

The Math *inquiries* Project

Highlights from Focus Groups Discussions Conducted among Eighth Grade Students, Parents and Algebra Teachers

Background

In 2003, two focus groups were conducted for the Math *inquiries* Project – one among parents of middle school students and one among math teachers. Both groups took place in San Francisco. These groups formed the basis for determining the need and value in forming an organization that focuses on math in middle school and, specifically, on the introduction of algebra into the curriculum.

The *raison d'être* for the Math *inquiries* Project is to examine and develop content to encourage students to keep up with algebra so that their options in colleges and future careers are as broad as possible. Statistics show that students who get lost and left behind when they move from arithmetic, a concrete application of math, to algebra, an abstract form of math, can permanently obscure their academic and career choices later on in life.

In March of 2006, the Math *inquiries* Project conducted another five groups, this time with eighth grade students and teachers. Because of the potential scope of the Math *inquiries* Project, parameters were set for this phase of the research. Research again would be conducted in the Bay Area, among eighth grade girls in March/April, and among boys in May/June.

The focus groups for boys and girls were held separately. Because of the age of the teens, we decided that each gender would be more open and comfortable speaking about math and algebra among themselves. This is very usual practice in qualitative research when we can anticipate differences in the responses to subjects such as skin care, educational topics, sports and athletics, careers, and eating habits. It was proven true in the Math *inquiries* Project groups, as you will see in reading the summaries for girls and for boys.

In addition to 8th grade students, we would also talk to algebra teachers, one group with 8th grade teachers, a second group with 9th and 10th grade math teachers.

In August 2006, we expanded our exploration to Southern California where we conducted two groups, one with middle school teachers, and the other with parents of eighth graders.

The following are highlights from these very enlightening and productive groups.

Highlights

Eighth Grade Girls' Focus Groups

- The subject of math and especially algebra is highly charged emotionally for eighth grade girls. The girls either love it or hate it but no one is neutral in their feelings about it.
 - While a few girls really love math and algebra, most experience a lot of tension, stress, and negative emotions around this subject. They don't "get it."
 - Among those girls who do "get it," they talk about math "clicking," a light bulb turning on. When this happens, they feel a tremendous sense of accomplishment.
 - However, even when positive about math, girls exhibit a self-consciousness and discomfort being in the minority, indicating that there's little positive reinforcement among their peers for being good in math. The norm is not to like it.
- Many of the negative feelings about math relate to the manner in which it is taught and the environment in which the girls study math.
 - Girls are highly social and unlike English and language arts where there is a lot of class participation, math seems to them more of a solitary subject.
 - This is completely contradictory to the way girls are engineered – they like to discuss, interact, build on each other's ideas, and work collaboratively in teams.

- Another quality that girls find extremely important is self-expression, and they feel that math leaves little or no room for this. To most girls math is about set rules and getting the right answer, with no room for opinion or creativity.
- Among those girls who are the most positive, even passionate, about math, they see the application of math beyond the problems they need to solve for class.
 - They use the logic of math to help them analyze and then solve life problems. They can lay out the issues and see the end result they want to achieve.
 - This insight provides a bigger context for studying and becoming proficient in math, one that could be used by teachers and the Math *inquiries* Project to reposition math in the minds of teens.
- Teachers play a key role not only in how girls feel about math but also in how they do in the subject.
 - Because math is a subject with high levels of anxiety, the girls need supportive, encouraging teachers. When girls feel they don't have that, their frustration compounds.
 - Having a teacher who loves math and is excited about it can make all the difference. The girls respond to this positive energy.
 - The girls also talk about teaching situations that bring math alive to them.
 - The use of stories and examples relevant to the teens' lives make math more fun and memorable.
 - Both the girls and the teachers talk about using specific, real life situations that seem to be highly involving for the students.
 - The girls are very knowledgeable about the different learning styles of students and feel they learn better when a teacher uses multiple ways to teach math, including visual, aural, and kinesthetic.
 - Being encouraged to ask questions is critical; otherwise the girls talk about feeling lost both during class and while doing their homework. And they can even feel alone.

"Nobody wants to ask because they think everyone gets it."
 - Clearly, there is an opportunity for a "case study" approach to teaching math. Both students and teachers express a desire for it.

- Surprisingly, or maybe not so surprisingly, girls who attend public school mirror many of the frustrations and problems discussed among the teachers in their focus groups. The requirements placed on teachers to teach “for the test” result in a pressure-cooker type classroom situation for students and teachers. Both discussed the following points with similar zeal:
 - Teachers move really fast ... and from the teachers’ point of view, class periods are too short so they have to move quickly.
 - If one day is missed, a whole subject area is missed.
 - Two tests a week ... highly stressful.
 - A really set agenda ... no room for creativity or real life examples.
 - Not enough explanation ... also a time factor.

- Eighth grade girls are very sophisticated in their thinking and ability to see the big picture.
 - Even though shopping is one of their favorite activities, they acknowledge that intangibles are more important to them. It is not the materialistic but family and friends, dogs, self-expression and creativity that are important.
 - They are not just thinking about the immediate, like going into high school, but are already projecting past college to careers.
 - From the groups with both girls and teachers, this is an untapped opportunity for showing the connection between math (and algebra in particular) and interesting, fun, lucrative careers.
 - The girls know that math leads to careers in science and technology, but their view of other careers that use math is very limited.

- There is no wonder that math is often perceived as having a bad reputation. There is evidence that this negative reputation comes from mixed messages. These are for the most part negative and fear based – from their parents, teachers, and the media.

“My parents tell me that if I don’t understand my math class right now then I need to get on it because it’s not going to get any simpler in the future.”

“You have to learn it or else you are not going to make it in the world.”

"It's kind of in the media that nobody likes math – it's not presented as a really good subject."

"If you don't learn it now and you think it's not a big deal because you are moving on to something else, it's going to come back and make you screw up."

"My math teacher says we will never use this in real life but I think it is the ability to think in an abstract way that will be used in everyday life even if the equations are not."

- When the messages are more positive, it changes girls' relationship with math.

"It relates to our life in the future, to know about interest and refinancing your houses, balancing checkbooks."

"Our Algebra teacher is always telling us to pay attention really, really closely because everything is going to help us later on in life."

"My mother says that everything you learn prepares you for the next step, and some of the higher steps prepare you for what you can do in life."

Eighth Grade Boys' Focus Groups

- When it comes to math and algebra, boys seem less emotionally charged about these subjects than the girls. Not that all boys like math, but they seem to take it in their stride, and are less stressed out by it.
 - For boys, it seems as though it is a fact of life for them.
 - In addition, they often have a somewhat broader perspective on the use of math in their lives than do the girls.
- Similar to the girls, one of the biggest influences in how they feel about math is their teacher.

- The math teacher is a primary motivator for the boys in how well they do and how hard they work.
 - Time and again, they mention that they cannot relate to the teacher, they cannot understand the teacher, and that the teacher just teaches out of the book.
 - They want a teacher who is young, empathetic and “gets” them.
- Specifically, they don’t want to sit in a classroom and be “taught at.” They want their math classes to be participatory just as girls do.
 - The boys want games to make it fun and challenging, they want field trips, and they want problems that are real world problems.
 - They want math to come alive, and a teacher who brings it alive.
- In contrast to the girls, the boys express a greater understanding of how math plays a role in the world, and in their worlds.
 - In their collages they show examples of how math is integral to things like designing cars, bridges, the world of money, and more.
 - They know that math is important in a whole range of careers from engineering, to technology, to science, to design, to teaching, to business.
 - They have a much broader view of “math-oriented” careers than the girls.
- This awareness does not necessarily alleviate boys’ frustration with learning algebra and math on a day-to-day basis.
 - They are typical teenagers in that short-term gratification outweighs any view of long-term benefits.
- For boys, there is an opportunity to teach algebra and math in a way that can turn their frustration into a greater enthusiasm for learning these subjects.
 - There is already a foundation of how important math is.
 - Boys have a lower level of stress and anxiety around learning algebra than as was expressed by the girls.
 - Similar to the girls groups, there is an opportunity for a “case study” approach to teaching math with boys.

- Girls want to be nurtured and encouraged in learning math. For boys, the biggest challenges are two-fold:
 - One, calm them down and get them to focus.
 - The second challenge, wake them up. It sounds as though a number of boys sleep through their classes, especially math. Or if they are not sleeping, they are not paying attention.

- Similar to girls, boys want to learn in a collaborative manner. They like interacting with their schoolmates and like learning in group situations.
 - In fact, class projects are their preferred way of learning math. A number mentioned small group projects.
 - Among both girls and boys, there is a tremendous opportunity for making math, and algebra in particular, a more participatory endeavor. The Math *inquiries* Project wants to take a prominent role in exploring what has been done already, what works according to teachers, and encouraging California algebra programs to embrace this concept as very important.

- Boys have heard the same messages about algebra and math that girls have, many of them negative rather than motivating.

"My teacher told me straight up, you won't use this later in life but I have to teach it to you anyway because it's the curriculum."

"Well if you just know the basics that's mostly what you need. Everyday when you go to the store we just use addition and stuff like that, we don't use all that complex stuff."

"A lot of people tell me that all you need is the basics like multiplication, subtraction, divide. Like he says, you don't need the quadratic formula or how to graph unless you become like an engineer or rocket scientist."

- While the girls have a fascination for self-expression and creativity, the boys have a focus on money. They see math as a means of making money in the future.
 - Because of the connection boys make between being good at math and making money, an algebra course that combines the

two, like business and financial math, would be more relevant to them and appeal to this association.

“Obviously, if you do good at math you’ll do successful things to make more money and live longer and you can afford to be healthy and all that. And then you work hard so you can make more money.”

“There’s always one time in your life or a big opportunity comes because you’re good at math and you get a lot of money out of it. And if you work hard and study you don’t have to worry about hospital bills.”

Math Teachers’ Focus Groups

- The 8th grade algebra teachers we spoke to care deeply about their students and how math is being taught in schools. Not only were they eager to participate in the focus groups, they had many observations and ideas to share with their peers. Importantly, many are experiencing high levels of frustration due to the restrictions imposed on teaching math.
- From their perspective, too much math is taught solely for testing purposes.
 - Teachers feel testing is detrimental to students because it doesn't matter whether their pupils understand what is going on; the important thing is that students memorize how to get the correct answer.
 - Teachers seem to agree that what actually matters — for everyday life and general betterment — is the *process* of arriving at the right answer.
 - Teaching for a test is problematic because it values answers over process.
 - Testing occupies too much class time.
 - Testing creates a lot of pressure for both students and teachers.

- Teachers feel rushed in class.
 - Many schools have cut the time allotted to math classes.
 - Because teachers have too much to cover in too little time, students can't learn subjects in depth, and some students just get left behind.
 - Teachers would like to have their students fluent in English so that teaching Algebra was not hidden behind language barriers.
 - Teachers lack enough class time to deal with individual students, so many students don't get the personal attention they need.
 - Things move too quickly for some students to keep up, making it more likely they'll fall behind.
 - Time constraints make it difficult or impossible to be flexible with the curriculum.
- Teachers want to collaborate with each other.
 - Algebra teachers want to meet with pre-algebra teachers to discuss basic skills and concepts that students will need for algebra.
 - Some algebra teachers feel that middle or elementary school teachers aren't adequately preparing students for algebra. Some speculate that elementary/middle school teachers aren't comfortable with math.
 - Teachers want to be able to tie math to other subjects, thus integrating the curriculum.
- Teachers believe that kids enjoy math when they get to see a fun and interesting application — and then learn how the math behind the application works.
 - For instance, students do a science project in one period and in the next period they learn the math behind it.
 - It is difficult for teachers to organize themselves and to integrate what they are doing across subjects.

- Furthermore, a lot of the subjects that use math in a non-threatening, integrated way — like art classes, shop, photography, and music — are devalued or cut from the curriculum entirely.
- Teachers lack the resources and time to teach math classes through application.
- Even though teaching materials that employ education through application exist, teachers do not necessarily have access to them, or aren't supposed to use them in class because they are restricted to a limited pool of textbooks.
- Students would benefit from a more mixed approach to math, one that combines fun, real-life hands-on activities, and applications with more traditional approaches.
- Students still need to memorize mathematical facts but they also need to learn how to apply those facts to real-life activities.
- When there is too much focus on memorization and not enough on concepts or logic, students are unable to solve novel problems.
- Math phobia is real.
 - Many students are afraid of math and give up too readily.
 - Teachers believe this fear can start early and can be passed on to kids by parents or other teachers.
 - Part of the fear is due to the fact that some students aren't ready for algebra on a cognitive level in 8th grade. They need more time.
- Suggestions from the 8th grade math teachers for improving math education include the following:
 - Integrate real-life situations and applications.
 - Integrate other subjects, like art and music, with math.
 - Explicitly tie math to subjects that kids are interested in.

- Invite interesting guest speakers to math classes.
- Gain access to better books and materials that have a balanced approach to math.

Teachers' Ideas for Making Algebra Education Successful

- Teachers all agree that an effective way to make learning algebra positive and successful is to relate the subject to their students' lives.
- One way to get students interested and excited about math is to allow kids to learn it through application, not simply memorization.

"Having kids discover the math through an application is good. Using real life to teach it, and then going ahead and showing the mathematics, and then going back to another application."

- This application-based approach allows students to "discover" math on their own and helps them get over problems like fear and boredom.
- Kids should "own" math, make it their own. Memorization, although an important component of learning math, is not enough. Students need to be able to *think* mathematically.

"I think the things to have kids do to have them feel like they're doing math, not just memorizing it, are out there. But they're not widely disseminated. Unfortunately, there's a whole culture war around them with a segment that says that's fuzzy math. We've got to get back to basics, teach the kids the skills. And I mean, the people who think that don't know how empty those skills can be."

- Teachers also want to show their students the connections between math and other subjects, like science, arts, and music. This can be a fun way to involve students.

"Students are not taught the relation between art and math. And so I think maybe beautiful things in design and music too; the arts and the math should be stressed more."

- Using math in everyday life isn't always explicit; it isn't necessarily about using formulas. Rather, it's an implicit use of mathematical reasoning that frequently comes into play across all subjects. Many classes that make use of applied math are being cut from the curriculum, like music, art, or shop.
- Teachers like the idea of bringing outside speakers to class to talk about math in everyday life, especially speakers whose professions are interesting to kids. Some suggestions for speakers were construction worker, engineer, physicist, golf course designer, electrician and sports star. Speakers could help teach special applications of math.

"I need to cover this topic in this two-week period, so if I could think of somebody to come in and speak on something that could lead me into teaching that topic it would be very beneficial to my lesson — inspirational, help them to move on."

- Outside speakers help students understand how math is used in everyday life.

"Just having the luxury of people, whether they're chefs or musicians or credit union employees with expertise who can say, this is really used every single day. I use this every single day . . . give it a try, let's try it."