no consequences. Even later in middle school, some reported feeling like they could "get away" with not doing homework on time; they might turn in the missing work late or not at all and still pass.

> *Elementary school--that's when I formed the habit of not doing my homework [but still] doing well on tests. I'd just do it late or something ... I remember in 6th grade, if we didn't do our math assignment, while they were in the class grading it, we were out in the hall finishing it.*

However, usually by late middle school this pattern of sporadic completion of assignments led to academic difficulties in general, but especially in math.

> *I think math is the only [subject I failed] - eighth grade math. It was pre-algebra, but it was because I wasn't doing my homework and turning it in. I don't know why. I just didn't.*

Another theme related to homework was students' perceived *inability to do the assigned work independently*. Participants did not understand lessons fully enough and then could not apply their partial understanding to subsequent homework assignments.

> *[In explaining a failing math grade in middle school] I think it was the homework part, [having to do] the homework and then having to bring it back in… By the time that I got home and I was ready to do my homework, that class period was already fading away, and I was forgetting how to do things.*

For these participants, homework did not represent a chance to practice newly learned skills because they had not adequately understood the concepts or procedures they were supposed to practice. Moreover, many likely did not have ready access to parental assistance or other resources to support homework practice and completion: Most came from single parent homes in which the parent worked; others had parents with limited English or limited education levels. Almost all faced one or more personal or family-related issues that impacted their home life, such as parental neglect/abuse, family conflict, housing instability or responsibility for younger siblings.

Students entered a punishing cycle of not really grasping fundamental concepts, not practicing and improving skills and understanding, feeling overwhelmed, and failing. Several participants explicitly linked math homework experiences in middle or early high school to increased frustration, low self-efficacy and poor academic performance and/or course failure, as captured in the excerpt below:

> *I was really horrible at math because...that took homework, so I just failed math. Then I was very discouraged every time I failed, so it was really hard to get me motivated.*

These findings resonate with research suggesting that math homework may actually *decrease math self-efficacy and achievement* for students who need some extra support, but who have more limited access to homework support resources, such after-school tutoring, parental assistance or a quiet place in which to do homework (Kitsantas et al., 2011).

The Downward Spiral

Once participants experienced ongoing math learning challenges in middle or early high school, virtually all eventually embraced a fixed mindset regarding their math abilities and developed a fatalistic attitude towards the subject. When faced with new intellectual challenges, they routinely withdrew, rather increased their intellectual effort. When they did not grasp a concept covered in class or in the text, they often sought to hide their lack of understanding from the teacher and other students, not wishing to be seen as "stupid." In contrast with more confident peers, when these students felt lost, they did not ask for help from the teacher. Or, if they did ask for help and did not understand the teacher's initial explanation, they often would not persist, assuming that the teacher a) would not want to help them or b) would not be able to help them. In short, they became such unconfident math learners that they did not want to risk engaging in learning tasks.

Math and Losing Confidence

Contrast the sharply different responses to a math challenge by a confident vs. an unconfident math learner in the excerpts below. The first represents the approach of one of the few study participants who continued to enjoy math into the present and who assumed that his efforts to learn unfamiliar material would pay off. He describes his response as a mid-year transfer student to being put into a geometry class for the first time:

> *When I … encountered geometry, that was difficult at first. I was like, " Okay…now we're doing shapes with math? Hold on, what's going on?" Because I was just thrown into the class. Like I just – I just showed up at the [new] school … I hadn't did geometry yet, so... I was like, "Well, I'm good at math, anyway, so I'll probably figure this out." It took me about a month to actually catch on, but after that it was just smooth sailing. .. I just asked for help. "I don't know how to do this, can you show me?"*

In contrast, the example below is from a student whose low sense of self-efficacy in math and subsequent avoidance behaviors was far more typical of participants:

> *[If I was presented with something challenging in math] I'd try to get as far away from it as possible. I'd try to be in the back [of the classroom], tried to be the last one to be picked. I'd … just kind of diddle around [with a classroom assignment], not do it at all and wait till time ran out, until it was time to go.*

In addition to backing away from new and challenging work, participants who were caught up in negative thinking about their math abilities commonly responded to math difficulties by:

1. Tuning out in class
2. Ignoring homework assignments
3. Skipping class.

These avoidance strategies only made matters worse for struggling students who, over time, fell further and further behind in math comprehension and demonstrable skills. Once caught in this downward spiral, students typically experienced course failure, which only served to further confirm their notions about their "fixed" math abilities. The excerpts below capture the sense of hopelessness and accompanying lack of effort, once they got caught up in this downward vortex:

> *My junior year I was in this math class, and I don't even know who the teacher was because I was just not there at all. I would go sit down, take out my granola bar, put my headphones on and just read or write, and that's all I did, was just read or write. And the teacher would come by and put some math in front of me and I would just be like, "I'm cool," and just not do <u>any</u> of it.*

Interestingly, the many participants who struggled with math in middle and high school tended to fall into two groups. One group portrayed themselves as rapidly retreating from exerting any real effort in math and failing early on. They tended to emphasize their own poor choices in not trying harder, not paying attention, and not doing homework. In hindsight, they often saw their downward spiral in math as an inevitable result of their failure to persist. However, another sub-group of participants described their negative attitudes toward math solidifying over time in part *because they had put forth effort* initially or at various points in time, yet continued to not understand and not do well in math classes. The excerpt below typifies the sentiments of this subset of students who felt that their unsuccessful attempts to learn challenging new material further lowered their sense of self-efficacy and, ultimately, their interest in trying to learn.

> *I would say [during early high school] math was, like, really the only thing that bothered me. It started to really frustrate me because I would be… [doing the work and] coming to math, and my grades were so bad. .. I would really, really try, like I would try my hardest and I would still mess up, like half a test or so.*

The entanglement of effort with low self-efficacy reported by some participants resonates with prior research, which has found that persistence alone may not pay off: persistence must be "productive," accompanied by a sense of mastery; one of the most important sources of positive self efficacy is successful mastery experience (Usher & Pajares, 2006). Research suggests that students who spend significant amounts of time on mathematics assignments without developing a sufficient sense of mastery *will experience lower self-efficacy* (Kitsantas, Cheema & Ware, 2011).

Those who claimed to persist and be further disappointed by their math outcomes often admitted that their efforts were not necessarily consistent. They might already be periodically skipping math class, not keeping up with assignments, or tuning out in class, so when they attempted to apply themselves, their efforts, not surprisingly, did not yield positive results. In

other classes they might be able to "catch up" on reading or writing assignments they had missed. Math, however, tends to be taught in a sequential manner, requiring an understanding of foundational concepts and procedures in order to progress. These participants seemed to believe that their periodic bursts of effort ought to have paid off, even though they were missing critical parts of a math learning sequence. They took their inability to catch up (the way they sometimes did in other classes) as further evidence of their low capabilities in math.

Math and Skipping School

During the interviews, we probed participants about how they started down a pathway to truancy and dropping out. As documented in a previous WSOHP report , most participants followed a common pattern, beginning with *signs of early disengagement* (most often in middle school), such as not paying attention in class and not completing assignments, then progressing to *limited and sporadic skipping*, followed by more *serious and persistent truancy* (Feldman, et al. 2013a). Youth participants described a myriad of factors contributing to their early and later disengagement from school, including *personal factors* (e.g., addiction, serious family problems), *peer group factors*, and *school factors* (e.g. bullying, social isolation, discipline policies and academic/instructional issues). Typically, multiple issues were at play, influencing participants' decisions to start pulling away from school physically by skipping. (Feldman et al., 2013b).

Among school related factors, participants' math struggles and math anxieties figured prominently in their narratives of early and later phases of disengagement from school. Not only did more than two-thirds of the group report learning difficulties associated with math. From the participants' perspectives, these difficulties seemed to grow and become unconquerable over time. Sitting in math class without understanding, trying to do math homework, taking tests and failing—these kinds of experiences led many to find math too stressful or painful; they sought ways to avoid math altogether.

We asked youth, "When you first started skipping, what classes you were likely to skip?" They replied "math" more frequently than any other subject. The linkage between troubles with math and the inception of truant behavior was quite direct in the minds of at least a quarter of the participants who struggled with the subject:

> *When the math [was] getting into harder stuff, that's when I started going downhill with the math [class], and especially when I [then] started skipping school.*
>
> *What classes [did I start skipping]? I think it was an English class… and then I think it was algebra class. I skipped [algebra] classes [because]…I can't really understand what [that teacher is] talking about.*
>
> *I don't remember me skipping middle school. I remember, like, in high school skipping. I would always skip my math because I just hated math class. … I knew … I was, like, "I don't even want to get to know math."*
>
> *I kept failing math. Everything else was okay, just [not] math. I would never go. I hated math.*

To be clear, the interview data do not suggest that math difficulties *alone* led participants inexorably to serious truancy and dropping out. Most participants described a confluence of factors influencing their school behavior. Commonly, personal or family problems impacted

their emotional, behavioral and cognitive functioning at school and helped to put them on a pathway to dropping out. Negative peer influences also figured prominently in the initiation of or increase in truant behavior. Some saw these non-school factors as overwhelmingly responsible for their subsequent failures in school:

> *I'd say it was late middle school, eighth grade– that's when my problem with attendance started because I had gotten introduced to marijuana. So that's when everything started falling apart right there…*

However, if the student had had some previous learning challenges and was already feeling a little precarious about their math abilities, then they appeared to be more vulnerable to personal and family factors influencing school behavior. If, for example, they felt frustrated and embarrassed by their inability to understand their algebra assignments, it was easier to succumb to peer influences and to skip class. Missing class or tuning out in class only served to further undermine their sense of self-efficacy, motivation, engagement in math learning, and, ultimately, their performance.

Dropping Out

The evidence in this study connecting math failure to the decision to drop out builds on previous research. Studies have consistently found that academic failure is the top reason students give for quitting school (Bridgeland, Dilulio & Morrison, 2006, Rotermund, 2007). In several national surveys, between 35 and 38 percent of school leavers cited academic failure as their prime motivation for leaving (Rotermund, 2007). In our previous study of the dropping out process (Feldman et. al., 2013a), we encountered a number of "*slow faders*" (about 35 percent of the study sample). These were youth who often started having attendance and academic problems in early middle school, but who stayed in school up to their junior or senior year and beyond, hoping to graduate. Slow faders constituted much of the group who said they left *primarily because of academic failure*. They wanted to stay in school, but were not making progress academically and did not have sufficient credits to graduate.

The current study has revealed that course failure in math played a prominent role in shaping students' identities as non-learners; in addition, math failure also appeared to be an influential factor in the decision to be truant and to drop out altogether. Students frequently mentioned having to repeat math classes a second and even a third time, yet still weren't successful. In addition to solidifying a negative mindset about math, the repeated course failures meant that students did not accumulate the credits required to graduate. Although we did not have access to student records to verify credits obtained, analysis of their narratives suggest that close to two-thirds may have been missing high school math credits prior to dropping out. About half of this group (or one-third of the total study sample) reported being between 17 and 19 years old at the time of their first drop-out. In other words, they were "slow faders" who were close to graduation age, but their (often repeated) math failures, along with other course failures, meant they could not graduate with their peers.

Conclusions and Implications

Using in-depth personal narratives, this study explored struggling students' attitudes, perceptions and experiences related to math. Through their stories we learned that more than two-thirds of these truant and dropped-out youth had faced significant math learning issues at some point in their education. Most subscribed to a "fixed" rather than a growth mindset about math; most exhibited low self-efficacy in meeting math challenges. These notions about math

abilities were often formed early on in elementary school and became more solidified over time as students were presented with more challenging work. However, interestingly, most of the students said that despite some problems with math, they still enjoyed elementary school and looked forward to going to class. Typically, students began to encounter substantial difficulties with math in middle school; algebra, in particular, seemed to function as an academic tripwire over which they stumbled and never fully recovered. Students at this stage clearly began to associate math with powerful negative emotions: embarrassment, anger, frustration and hopelessness. By late middle school or early high school, these vulnerable students expected to fail, creating a self-fulfilling prophesy.

Student accounts of their math struggles provided insight into the dynamics of their disengagement process. The major themes to emerge from their stories also suggest ways in which we might more successfully intervene to arrest and reverse this process.

At the Elementary Level:

- Use ongoing formative assessment to carefully track student understanding of foundational concepts and to inform instruction. Many students seemed to have entered middle school unprepared for the math they are expected to do; formative assessment use might help middle level teachers adapt instruction to meet the needs of students who are struggling in math.

- Ensure that every student is sufficiently versed in the basic concepts and skills they will need to progress and be successful in middle school.

- Be aware that ability comparisons start to emerge by late elementary school in ways that can promote a fixed mindset with regard to math, as well as other subjects. Purposefully use language to promote a growth mindset with regard to math learning in order to protect against the "I'm no good in math" syndrome. For example< (Barbara)

- Explicitly prepare older elementary students for the transition to middle school—what they might expect and how to navigate the new environment in which individual help may not always be immediately available during class. For example, students might practice through skits or role playing how to ask for help.

At the Middle School Level

- Work with elementary feeder schools to identify entering students who are likely to need some extra instructional supports; develop support systems based on the needs of entering students and have them in place before the new students enter. For example, ensure that entering students are appropriately matched to a supportive adult advisor who initiates contact, monitors the youth's adjustment over the first few weeks and helps connect the youth to supports as needed.

- Ensure that teachers understand the role that fixed mindsets and low self-efficacy play in undermining effort and performance and are aware of steps they can take promote a growth mindset.

- Explore creative opportunities for engaging low-performing students, especially girls, in math-related activities.

- Promote the use of ongoing classroom-based assessments to pinpoint student misconceptions and knowledge gaps related to foundational concepts (e.g., understanding and working with fractions, decimals and percentages). Use flexible, short-term grouping and regrouping strategies to address common misconceptions.

- Move away from heavy reliance on teacher-centered, direct instructional practices that demonstrate procedures. Best practice research suggests that multiple instructional approaches, including small group work and project-based learning, are more effective.

- Encourage students to seek additional assistance when needed and convey a positive interest in their success. Recognize that students in the grip of an "I'm no good in math" mindset may be especially reluctant to engage in math learning tasks at first; poor academic behaviors such as not listening in class or not doing homework may be a protective strategy.

- Track and analyze student course-taking data to learn in which courses the D's and F's tend to cluster. Of particular interest are the failure rates in Algebra I and II classes. Use this information to engage teachers in discussions about measures they might take to improve student learning in these areas.

- Create greater relevance in the math curriculum to engage more students. Contextualize math instruction by relating concepts and skills being taught to real world problems.

- Positive social connections to teachers contribute to student engagement and learning. Promote teacher practices that contribute to a welcoming, positive atmosphere in the class.

At the High School Level:

- Restructure math curricula to allow students greater flexibility in mastering core concepts and skills at their own pace. Requiring all students within a class to be working on the same material at the same time will automatically penalize students who lag behind.

- Consider alternative grading schema that reward students who have fallen behind when they progress and demonstrate mastery over new material.

- Examine whether homework policies, particularly with regard to grading, may be inadvertently discouraging struggling students. Ensure that struggling students are given the opportunity for guided practice on a new topic before requiring totally independent homework assignments.

- Develop homework supports for students, such as call-in centers, study halls or after school tutoring staffed with teachers, tutors or volunteers that have math expertise matched to the students' needs.

- Investigate ways for career exploration activities to be more tightly integrated with math instructional goals. For example, wok with community partners to develop internships that require the student to apply common business math skills in their work—inventorying, comparing rates of growth, simple data base construction, simple data analysis, etc.

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