Brown University and The Met School
Applied Math Partnership
Partnership History

- Richard Gil, a student at The Met, a public school in Providence, RI, began interning in the Applied Mathematics Department at Brown University in the Fall of 2006.
- Richard’s advisor, Courtney Jacobs, and his mentor, Professor George Karniadakis, realized that Richard needed additional math skill instruction and practice to be successful at his internship.
- Richard began meeting weekly with Brown undergraduate, Kate Goldstein, to get tutoring and to work on the math in his internship project work.
- Richard worked with his mentor and advisor to expand this opportunity to include other Met students and other Brown students.
- This idea grew into a partnership between The Met and Brown University.
The Met School is a network of six small, public high schools in Rhode Island. All Met students have tailored curricula and apply their academic learning at internships in the community. To date, The Met has inspired a national network of more than 40 similar schools, all founded by The Big Picture Company.

http://www.themetschool.org
The Big Picture Company’s mission is to catalyze vital changes in American education by generating and sustaining innovative, personalized schools that work in tandem with the real world of their greater community.

- We design break-through public schools, research and replicate new designs for education, train educators to serve as leaders in their schools and communities, and actively engage the public as participants and decision makers in the education of our youth.

- We believe that true learning takes place when each student is an active participant in his or her education, when his or her course of study is personalized by teachers, parents and mentors who know him or her well, and when school-based learning is blended with outside experiences that heighten the student’s interest. In a country obsessed by "test-score accountability," we promote “one student at a time accountability."

- [http://www.bigpicture.org/](http://www.bigpicture.org/)
Major Aspects of the Partnership:

- Brown/Met math tutoring and exploration program
- Met student internship in Brown University’s Applied Mathematics Department
- Met teacher/advisor math software research
Brown/Met math tutoring and exploration program

- Objectives: expose students to the uses of applied math and technology in the real world, reduce students’ math anxiety, and increase the chance students will choose internships in math-related fields.

2006-2007 Met Student Survey Data:

- 62% had poor middle school experiences with math
- 50% felt their middle school teachers were helpful with math
- 75% responded that they need help in all areas of math
- 100% wanted to do further math work as part of the Brown/Met math program
Spring 2007 Activities

- Tour of 3-D “CAVE”
- Teambuilding between Brown and Met students
- Interactive math lessons led by Met staff and Brown undergraduates
- Visit by educators from Bronx Guild, a Big Picture school in New York City
Fall 2007 Activities

- Brown student orientation and planning
- Five whole group sessions planned to address algebra skills
- Excel training
- Four one-on-one sessions between Met students and their Brown tutors
- Pre and post-program assessments
Spring 2008: Creating Scale Models

- Brown and Met students visited three local sites to note their architectural features and take measurements
- Groups visited: Save the Bay, the lobby of Hasbro Children’s Hospital, and Ladd Observatory
- Brown students and a professor led a tutorial for Met students on using Microsoft Excel
- Groups used the program to record their site visit measurements and to scale down their measurements for their models
Spring 2008: Creating Scale Models cont.

- Brown and Met students worked together to build scale models of the three sites they visited.
- Met students also met one on one with their Brown mentors to review math concepts related to scale models.
Fall 2008

- Met students ran a protein assay lab at Brown
- Students worked one-on-one with their Brown mentors to learn how to find the slope and equation of a line as well as how to plot it
Fall 2008 cont.

- Met students used the data they collected from the protein assay lab as the context for their math work on plotting and slope.
- One Brown student in particular helped teach the whole group math sessions with the Met students.
Students recreated the protein assay lab, using jello mix this time as one of the substances and comparing it against the standard.

Again, students worked with their Brown undergraduate mentors to master the concepts of collecting and plotting data, finding the line of best fit and the equation of the line.

They were able to use this information to predict the amount of protein in an unknown sample.
During the summer of 2009, Courtney continued to work on software research and outreach. Some of her work included:

- Working with a Brown professor and Providence Public School students to help create a curriculum for Fall 2009 that is aligned to RI state math and science standards.
- Researching a new software program from Tom Snyder Productions called “Fraction Nation.” This program will be launched in January 2010 and Courtney will conduct a trial of the software with two classes of students.
- Expanding the use of Tom Snyder Productions’ FASTT Math program to two classes of incoming 9th grade students. Courtney had the software installed in classrooms and trained their new teachers to use the program.
- Recruiting five “lead” Brown undergraduate students to be facilitators of the Brown and Met School outreach program. Each lead Brown student will be paid a small stipend for his/her work during the semester.
- Collaborating with Brown faculty who are working on envisioning a potential Math Institute at Brown.
- Securing funds through the Raytheon Math Heroes Award to buy supplies for Met students to use during the 2009-2010 Brown/Met School partnership.
Fall 2009

- 10 students and 2 Met School staff members visited the Brown Applied Math CAVE for a 3-D demonstration
- Students worked in small groups to test Charles’ gas law. They calculated the volume of the balloons they used at room temperature, a cold water temperature and a hot water temperature. They also recorded the temperatures.
Fall 2009 cont.

- Students worked one on one with their mentors to practice finding volumes of different shapes. They also compiled the data collected from each group.
- In the whole group sessions, students decided on the best format to use to record and represent their data. They took averages and graphed the data using excel.
- Finally, students wrote lab reports to explain their hypotheses, procedures, results and conclusions.

**Temperature vs. Volume**

\[ y = 2.5777x + 365.19 \]
Spring 2010

- Five new Brown student mentors joined the program in the Spring of 2010.
- The semester’s program consisted of a combination of group and one-on-one meetings that totaled 15 sessions.
- Met students worked with their mentors on a lab that involved measuring the displacement of a bungee cord when different amounts of force were applied.
- They learned about the relationship between force, mass and acceleration.
- Students learned about and practiced converting a variety of measurements including Newtons.
In small group meetings, Met students practiced their basic math skills and also work on algebra skills. They practiced graphing, finding slope and calculating equations of lines. The semester culminated with group competitions that included making predictions about bungee displacement based on students’ calculations from this semester. Met students, with the help of their Brown mentors, recorded their work in a lab report and uploaded it on their digital portfolio as evidence of meeting four different RI math and science standards.
Fall 2010

- All of our Brown student mentors returned to the program providing enough mentors for each Met student to have his/her own
- Mentors received stipends for their participation through the generosity of Dr. George Em Karniadakis and the Applied Math Department at Brown University
- As a group project, students investigated the mathematics and physics behind trebuchets
- Concepts explored in the group meetings include potential and kinetic energy, projectile motion, and solving equations
- In one-on-one tutoring meetings, Met students worked with their Brown student mentors to prepare for the state NECAP math test
Fall 2010 cont.
Example of Trebuchet Work:

Counterweight Mechanism

Potential energy is transferred to Kinetic Energy, so:
\[ m_1 g h = \frac{1}{2} m_2 v^2 \]

Try solving for \(v^2\) above!
Courtney Jacobs, a Met teacher/advisor, has conducted research since summer 2007 to find and analyze math software.

The goal of this research was to find programs that might be utilized with Courtney’s students to improve their math comfort and skills.
## Math Research Findings

<table>
<thead>
<tr>
<th>Organization</th>
<th>Contact</th>
<th>Software available</th>
<th>Software comments</th>
<th>Next Steps</th>
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</thead>
<tbody>
<tr>
<td>MIT Education Arcade</td>
<td>Scot Osterweil</td>
<td>Zoombini’s Logical Journey</td>
<td>The skills addressed include problem solving, logic, and combinations. Students are asked to identify characteristics that are similar and different and make combinations based on these characteristics and logic. The point of the journey is not very clear and the animation makes the game look like it's for much younger kids. It is also slow moving and repetetive. I see the students being bored by the exercises/game.</td>
<td>None</td>
</tr>
<tr>
<td>MIT Education Arcade</td>
<td>Scot Osterweil</td>
<td>Zoombini’s Mountain Rescue</td>
<td>This program is much the same as Zoombini’s Logical Journey. It appeals to a young (1st-3rd grade) audience and is boring to play. It asks the players to sort, identify patterns, and problem solve.</td>
<td>None</td>
</tr>
<tr>
<td>MIT Education Arcade</td>
<td>Scot Osterweil</td>
<td>Zoombini’s Island Odyssey</td>
<td>This program is much the same as Zoombini’s Logical Journey. It appeals to a little older audience but it is also a slow moving game. It asks the players to notice rate and to problem solve. While some of the challenges are more interesting than those in the other two games, they are not engaging over time.</td>
<td>None</td>
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</tbody>
</table>
## Math Research Findings

<table>
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<tr>
<th>MIT Education Arcade</th>
<th>Scot Osterweil</th>
<th>Zoiks</th>
<th>None</th>
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<tbody>
<tr>
<td><strong>This program appears to appeal to an older audience than the Zoombini programs but the skills addressed are much the same. Logic, problem solving, and patterns are emphasized. The game gets boring quickly, though, and is very repetitive.</strong> I had Kip and Katherine (math staff) try the game and they found the same to be true.</td>
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<thead>
<tr>
<th>Tabula Digita</th>
<th>Dan (tech help)</th>
<th>Veronica (sales)</th>
<th>Dimension</th>
<th>Ordered 1 copy of 2 of the programs. Tech installed them and students have begun testing them.</th>
</tr>
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<tr>
<td><strong>Demo: The graphics on this game make it look more like a video game. In the demo, students are asked to make their way to different stations on a graph to download information. Students have a first person view of the graph on the ground and they use knowledge of coordinates to make their way to stations. Along the way they are asked to identify their coordinates and the graph quadrant numbers. When they get the answer wrong, they are prompted to try again. The first few times I tried this game my computer shut down to a lined screen. I am seeking an answer to why this happened and also to try out the different missions which are part of the game. The first mission is fairly introductory and repetitive in terms of addressing the graph reading skills.</strong></td>
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</table>
## Math Research Findings

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<tr>
<th>Tom Snyder Productions</th>
<th>FASTT MATH</th>
<th>Ordered copies which were installed on computers in the advisory. Students are using the program independently. While it is targeted at children younger than them, they use the software with enthusiasm and have showed progress in their multiplication skills.</th>
</tr>
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<tbody>
<tr>
<td>Demo: This software appears to be an effective and easy way to allow students to practice their addition, subtraction, multiplication, and division skills in small chunks each day (10-15 minutes). While the graphics and games seem targeted to younger students, I think that students who recognize the need for fact practice would be willing and eager to try using this program each day.</td>
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## Math Research Findings

| Tom Snyder Productions | Prime Time Math series | This software uses real world situations to teach math concepts. The students are assigned jobs and groups. They watch a short film to understand the context of the problem and to gather information to solve the math problems. They work in groups to learn the math concepts and apply them. They can check their answers or get hints from the software program. This software comes in a variety of grade levels and math concepts. Only one computer is necessary for this program. | While the programs are aimed at students younger than high school, the students in my classroom did not feel that the program was too young for them. They listened intently during the movies and eagerly worked together to solve the problems. Even some of my most resistant math students enjoyed the program and participated. |
We would like to thank the following people and organizations for their support:

- Brown University Applied Mathematics Department
- Professor Karen Haberstroh of Brown University
- Katherine McWalters and Kip Krushinsky of The Met School
- Ben Castleman
- David Cedrone, RI Governor’s Commission on Math and Science
- The Met School
- Scot Osterweil, MIT Education Arcade