MATH DESIGN PROJECT

2017

WE DESIGN
INCLUSIVE AND CREATIVE APPROACHES
TO COMPLICATED SOCIAL PROBLEMS

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PROJECT OBJECTIVES

- Increase the level of academic integrity and intensity with which math is taught to ensure students succeed in math
- Involve teachers, students and community in the problem solving process.

PROJECT BACKGROUND

DESIGNING FOR MATH LEARNING

Despite STEM-focused programming in Cincinnati Public Schools (CPS), some high school students still struggle with math. These students graduate from CPS without the competency or confidence to succeed in post-secondary experiences that demand math. After rich qualitative research was conducted in 2015 by Design Impact and the Greater Cincinnati STEM Collaborative (GCSC), partners learned that **teachers struggle balance teaching with the rigor needed to produce capable math learners and addressing the social and emotional health of students experiencing poverty.** It seemed imperative that community partners, parents, students and teachers should come together to explore potential approaches that would change these outcomes.

HOW MIGHT WE CREATE A LEVEL OF ACADEMIC INTENSITY AND INTEGRITY AROUND MATH SO THAT **HIGH SCHOOL STUDENTS SUCCEED IN MATH?**

BEHIND THE SCENES

PARTNERS

- **Design Impact**
  Project Leader
- **Strive Partnership**
  Community Partner and Funder
- **Greater Cincinnati STEM Collaborative**
  Community Partner and Funder
- **Cincinnati Public Schools**
  School Partner
- **Winton Woods City School District**
  School Partner
- **Hughes High School**
  School Partner
- **Riverview East Academy**
  Learning Partner
- **University of Cincinnati**
  School Partner

COLLABORATION

Having previously partnered together, Strive Partnership, GCSC and CPS were eager to further explore ways **to increase the intensity with which math is taught in high schools while reducing the anxiety students feel about the subject.** The complexity of the challenge and the variety of stakeholders involved in this issue required a new approach to the work.

A HUMAN-CENTERED APPROACH

Strive Partnership and GCSC approached Design Impact (DI), a nonprofit social innovation firm, to lead the project. DI specialized in applying design thinking, a human-centered problem-solving approach, to uncover community-driven solutions to pressing social issues. For this project, partners wanted to involve teachers, students and their parents/guardians.

Using design thinking and GCSC and DI's previous collaborative work as a road map, the team asked:

HOW MIGHT WE create a level of academic intensity and integrity around math so that high school students succeed in math?

The goal was not only to generate new solutions to this challenge, but also to move an idea into action. Design thinking is helpful because it leans on prototyping, or the rapid and affordable testing of an idea, to learn and arrive to a solution that creates impact.

DESIGN THINKING AS THE ROAD MAP TOWARDS INNOVATIVE AND INCLUSIVE SOLUTIONS:

Talk to students, teachers, parents and administrators who lend perspectives on why students struggle with math

DISCOVERY

Identify opportunities where new interventions in school and in the community might impact students abilities in math

SYNTHESIS

Bring stakeholders together to generate ideas within these opportunities

IDEATION

Choose an idea to test with a school

PROTOTYPING

DESIGN THINKING:
A problem-solving process that focuses on understanding and building empathy with users, considering divergent possibilities, and learning through action.

PHASE 1: DISCOVERY

LISTENING TO STUDENTS AND TEACHERS

In order to understand why students struggle to not only enjoy math but succeed in it, it was important to listen to those closest to the problem — students, teachers and math coaches. In addition to one-on-one interviews, Design Impact and the core team drew from both qualitative and quantitative research previously completed.

DISCOVERY PRINCIPLES:

- Engage many voices
- Listen and observe
- Avoid assumptions
- Maintain childlike curiosity

WHO WE TALKED TO:

Students

Math coaches

Teachers

Parents

Refer to Appendix 1 (page 20) for full list of insights obtained during Discovery Phase.

PHASE 2: SYNTHESIS

UNDERSTANDING WHAT MATTERS

SENSE-MAKING

One of the trickiest parts of the design process is to make sense of hundreds of data points, or *insights*, that come out during the discovery phase. These insights were categorized into themes. This phase of the design thinking process is called *synthesis*.

Based on these themes, the core team identified major *opportunity spaces*, or topics with high potential for innovation.

SYNTHESIS PRINCIPLES:

- Visualize the data
- Identify themes
- Be comfortable with ambiguity
- Translate insights into design opportunities
- Create insight statements

PHASE 3: IDEATION

CREATING SOLUTIONS...TOGETHER

BRAINSTORMING

New ideas are generated during the *ideation* phase. These ideas may be big, small, wild or even just a twist on an old way of doing things.

DI hosted an ideation session at Woodward High School with students, teachers, parents, administrators and math coaches. The goals was to create an open creative environment where all ideas could be heard, as well as to begin building ownership around ideas.

IDEATION PRINCIPLES:

- Immerse in the research
- Engage diverse voices
- Keep an open mind
- Stretch the imagination

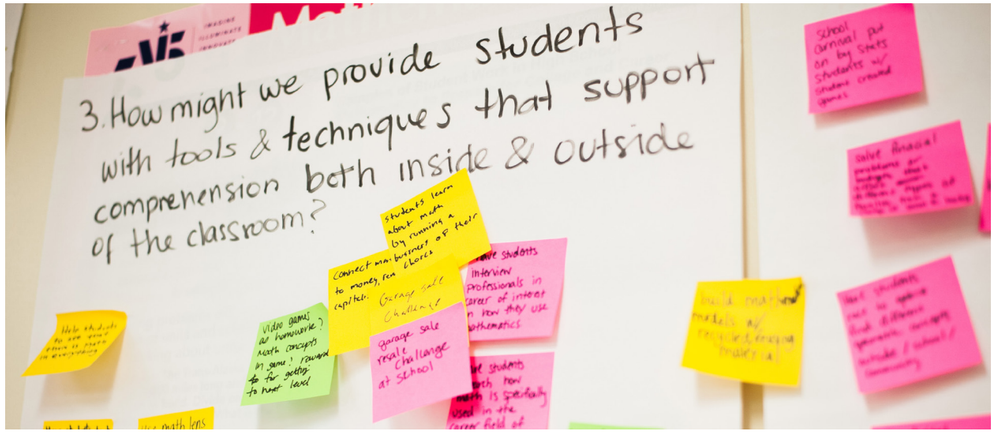
IDEATION TOPICS

SUPPORT THE TEACHER BEHIND EVERY STUDENT
How might we better support teachers to effectively teach math?

CREATING A CULTURE OF INNOVATION
How might we create a school environment where teachers can be creative and take risks?

MAKE MATH STICKY
How might we provide students with tools and techniques for learning math that support comprehension both inside and outside of the classroom?

THE POWER OF FAMILY RELATIONSHIPS
How might we foster positive family interactions that instill confidence and excitement for math learning in students?



PHASE 3: IDEATION

THE TOP CONCEPT FROM IDEATION

MATHLETICS

HUNDREDS OF IDEAS
Participants were challenged to generate as many ideas as possible. These ideas were distilled down to the top eight

POLISHED + CLARIFIED
More details were added to the eight ideas to bring them to life

ONE IDEA
Partners chose one idea to test at Woodward Career Technical High School

PHASE 4: PROTOTYPES

TESTING MATHLETICS

During the prototyping phase, an idea is quickly simulated or modeled in order to get feedback from students and families to understand if it has merit.

PROTOTYPING PRINCIPLES:

- Build inexpensive mockups
- Celebrate learning and failure
- Capture feedback from stakeholders
- Test multiple versions

DESIGNING MATHLETICS

Mathletics was designed by two students, a teacher and a resource coordinator from Woodward High School (WHS) to plan how students and their guardians might come together to learn and get excited about math.

LAUNCHING MATHLETICS

The WHS staff and teachers designed Math activities that were relevant to students. Student Coaches were able to choose which math skills they were most comfortable teaching. While this event was initially intended to for students to teach family, attendance by Student Coach peers was tremendous, indicating enthusiasm for peer to peer learning.

KEY INSIGHTS

Below are a few insights that came from student, parent and teacher interviews. These were foundational for the brainstorming session out of which the Mathletics prototype was born.

- A student stopped asking family members for help when doing Math homework because it caused conflict (around methods used to complete homework).
- A teacher expressed that her highest performing class was also the class with the highest parental involvement.
- What students believe about their own ability in Math, as well as what their teachers and parents believe (about their own ability and their child's) — can be big barriers to changing outcomes for students in Math Students, and their teachers and parents, must believe to succeed.
- Students teaching math helps them reinforce their own learning.

WHAT IS MATHLETICS?

We've flipped the role of students and guardians!

Mathletics encourages students to prepare and lead math tutoring sessions for their family members, who often feel out of touch or uncomfortable with how math is taught today. Students set up stations - with help from teachers - where they can teach their peers and family about different topics they are learning in math.

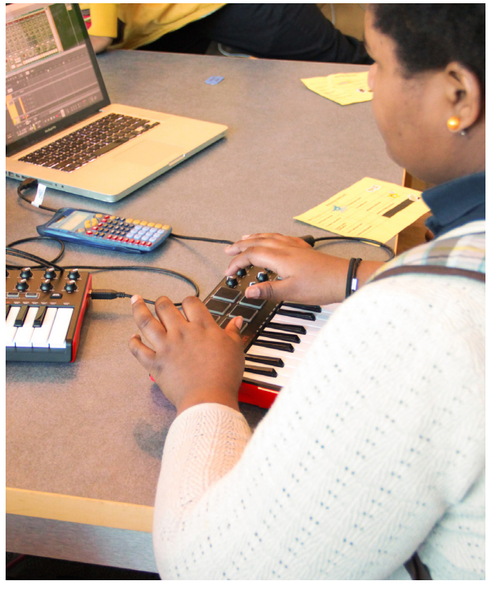
Not only do students benefit from exploring Math lessons in greater detail, but family feels more confident in their ability to support their child becuase they get a closer look at what and how they are learning.

Refer to Appendix 2 (page 28) for full list of top concepts generated during ideation.

Mathletics recruitment flyer

Students worked together to solve a math challenge at each station with support from Student Coaches and teachers.

Students had the opportunity to share their math skills and knowledge with family members.



Stations incorporated math challenges related to other disciplines such as music, art, paleontology, etc.

“I want my grandson to be the best that he possibily can... I brought him despite of my schedule. I didn’t have to do it because I do daycare with kids all day, but **I am here to support him.”**

— Carmela Simmons, grandmother

WHAT WE LEARNED

STUDENT-LED LEARNING IS POWERFUL

Studies show that not only are Student Coaches reinforcing their own learning, their peers are more likely to understand the content. This model also helps increase attendance, for students are more likely to invite their peers to join.

MATH ACTIVITIES THAT RELATE TO REAL LIFE MAKE IT FUN

Mathletics stations are designed around content that mirror students' interests, which captivated students.

INVITE PARENTS THROUGH MULTIPLE CHANNELS

In order to increase parent attendance, try multiple methods for communicating the event to ensure the message gets out — teacher notes, flyers, e-mails and one-on-one interactions.

TEACHER LEADERSHIP AND COLLABORATION IS KEY

Mathletics gives teachers an opportunity to collaborate and build relationships with students outside of the classroom.

BRING STUDENT-LED LEARNING INTO THE CLASSROOM

There is plenty of research that points to the benefits of peer teaching. With the success of Mathletics this model could benefit students in the classroom as well as after school.

KEEP TESTING

While the first Mathletics event was very successful, organizers also learned a lot about what to do better next time. Adjust, try again and keep learning!

PROTOTYPE LEARNINGS

A total of 23 students and 4 guardians responded to the survey. The follow results are based on those completed surveys.

WHO WAS IN THE ROOM?

67 PARTICIPATING STUDENTS

25 STUDENT COACHES

4 GUARDIANS
(parents and grandparents)

20 TEACHERS AND STAFF MEMBERS

83%
of participants responded math was more fun and engaging after Mathletics

100%
of participants responded they would participate again and would recommend it to others

QUOTES FROM THE FIELD

Students and guardians shared with us why they attended Mathletics and what they learned in the process:

"I learned not to give up, to keep trying."

"I wanted to learn more about how math is being taught today in the classroom so I could support my son."

"I wanted to help others who were struggling."

"Math is more fun than I thought."

"You can do math with almost anything."

"I learned about the different ways of learning math and how it affects different skills (cooking, art, puzzles...)"

"I learned that math has a lot to do with everything, math can be fun."

MATHLETICS TOOLKIT

Mathletics is still in its testing phase but the core team learned a great deal about what worked well. Below you will find suggested steps for implementing your own version of Mathletics.

STEP 1:

DESIGNING THE MATH ACTIVITIES

- Find out what topics interest students
- Identify math activities that speak to those interests
- Invite students to lead Mathletics
- Allow students to decide which math activity they feel comfortable teaching
- Give teaching materials to students and allow them to figure out how they want to teach it to their peers and family
- Coach students on leading the activity

STEP 2:

PROMOTE THE EVENT

- Give your event a name that speaks to students' interests
- Create a tone and visuals for the event that is fun and relevant
- Share the event with students and guardians in multiple ways: e-mails, flyers, social media, newsletters, robo-call, etc
- Share the opportunity with the school's community resource coordinator
- Use an electronic invitation platform (e.g. Eventbrite) to estimate attendance

TIPS

- Give yourself 2 months to plan the first event
- Find a space that can accommodate all of the stations

BUDGET

- $100 - $200 for food and materials

STEP 3:

COLLABORATE WITH YOUR SCHOOL

- Engage teachers who might want to incentivize students to attend for extra credit.
- Work with teachers to coordinate their coursework to connect to the event
- Ask teachers to help guide Student Coaches leading up to the event
- Find ways to partner with other after-school clubs who can connect math to seemingly unrelated topics, such as cooking or music
- Identify and organize students who can contribute to Mathletics on an ongoing basis — spreading the word, determining math activity content

STEP 4:

IMPLEMENT

- Create no more than four unique math stations. If you need more to accommodate attendance, duplicate stations
- Spend 12-15 minutes at each station to give participants enough time to dig deeper into the subject and "solve" the challenge
- Recruit teachers to support math stations and Student Coaches at the event
- If you're going to serve food, make sure the activities come first
- Build in time after the station rotation to bring the group together and celebrate student and guardian successes!

STEP 5:

EVALUATE

- Create anticipated outcomes and measures ahead of time
- Capture student and guardian feedback immediately
- Involve Student Coachess in the ongoing evaluation plan

“Math is kind of a tricky subject, but **with the right people helping you, you can definitely excel at it...** I know math is not typically smiled upon and it can be hard, so I wanted to show people it can also be fun!”

— Marcus, 12th grade student

THANK YOU

Strive Partnership, Greater Cincinnati STEM Collaborative and University of Cincinnati for funding this work and serving as key collaborators in propelling this project forward.

Cincinnati Public Schools and Winton Woods City Schools, whose staff and teachers were instrumental in directing the project and deepening the work.

Specifically **Woodward High School, Hughes High School and Riverview East Academy** students and teachers for openly sharing their challenges with math, brainstorming solutions and building Mathletics.

Finally we’d like to thank the **many individuals** who contributed their time, thoughts, experiences, creativity and skills to this project.

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APPENDIX 1

OPPORTUNITY AREAS AND INSIGHTS

1. FUELING TEACHER PASSIONS

Opportunity: How might we continuously energize teachers so they can live out their passion as educators?

- Professional Development opportunities have the potential to be transformative for teachers; teachers feel frustrated when after PD days, they leave with no specific, actionable items to put into practice what they learned.
- "I used to do after-school tutoring years ago. I was energized and optimistic when I started teaching, but nowadays, the school day is tiring and draining."
- Most teachers attributed their passion for teaching math to their success as math students.
- Teachers want to keep learning and growing, but need more confidence to try new things.
- "Autonomy helped me succeed in other schools... Here, I am forced to do what the school requires and haven't succeeded. I know I can succeed because I have done it with other schools with the same student demographic.
- Often times primary teachers enter the field because they have a passion for kids, not for certain subjects.
- Some teachers want to be in elementary schools so they can avoid teaching at a more technical or conceptual level (math), particularly if they struggled with the subject as a child.

2. CLASSROOM CULTURE

Opportunity: How might we build a strong classroom culture that is conducive to learning and success?

- "The culture here is not always be conducive to pushing students academically. Students come into the class listening to music and expect teachers to let them do it while they work."

3. CREATING A CULTURE OF INNOVATION

Opportunity: How might we provide teachers with a school environment that is ripe and ready for innovation?

- A teacher didn't self-identify as doing something remarkable when talking about some of the innovative methods she uses in her classroom.
- Teachers are finding and creating methods that work, but they aren't sharing those with teachers who might be struggling.
- A teacher makes students repeat assessments and practice skills until they master them before she moves them on.
- Teachers want to keep learning and growing, but need more confidence to try new things - "I am leery of putting new things out there in case they fail."
- "When I try new things in class, often they don't go well the first time... It takes practice."
- Teachers fear that if they incorporate too much "freedom" or new elements into the class, students won't take it seriously.
- "I try to get them to translate information from paper to reality. We do hands-on activities: M&M's to make things visible and tangible, go outside and measure real objects with angles, etc."
- "Autonomy helped me succeed in other schools... Here, I am forced to do what the school requires and haven't succeeded. I know I can succeed because I have done it with other schools with the same student demographic."
- Some teachers are always on the lookout for new tools and resources to use in the classroom.
- A teacher mentioned using tools designed for other subject matters, and re-designing them to fit her math curriculum.
- Teachers may feel overwhelmed when they have too many resources at their disposal. It is difficult to sort through all of them without knowing which ones work for them and/or are more efficient.
- Teacher demanded students NOT to use Math during the day as a creative way to show the relevance of Math in daily life.
- A teacher explains Math through analogies that are simplified and relatable to students.
- Traditional school structure does not support a project based learning methodology, which requires more teacher planning and collaboration (co-teaching) time.

4. STUDENTS AT DIFFERENT LEVELS

Opportunity: How might we provide targeted support to all students regardless of their academic level?

- A teacher makes students repeat assessments and practice skills until they master them before she moves them on.
- Some schools are trying a new "intervention" practice where students who need help in something specific are identified and provided with more focused attention based on their needs.
- Standards are out of reach for some students with learning disabilities and English as second language challenges, yet there isn't a practice in place to help them focus on what they do need to learn.
- Teachers acknowledge it is important to provide options for students to show their knowledge and work in different formats (drawing, solving an equation, verbally).
- Separating students based on their academic level eliminates opportunities for students to see positive examples of students trying and succeeding.
- "When students don't know the content, they revert back to acting out, getting distracted, etc."
- Teacher mentioned that in order to differentiate each student based on their level, she adapts the content of task cards and exam questions, while maintaining their appearance the same (as to not discourage students).

5. MY CLASSROOM, YOUR RULES

How might we ensure teacher voice and expertise plays a stronger role in school decision making?

- Walnut Hills' diversity attracted both long-time "Students enjoy using technology. If you are not using it, you're missing out. However, it takes a level of training and planning - you often run into downfalls, and need backups when devices crash."
- There is emphasis from the District to use technology, but teachers agree it is not always the best way to teach math comprehension and skills. Teachers want flexibility on how/how much they incorporate it into their own teaching style.
- Teachers recognize the importance of incorporating activities that kids like to do into the way they teach math.
- Not all teachers have choice in what resources they are allowed to use.
- "The District always comes up with different testing methods, but nothing ever lasts. By the time we start making sense of it, these new initiatives are gone."
- "All students need are pen and paper to learn math. Technology is a good way to complement this, but should not be the focus of how students are taught Math."
- Some teachers struggle to adapt to the new strategies and technologies being tested out within CPS.
- A teacher recognizes she is "causing" students to fail because she is not able to equip them with the right tools, but rather, is tied to school processes and parameters.

6. MAKE MATH STICKY

Opportunity: How might we positively shift mindsets and perceptions around Math?

- Students are doing Math through games, but don't realize they are doing Math -- students know more than they think they do.
- "CPS has not figured out how to shift the mindset around Math as something critical to all schools, reaching not just teachers, but students and parents as well."
- Students in early elementary grades love Math when presented in a game-based learning experience (ST Math, computer software).
- "The current way we are attempting to "market" and motivate students to love Mathematics needs to change."
- "My Math skills would be about 7.5/10, but I just don't stay focused in Math class, it doesn't really get my attention."for the community to enjoy where all patrons feel welcome

7. THE SKILLS GAP

Opportunity: How might we eliminate the gap in Math skills and understanding among students within a school or classroom?

- Teachers spend their time and energy in catching up students who are at a lower academic level, which prevents them from focusing on enrichment for students in a higher academic level.
- Teachers manage gaps and rigor by grouping students based on what they need to learn, so they are not intimidated by students who are doing better.
- When talking about separating students based on their academic level, a teacher mentioned a drawback was that struggling students need to see other students try and succeed -- they need to have an example of proactive students in the classroom.
- Teachers are expected to deliver successful results, but are asked to teach at a level that is above most students' capabilities -- students lack the basic skills needed to deliver those results.
- Teacher said she is expected to work with students on project-based learning and enrichment, but they don't even have the prerequisite skills to work at this level.
- "Students might be in 5th grade, but their math skillset corresponds to 2nd grade."
- Teachers offer help during the day and after school hours, but students who show up are not the ones who are behind, but rather, the ones who want to get ahead of their work. Students who really need help don't show up.
- Struggling students may be changed to a different school when parents try to avoid their children repeating grades, therefore, they start the school year already behind.
- Student missed first few classes and never caught up (and did not learn those skills).
- Students feel the constant need to slow down to catch up (9th grade Algebra).
- When students don't catch up, their struggle increases in higher grade levels.
- Students start off the year already behind in school; teachers spend a lot of time catching them up during the first weeks.
- Students struggle to retain content week to week, let alone year to year.

8. INCENTIVES MOTIVATE KIDS

Opportunity: How might we find creative and relevant ways to incentivize students to learn and do well in Math?

- AStudent was driven and motivated externally — incentives for good grades can make a difference.
- "If I could change something... I'd reward kids (not necessarily with getting an A, since some don't have a sense with what a good/bad grade is). I'd give them a different kind of reward, like 10 minutes outside, using the computer, listening to music, etc."
- Sports can be big motivators and/or be used to incentivize students. Students who play sports have a required "study hall" period to do homework.
- Students don't necessarily believe in the value of education because some celebrities of famous entrepreneurs didn't go to school.
- Young people get excited about fame.

9. BUILDING TEACHER AND STUDENT RELATIONSHIPS

Opportunity: How might we ensure that teachers are comfortable and equipped to build relationships with students in and outside of the classroom?

- PA student lost interest in Math because they felt their teacher wasn't excited about the subject matter.
- Math can be easier when a relationship is built between teacher and student.
- Students like teachers who can relate to them on a personal level.
- When students think of their favorite teacher, they think of someone who will connect with them,. Favorite teachers are often not related to favorite subject matters.
- "The best teachers get to know the kids outside of school, they are more of a coach, they go above and beyond -- show up to their games, drive them to practice..."

Teachers who have not experienced inequities (economic or racial) don't always have the sensitivity to understand the challenges of those students facing these life circumstances.

10. SUPPORTING THE TEACHER BEHIND EVERY STUDENT

Opportunity: How might we better prepare teachers to effectively teach Math?

- Primary school teachers are only required to take 2 courses in math as part of their degree, yet these early years are formative in terms of how students learn how to understand math.
- Often times primary teachers enter the field because they have a passion for kids. Sometimes this is even an attempt to avoid teaching a subject (like Math) that they had trouble grasping themselves as students. So they struggle to teach in a way that leads to deeper comprehension among students.
- Specific teaching styles may be effective for some students, and not all.
- The environment and culture a teacher creates in the classroom is key in the performance of the students (safe, ask questions, interactive)
- "It was a very quiet class, nobody talked, nobody spoke, nobody asked questions. He would open a book and talk in a low, raspy voice... I went to college, and it was way easier than that school geometry class."

11. TROUBLE WITH TRANSFER

Opportunity: How might we provide support and structure for students to continue to build Math skills and comprehension once they leave the classroom?

- Students complain that they remember what they learned in school when in the classroom, but forget when they are doing their homework.
- Teachers assume that no Math homework or parent tutoring will happen outside of the classroom, and therefore, they don't assign homework.
- "I assign homework that I know won't be a challenge to the parents."
- "I got a tutor and during the class I would get it, but once I got home, there was a complete block and I couldn't get it..."
- When teachers vary elements in content for homework (such as positive / negative numbers), students automatically believe it is a new type of content they have not learned.

12. MAKE MATH RELEVANT

Opportunity: How might we help students see the relevance of Math in their current and future worlds?

- "Career Search is my easiest class because it is kind of about me and the kind of stuff I will do when I get older."
- Math teacher felt some of the Math skills she had to teach were irrelevant.
- A student thinks learning how to balance a checkbook, do taxes, etc. would be more useful than learning AQR Math.
- Teacher demanded students NOT to use Math during the day as a creative way to show the relevance of Math in daily life.
- Student saw Math classes as important because you have to get good grades to get a good job, not realizing that mathematical reasoning, and not merely good grades, are the gateway to good jobs.
- Students don't see Math in other areas such as dance, music, art, which are some of their favorite hobbies.
- Math concepts are taught in isolation. They are not put into contexts that make sense for students.
- "My favorite part of Math class is when we do experiments with candy, I like the hands-on activities, it's different that just taking stuff out of the book."
- "The book is boring because it's just a bunch of numbers... It doesn't give any information on what would happen in the real world. I like stories and stuff that I can relate to."
- Student has been told she will need Math most when she gets older. She knows her family uses Math on a daily basis, but is not sure how.
- Students question WHY they learn Math and why they will need it in the future. It gets harder to explain as the Math becomes more complex. Students need concrete examples.
- Students in earlier grades don't see graduation as a real, immediate goal. Teacher focuses on "do you want to keep re-taking this test?"
- Students don't visualize how their performance in a class can have an impact on the long run.
- Kids are good at Math when they have a strong conceptual understanding of it. Teachers have to influence this and relate the curriculum to the real world.

13. FAILURE TO LEARN

Opportunity: How might we host a constructive classroom environment where students are encouraged to learn from failure?

- In a typical classroom, once a student fails to show competency in a skill, they are sent a message that they just aren't good at Math, and that there is no hope to succeed.
- Students equated good behavior (turning in work, going to class, not talking) instead of Mathematical reasoning, as ways of being successful in Math.
- Students associate Math intelligence to memorization skills, rather than the reasoning behind a right answer.
- Student "knew" when he couldn't remember multiplication factors as quickly as his friends, that he was not good at Math.
- Students don't recognize the same cycle of learning (try, tweak, make better, try again) applies to Math, but rather, students look for correct answers.
- "The only person in my family who doesn't say he can't do Math is my papa... He has a million numbers written down and he will do it the longest way possible to find out the answer."
- "I overcame challenges in Math with practice and repetition... All you have to do is practice and you will get the answer correct."

14. LIMITING THE LITERACY GAP

Opportunity: How might we close the literacy gap so that students can be better prepared to comprehend Math?

- Reading is a limiting ability to do Math, which is often word-based problem-solving.
- Math teachers are teaching Math vocabulary before they can begin to teach the full content of the curriculum.
- Students who come in with low reading levels struggle with reading math problems and keeping up with taking notes.
- Students' literacy abilities impact their success in courses.

15. THE POWER OF FAMILY RELATIONSHIPS

Opportunity: How might we foster positive family interactions around Math learning?

- Parents were taught Math in a different style and vocabulary than their children use in Common Core. Parents help their kids the way they know how to, which is often not in line with how the subject matter is being taught in the classroom.
- Parents feel stressed when trying to help their children with Math because they don't feel like they know how to help. This stress is likely to be picked up by the students.
- Parents' education level plays a big role in students' ability to guide their kids.
- A student stopped asking family members for help when doing Math homework because it caused conflict (around methods used to complete homework).
- Parent didn't do well in Math and didn't graduate — "it was good enough for me, so it's good enough for my son."
- Educated parents and grandparents play a critical role in helping students get back on track when they get behind, especially when the teacher quality is not good."
- Educated and informed parents know how and where to find help for their children.
- Parents who value education are more likely to push and hold their kids accountable academically.
- Teacher expressed that her highest performing class was also the class with highest parental involvement.
- Parents have a direct influence on how students feel about Math. Whether they had a positive or negative experience with Math, it trickles down to their children.
- Parents with resources and knowledge can ensure their child has a better experience with Math by navigating the system (i.e. avoiding "bad" teachers).
- Beliefs - a student's belief in his/her ability in math, a teacher's belief about a student's abilities, a parent's belief about his/her math ability and the child's ability - can be big barriers to changing outcomes for students in math. We can't just look at solutions that touch on how we teach math.
- "My pa'pa sits down at the table with me and he don't know how we do it now, so when we do it when he is learning too."

16. TRANSITIONAL GRADES

Opportunity: How might we help to form a love and understanding of Math during middle school years when concepts become harder to grasp?

- Students don't know how to take notes and lack study skills and habits. When they transition to middle school or high school, they aren't prepared for the Math rigor.
- A teacher reflected on the system focusing mainly on K-3 (reading) and after 8th grade (high school), forgetting about the transitional years in between, which are as important in academic development.
- "The older I got and the more I advanced through school, the harder the Math classes. The harder they got, the more I gave up."
- Middle school was identified as the period when Math became confusing. Prior to this, teachers' explanations included pictures and lots of different ways to visualize.
- Kids are good at Math when they have a strong conceptual understanding of it. Teachers have to influence this and relate the curriculum to the real world.

17. UNSTRUCTURE THE SCHOOLHOUSE

Opportunity: How might we restructure school to graduate students who are prepared for the 21st Century workforce?

- "There is a lot going on. One minute we're doing fractions, and another minute we are doing division. Too many things in a short amount of time."
- The feeling towards the class is often driven by grades, which undercuts learning and real interest.
- Sometimes students felt they knew the Mathematics, but didn't have enough time to finish (assessments have a time limit).
- Teachers prefer classes with fewer students so they can provide the individualized attention they need.
- Teachers are overwhelmed with meetings that eat into prep time and time they would use to create more engaging experiences.
- With new curriculum and ways of teaching, each school has developed their own ways to implement based on their resources.
- Teachers can see math coaches as someone who is coming to judge their teaching style/classroom. They assume they are 'in trouble' when a math coach shows up in the classroom.
- The current fail/pass method of assessment doesn't teach students the value in learning.
- A teacher makes students repeat assessments and practice skills until they master them before she moves them on.

18. BELIEVE TO SUCCEED

Opportunity: How might we build and sustain self-confidence in students so that they will succeed in Math?

- "Well I think I see a lot of people give up easily in Math and that is probably where I get it."
- Students who struggle with a subject believe they aren't good at it.
- Students feel they can learn Math when they start to believe they can learn it.
- Kids are predisposed to think they're bad at Math because of what they hear from parents and/or teachers.
- "Assessing students on their skill set at the beginning of a Math unit is painful. Most students don't understand the Math concepts they haven't covered yet so it kills confidence and makes things stressful."
- If the student self-concept is one that holds a belief that they are not good at Math or can't do Math, then they won't succeed.
- A student's belief in his/her ability in Math, a teacher's belief about a student's abilities, a parent's belief about his/her math ability and the child's ability - can be big barriers to changing outcomes for students in Math. We can't just look at solutions that touch on how we teach Math.
- A student expressed that being smart as a person of color is associated with being "white," which is seen as negative in his/her environment.
- Students lose confidence in themselves when they get stuck in Math. Without the right support, it's easy to get stuck, feel incapable, and spiral down.

APPENDIX 2

CONCEPTS

Supporting the Teacher behind every Student

1. MINDFUL MATH

THE IDEA

Today's children are more anxious and stressed at school than ever before due to more rigid testing requirements and higher academic and social expectations. Mindful Math is a tool easy to use in any classroom. It incorporates yoga and meditation into Math lessons and class time. Mindful Math not only eases students' stress and anxiety, but can also be used to reinforce associations to lessons through yoga and exercise movements. Through this method of kinesthetic learning, teachers can create a more engaging and healthy learning environment for themselves and their students.

GOALS

- ☐ Involves family members in students' Math learning experience
- ☐ Fosters positive family interactions
- ■ Changes students' perception of Math
- ■ Supports teachers in collaborating and being creative
- ■ Creates an innovative school culture and environment
- ☐ Supports students' comprehension

RELATED INSIGHTS

- Specific teaching styles may be effective for some students, and not all.
- A teacher explains Math through analogies that are simplified and relatable to students.
- A teacher mentioned using tools designed for other subject matters, and redesigning them to fit her math curriculum.

RESOURCES + COLLABORATIONS

- Yoga teacher (www.yogakids.com)
- Yoga videos
- Open space and yoga mats

Supporting the Teacher behind every Student

2. EDUCATE, ROTATE, REJUVENATE

THE IDEA

Teaching can be emotionally, physically, and mentally consuming. Educate, Rotate, Rejuvenate is a model designed to prevent teachers feeling burned out, while maximizing the students' learning experience. In this model, teachers take turns leading lessons throughout the week. Each day of the week, there is a different lead teacher. In order to take some of the weight off the lead teacher, his or her peers provide support by offering feedback, observing students and learning from different teaching styles. Supporting teachers can also form smaller groups with students and provide more personalized attention (such as breakout sessions for specialized learning).

Educate, Rotate, Rejuvenate's flexible structure also allows teachers the necessary time to plan and modify their lessons according to the feedback received by their peers. Teachers can further enrich their lessons by inviting teachers of different subject matters to join their class as supporting teachers.

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- ☐ Changes students' perception of Math
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- ■ Creates an innovative school culture and environment
- ☐ Supports students' comprehension

RELATED INSIGHTS

- Specific teaching styles may be effective for some students, and not all.
- The environment and culture a teacher creates in the classroom is key in the performance of the students (safe, ask questions, interactive).
- Traditional school structure does not support a project-based learning methodology, which requires more teacher planning and collaboration (co-teaching) time.

RESOURCES + COLLABORATIONS

- Principal and administrative staff
- Models that are already working

Creating a Culture of Innovation

3. COLLABORATION FOR CREATIVITY

THE IDEA

Collaboration for Creativity is a team of teachers who work together to strengthen their teaching experience. This initiative fosters deep collaboration and community between teachers who plan instruction and assessments together, but also share critical feedback and reflection on each other's work and outcomes. This support network holds each teacher accountable for their peers' work, and encourages them to be creative and take risks in the classroom, judgement-free.

Collaboration for Creativity provides teacher common planning time, time to observe how their peers conduct their lessons, and the opportunity to participate in feedback sessions where successes, but also failures, are celebrated. This close-knit community of teachers also has the opportunity to share educational experiences in social settings as well, such as teachers' happy hours and seasonal retreats.

GOALS

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- ☐ Changes students' perception of Math
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- ■ Creates an innovative school culture and environment
- ☐ Supports students' comprehension

RELATED INSIGHTS

- Teachers are finding and creating methods that work, but they aren't always sharing those with teachers who might be struggling.
- Teachers want to keep learning and growing, but need more confidence to try new things — "I am leery of putting new things out there in case they fail."
- Teachers may feel overwhelmed when they have too many resources at their disposal as they are uncertain how to determine which ones may work and which ones may flop.

RESOURCES + COLLABORATIONS

- Principal and administrative staff
- Models that are already working

Creating a Culture of Innovation

4. CLASSROOM OLYMPICS

THE IDEA

Classroom Olympics is a year-long event that brings together all Math classrooms into a school-wide competition. Each participating classroom earns points when teachers and students successfully complete academic missions. Whether it's completing a homework assignment, or passing an assessment, each student will be tasked with earning points for their whole classroom. Classroom Olympics fosters and celebrates student's personal successes and gives each of them a sense of pride in their work and effort.

Classroom Olympics also challenges teachers to step up their game, by rewarding their classroom with points whenever they complete their own mission; whether that's trying out a new activity or doing something different and innovative with their class.

Classroom Olympics is all about celebrating effort and hard work of individual students, as well as the effort of working together as a team. Every classroom can visualize their progress, and at the end of the year, the winner is announced and celebrated school-wide.

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- ■ Creates an innovative school culture and environment
- ☐ Supports students' comprehension

RELATED INSIGHTS

- A teacher makes students repeat assessments and practice skills until they master them before she moves them on, coaching them along the way.
- Students do better when they feel connected to their peers and their teacher.
- The current fail/pass method of assessment doesn't teach students the value in learning.

RESOURCES + COLLABORATIONS

- Principal and administrative staff
- Tech support

Make Math Sticky

5. FLIP THE APPLICATION

THE IDEA

Flip the Application is a creative technique that asks students to think critically about how math shows up in their daily lives. Teachers identify and share with students mathematical models (graphs, charts, tables, functions, equations, etc.). Students, armed with clear sheet protectors and dry erase markers, take those mathematical models and create a scenario or situation that fits the model. Flip the Application allows the students to take charge of their own learning and exposes the entire class to multiple ways to connect math concepts to real life.

GOALS

- [ ] Involves family members in students' Math learning experience
- [ ] Fosters positive family interactions
- [x] Changes students' perception of Math
- [ ] Supports teachers in collaborating and being creative
- [ ] Creates an innovative school culture and environment
- [x] Supports students' comprehension

RELATED INSIGHTS

- Students don't see Math in other areas such as dance, music, art, which are some of their favorite hobbies.
- Kids are good at Math when they have a strong conceptual understanding of it. Teachers have to influence this and relate the curriculum to the real world.
- Students question WHY they learn Math and why they will need it in the future. As Math becomes more complex, students need concrete examples.

RESOURCES + COLLABORATIONS

- Teachers
- Dry erase markers and clear protector sheets

Make Math Sticky

6. CHOOSE YOUR MATH ADVENTURE

THE IDEA

Choose Your Math Adventure allows student to choose how they want to relate Math to their daily life. Teachers, eager to re-imagine homework or lesson plans, provide students with some parameters and guidelines that relate to certain Math concepts but then let the student decide how he or she wants to work through a real life problem using said concepts. When students have choice in their learning, they become highly engaged and productive. Choose Your Math Adventures gives students an opportunity to choose how Math is relevant in their lives, more deeply understanding Math and its' relatability to life outside of school.

GOALS

- [ ] Involves family members in students' Math learning experience
- [ ] Fosters positive family interactions
- [ ] Changes students' perception of Math
- [ ] Supports teachers in collaborating and being creative
- [x] Creates an innovative school culture and environment
- [x] Supports students' comprehension
- [ ]

RELATED INSIGHTS

- Students are good at Math when they have a strong conceptual understanding of it. Teachers have to influence this and relate the curriculum to the real world.
- "Career Search is my easiest class because it is kind of about me and the kind of stuff I will do when I get older.
- Students don't see Math in other areas such as dance, music, art, which are some of their favorite hobbies.

RESOURCES + COLLABORATIONS

- Principal and administrative staff
- Models that are already working

The Power of Family Relationships

7. MONDAY MATH CHALLENGE

THE IDEA

On Math Monday each week, teacher send home a math challenge for students to solve with family or friends. Students are given a Math challenge related to a daily experience, perhaps while grocery shopping, waiting for the bus or even cleaning up around the house. Family and friends learn together with the student, associating positive relationships and fun with Math's relevance in the real world.

GOALS

- [x] Involves family members in students' Math learning experience
- [x] Fosters positive family interactions
- [x] Changes students' perception of Math
- [ ] Supports teachers in collaborating and being creative
- [ ] Creates an innovative school culture and environment
- [x] Supports students' comprehension

RESOURCES + COLLABORATIONS

- Family or friend involvement

RELATED INSIGHTS

- Parents often teach kids Math the way they learned, which is different and sometimes contradictory to the way students are being taught Math in the classroom.
- Students lose confidence in themselves when they get stuck in Math. Without the right support, it's easy to get stuck, feel incapable, and spiral down.
- Some parents didn't do well in Math and didn't graduate, but feel successful in life — "it was good enough for me, so it's good enough for my son."

The Power of Family Relationships

8. MATHLETICS

THE IDEA

Often times we expect parents or guardians to support a student's Math learning by being another instructor at home. But curriculum and ways of teaching have evolved and may no longer be familiar to parents. So we've reversed roles in an attempt to support comprehension among students and bring families together around Math. Student-led tutoring sessions with parents allow students to demonstrate their skills and share Math content with their parents in a unique shift of roles. Not only do students more deeply understand the lessons, parents feel more confident in their ability to support their child because they know how they learn and what they are learning.

GOALS

- [x] Involves family members in students' Math learning experience
- [x] Fosters positive family interactions
- [ ] Changes students' perception of Math
- [ ] Supports teachers in collaborating and being creative
- [ ] Creates an innovative school culture and environment
- [x] Supports students' comprehension

RESOURCES + COLLABORATIONS

- Principal and administrative staff
- Parents and/or guardians

RELATED INSIGHTS

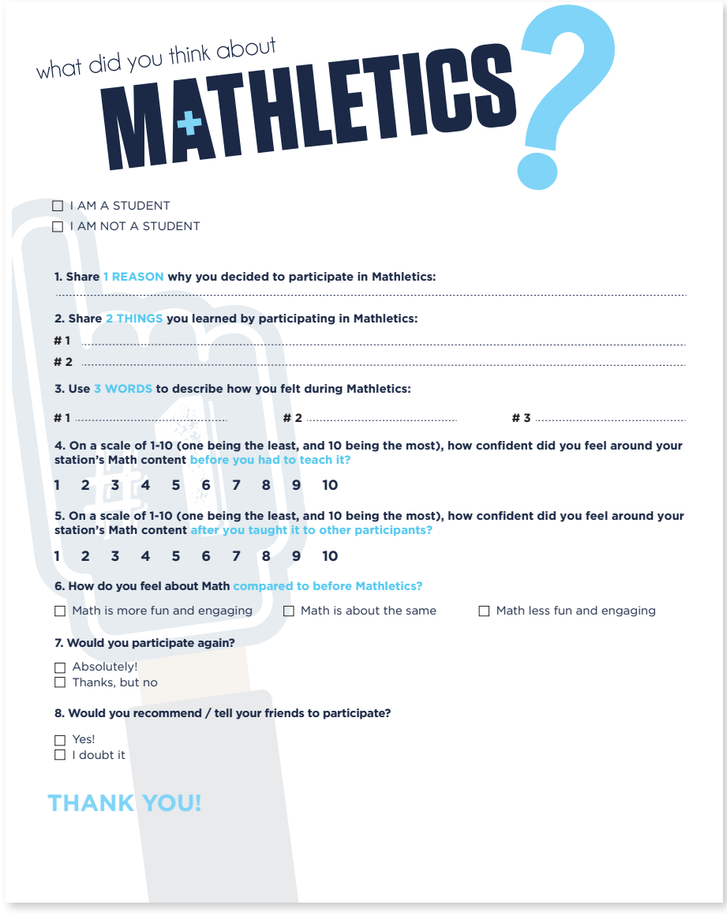
- A student stopped asking family members for help when doing Math homework because it caused conflict (around methods used to complete homework).
- Parents' education level could play a big role in their ability to guide their kids.
- Teacher expressed that her highest performing class was also the class with highest parental involvement.

APPENDIX 3

MATHLETICS MATERIALS

Flyer created to spread the word about the event and promote it among students and their guardians.

Signage was developed to indicate the location of the different stations.


what did you think about MATHLETICS?

☐ I AM A STUDENT
☐ I AM NOT A STUDENT

1. Share 1 REASON why you decided to participate in Mathletics:

.....

2. Share 2 THINGS you learned by participating in Mathletics:

 # 1 .....
 # 2 .....

3. Use 3 WORDS to describe how you felt during Mathletics:

 # 1 ..... **# 2** ..... **# 3** .....

4. On a scale of 1-10 (one being the least, and 10 being the most), how confident did you feel around your station's Math content before you had to teach it?

1 2 3 4 5 6 7 8 9 10

5. On a scale of 1-10 (one being the least, and 10 being the most), how confident did you feel around your station's Math content after you taught it to other participants?

1 2 3 4 5 6 7 8 9 10

6. How do you feel about Math compared to before Mathletics?

☐ Math is more fun and engaging ☐ Math is about the same ☐ Math less fun and engaging

7. Would you participate again?

☐ Absolutely!
☐ Thanks, but no

8. Would you recommend / tell your friends to participate?

☐ Yes!
☐ I doubt it

THANK YOU!

A survey was distributed to participants after the event to gather their feedback.