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# San Francisco Math Circle: Evaluation of Changes in Mathematical Attitude, First Report

Dr. Brandy Wieggers,  
MSRI & SFSU

MathFest 2012



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# Goals/Outline of Talk

- Review of Math Circle Evaluation Development
  - Developing Program Goals
  - Developing Evaluation Framework
- Resulting Questions and First Report on Evaluation
- Questions

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Next: Workshop overview

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# SFMC Program Goals

At San Francisco Math Circle we hope to develop a Safe Mathematical Community for individual students and teachers involved in the program which will result in:

- increased individual mathematical competency;
  - increased problem solving competency;
  - individual students choosing to do mathematical activities;
  - individuals students choosing to explore harder mathematical tasks;
  - increased persistence on mathematical tasks;
  - an increased understanding of what math is.
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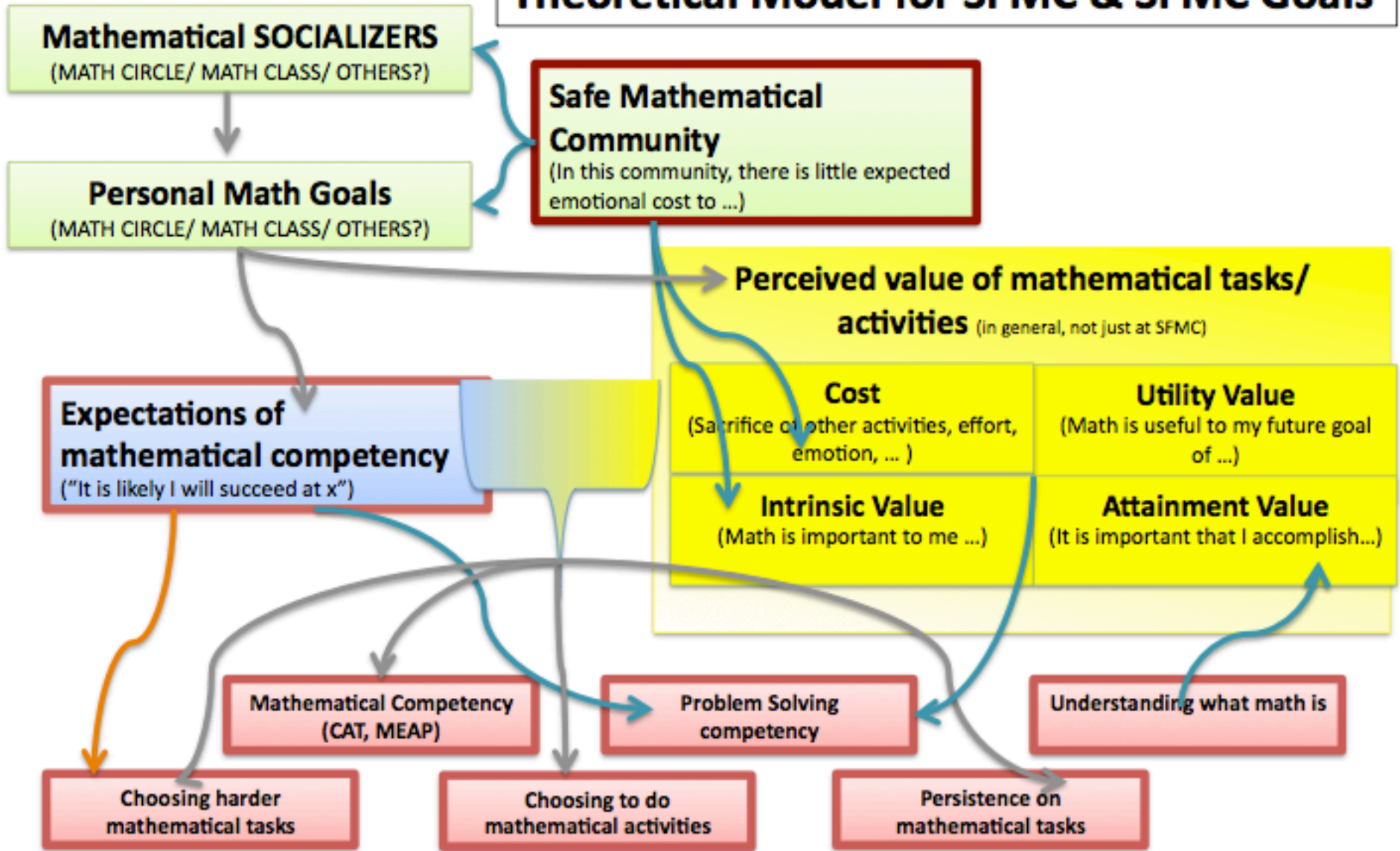
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# Creating the Theoretical Model of Evaluation of San Francisco Math Circle

The literature has shown a strong connection between the SFMC goals and the measurable values of:

- Personal expectations of mathematical competency;
  - Personal values of mathematical tasks and activities.
    - Utility Value – Math is useful for my future goals
    - Intrinsic Value – Math is important to me
    - Attainment Value – It is important that I accomplish...
    - Cost – Sacrifice required to participate in math
-

# Theoretical Model for SFMC & SFMC Goals



Symbol	Meaning/ Role	Implication for writing evaluation report
→	"influences"	Need to argue why A -> B influences either by a summary (citation) of someone else's work or by your own argument.
Boxes	A theoretical construct	Need to definite it, in a sentence (if applicable) followed by a paragraph of citations for who researched it.
	SFMC GOAL	



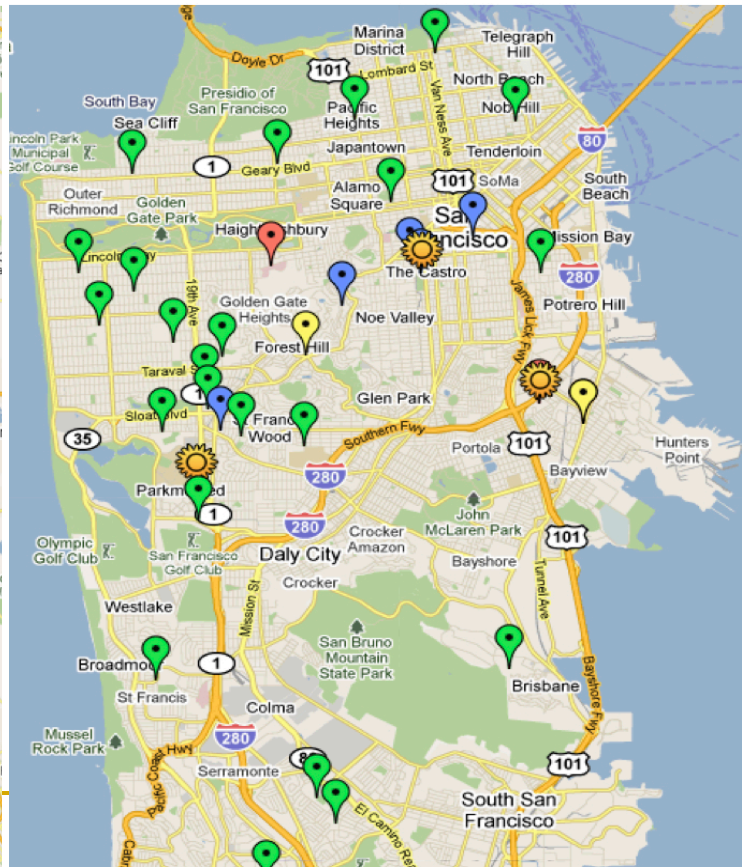
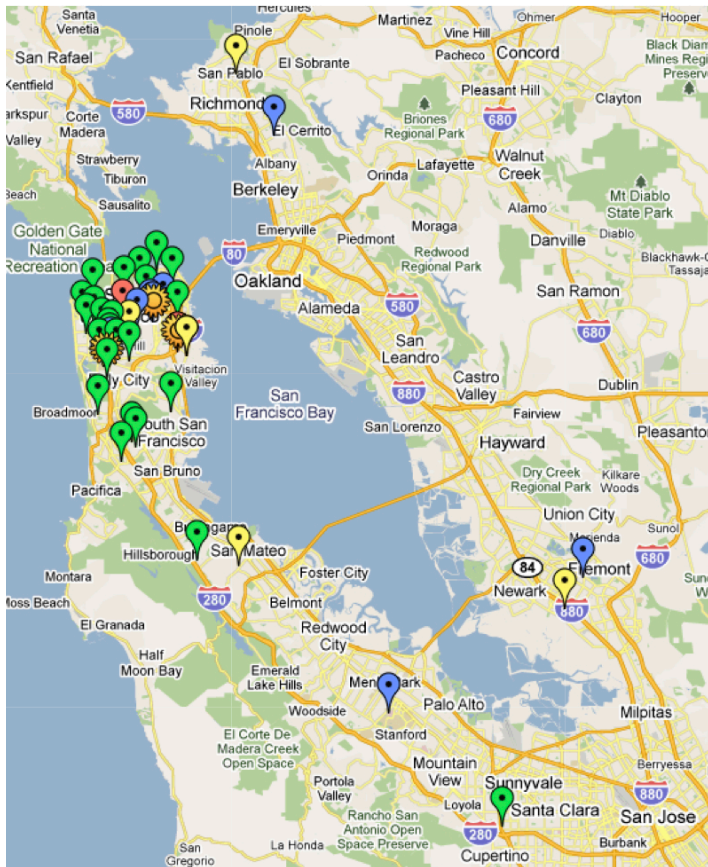
**Mathematical SOCIALIZERS**  
(MATH CIRCLE/ MATH CLASS/ OTHERS?)



**Personal Math Goals**  
(MATH CIRCLE/ MATH CLASS/ OTHERS?)

**Safe Mathematical Community**

(In this community, there is little expected emotional cost to ...)



SFSU students & teachers



Mission students & teachers



Bayview students & teachers



SFSU teachers

# Spring 2010 Evaluation Form

<p><b>San Francisco Math Circle 2010 Program Evaluation</b></p> <p>We are asking everyone to complete the following evaluation of the 2010 SFMC Program. Please complete all the pages and bring it back with you next week for the SFMC Plenary Session at Mission High School.</p> <p>You'll need a completed evaluation form at the meeting for your SFMC attendance prize so please fill it out!</p> <p>Thank you for taking the time to complete this form. We really appreciate your feedback.</p> <p><b>Personal Information</b></p> <p>What grade are you in?  <input type="radio"/> 3  <input type="radio"/> 4  <input type="radio"/> 5  <input type="radio"/> 6  <input type="radio"/> 7  <input type="radio"/> 8  <input type="radio"/> 9  <input type="radio"/> 10  <input type="radio"/> 11  <input type="radio"/> 12  <input type="radio"/> Other: _____</p> <p>What school do you attend?          _____</p> <p><b>DON'T FORGET TO FILL OUT BOTH SIDES OF THE SURVEY</b>          QUESTIONS ARE ON THE FRONT AND BACK OF ALL OF THE PAGES</p>	<p><b>San Francisco Math Circle 2010 Program Evaluation</b></p> <p>We are asking everyone to complete the following evaluation of the 2010 SFMC Program. 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For example, you might be better in math than in reading. Compared to most of your other school subjects, how good are you in math?          1 2 3 4 5  <input type="radio"/> a lot better in math than in other subjects <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> a bit worse in math than in other subjects</p> <p>How good would you be at learning something new in math?          1 2 3 4 5          very good <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> not at all good</p> <p>I enjoy the math we do at Math Circle.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>I enjoy solving challenging math problems.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>I enjoy the subject of math.  <input type="radio"/> YES</p>	<p><input type="radio"/> YES  <input type="radio"/> NO</p> <p>How much thinking do Math Circle activities require?          1 2 3 4 5          a lot of thinking <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> not very much thinking</p> <p>Success in math requires a big investment of my time.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>Being a Math Circle participant is a major part of who I am  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>People at Math Circle tell me I can learn math.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>If you were to list all the students in your class from the worst to the best in math, where would you put yourself?          where would you put yourself?          1 2 3 4 5  <input type="radio"/> One of the best <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> One of the worst</p> <p>I would rather be in my math class than my other classes.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>I need to have good mathematics problem-solving skills to be successful in the future?  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>In our math class, it's OK to make mistakes as long as you are learning.</p>	<p><input type="radio"/> YES  <input type="radio"/> NO</p> <p>How certain are you that you can learn everything taught in math?          1 2 3 4 5          Very Certain <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> Uncertain</p> <p>My teacher expects me to continue in math in the future.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>Explanations are a big part of math.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>Math will be useful for me later in life.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>Problem solving is an important part of mathematics  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>According to my teachers, it is important for me to be able to think and reason mathematically.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>How well do you expect to do in your math class this year?          1 2 3 4 5          very well <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> not at all well</p> <p>On Monday afternoon, I would rather be at Math Circle than anywhere else.  <input type="radio"/> YES</p>	<p><input type="radio"/> NO</p> <p>For me, being good in math is:          1 2 3 4 5          very important <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> not at all important</p> <p>Hard math problems scare me.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>In general, I find working on math assignments          1 2 3 4 5          Very interesting <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> Very Boring</p> <p>It is important to me to be a person who reasons mathematically.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>How much do you like doing math?          1 2 3 4 5          not at all <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> very much</p> <p>Doing well on my math homework is important to me.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>The Math Circle instructors want students in this class to respect each others' ideas  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>I enjoy studying math at Math Circle  <input type="radio"/> YES</p>
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<p><input type="radio"/> NO</p> <p>In addition to getting the right answer in mathematics, it is important to understand why the answer is correct.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>At Math Circle, my teachers would like me to do challenging math problems, even if I make mistakes.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>I have friends at Math Circle?  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>Knowing advanced mathematics is important to me, even if it's not necessary for the classes I take.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>Learning a lot of new things is what is important to me in math.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>My math homework scares me.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>During Math Circle I think about whether I understand what the teacher is trying to explain.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>In our Math Circle, it's OK to make mistakes as long as you are learning.</p>	<p><input type="radio"/> YES  <input type="radio"/> NO</p> <p>Some things that you learn in school help you do things better outside of class, that is, they are useful. For example, learning about plants might help you grow a garden. In general, how useful is what you learn in math?          1 2 3 4 5          very useful <input type="radio"/> <input type="radio"/> <input type="radio"/> not at all useful</p> <p>Math is useful in everyday life?  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>Compared to most of your other activities, how useful is what you learn in math?          1 2 3 4 5          very useful <input type="radio"/> <input type="radio"/> <input type="radio"/> not at all useful</p> <p>How often do you feel happy in Math Circle?          1 2 3 4 5          all the time! <input type="radio"/> <input type="radio"/> <input type="radio"/> never</p> <p>Being good at problem solving in math is important to me.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>The Math Circle instructors care about how we feel.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>Our Math Circle instructors encourage us to share ideas with one another in class.  <input type="radio"/> YES  <input type="radio"/> NO</p>	<p>I enjoy studying math in my school math class.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>Success in math requires giving up other pursuits.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>Solving hard math problems is important to me.  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>What are you going to do after you graduate from high school?  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>If you were in college now, what major would you choose?          _____</p> <p><a href="#">Back</a> <a href="#">Continue</a></p> <p>Powered by Google Docs  <a href="#">Report Abuse</a> - <a href="#">Terms of Service</a> - <a href="#">Additional Terms</a></p>	<p><b>San Francisco Math Circle 2010 Program Evaluation</b></p> <p>Did you enjoy Math Circle this Year?  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>Describe your overall experience with the Math Circle in 2 sentences:          _____</p> <p>Have you met a mathematician while at the San Francisco Math Circle?  <input type="radio"/> YES  <input type="radio"/> MAYBE  <input type="radio"/> NO</p> <p>Describe what a mathematician is. What do they do all day?          _____</p> <p>Do you plan to come back to Math Circle Next Year?  <input type="radio"/> YES  <input type="radio"/> NO  <input type="radio"/> Other: _____</p>	<p>Please describe the hardest math problem you had ever worked on while attending the SFMC?          _____</p> <p>Did you enjoy working on this problem?  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>Did you think about the problem when you were at home, later that night?  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>Did you think about that problem later during the next week?  <input type="radio"/> YES  <input type="radio"/> NO</p> <p>How mathematical are the following tasks?  <table border="1"> <thead> <tr> <th></th> <th>Very mathematical</th> <th>Somewhat mathematical</th> <th>A little mathematical</th> <th>Not at all mathematical</th> </tr> </thead> <tbody> <tr> <td>Drawing a Circle</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> <tr> <td>Solving a math equation, like 3x+2=5</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> <tr> <td>Solving a Rubik's cube</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> <tr> <td>Playing a card game</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> <tr> <td>Eating an apple</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> <tr> <td>Building a bridge</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> <tr> <td>Watching a movie</td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> <td><input type="radio"/></td> </tr> </tbody> </table> </p>		Very mathematical	Somewhat mathematical	A little mathematical	Not at all mathematical	Drawing a Circle	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Solving a math equation, like 3x+2=5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Solving a Rubik's cube	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Playing a card game	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Eating an apple	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Building a bridge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Watching a movie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<p><b>THANK YOU FOR COMPLETING THE 2010 SFMC Survey - Don't forget to bring it next week to the group meeting at Mission High School!</b></p> <p>We are asking everyone to complete the following evaluation of the 2010 SFMC Program. 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12 PAGES – 6 pages front/ back

Sent home with incentives to bring back

# Fall 2011 Pre Program Survey

**SFMC Pre Program Survey**

Thank you for taking the time to complete this form. We really appreciate your feedback.

What school do you attend?  
\_\_\_\_\_

What grade are you in?  
\_\_\_\_\_

What math class are you taking?  
 Pre-Algebra  
 Algebra  
 Geometry  
 Pre-Calculus  
 Calculus  
 None  
 Other: \_\_\_\_\_

Who asked you to take this survey?  
 My math teacher  
 Someone from San Francisco Math Circle

Have you previously attended a Math Circle?  
 Yes  
 No

Would you like to attend a Math Circle?  
 Yes  
 No

What is the first letter of the street where you live?  
\_\_\_\_\_

What is the last three numbers of your phone number?  
\_\_\_\_\_

I enjoy the subject of math.  
1 2 3 4 5  
Not at all      Yes, I love math

Some kids are better in one subject than in another. For example, you might be better in math than in reading. Compared to most of your other school subjects, how good are you in math?  
1 2 3 4 5  
A lot worse in math than in other subjects      A lot better in math than in other subjects

Being a Math Circle participant is a major part of who I am.  
 YES  
 NO

I would rather be in my math class than my other classes.  
 YES  
 NO

According to my teachers, it is important for me to be able to think and reason mathematically.  
 YES  
 NO

I need to have good mathematics problem-solving skills to be successful in the future.  
 YES  
 NO

In our math class, it's OK to make mistakes as long as you are learning.  
 YES  
 NO

Compared to most of your other activities, how important is it for you to be good at math?  
1 2 3 4 5  
Not at all important      Very important

Math will be useful for me later in life.  
 YES  
 NO

Problem solving is an important part of mathematics.  
 YES  
 NO

In my math class my teachers would like me to do challenging math problems, even if I make mistakes.  
 YES  
 NO

How well do you expect to do in your math class this year?  
1 2 3 4 5  
Not at all well      Very well

Hard math problems scare me.  
 YES  
 NO

In addition to getting the right answer in mathematics, it is important to understand why the answer is correct.  
 YES  
 NO

I have friends in my Math Class.  
 YES  
 NO

Being good at problem solving in math is important to me.  
 YES  
 NO

I enjoy studying math in my school math class.  
 YES  
 NO

What are you going to do after you graduate from high school?  
\_\_\_\_\_

If you were in college now, what major would you choose?  
\_\_\_\_\_

Did you think you will enjoy your math class this year?  
 YES  
 NO

Have you met a mathematician before?  
 YES  
 MAYBE  
 NO

Describe what a mathematician is. What do they do all day?  
\_\_\_\_\_

How mathematical are the following tasks?

	Not at all mathematical	A little mathematical	Somewhat Mathematical	Very mathematical
Drawing a Circle	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Solving a math equation, an $+ 3x = 5$	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Watching a movie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Thank you**  
Thank you for completing the Math Circle survey!

2 pages – 1 front/ back

Given to SFMC, (CM)<sup>2</sup>, SFUSD teachers, OEBMC – 300+ responses

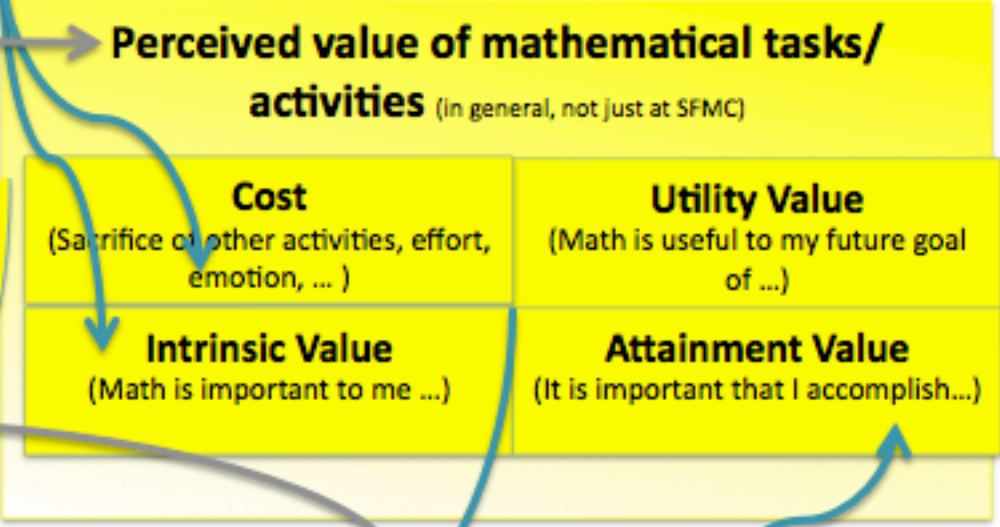


# Theoretical Model for SFMC & SFMC Goals

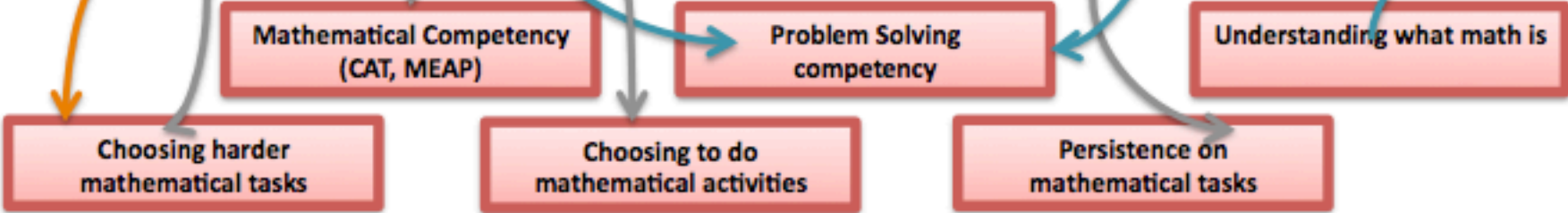
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**Expectations of mathematical competency**  
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Symbol	Meaning/ Role	Implication for writing evaluation report
→	"influences"	Need to argue why A -> B influences either by a summary (citation) of someone else's work or by your own argument.
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	SFMC GOAL	

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# 2011-12 Survey Responders

- **Previously administered Surveys:**
    - Spring 2010
    - Fall 2010/ Spring 2011
  - **598 2011/2012 Pre-Surveys (September 2011)**
    - 362 identified non-MC
    - 55 identified as returning Math Circle
  - **235 2011/ 2012 Post-Surveys (May 2012)**
    - 120 identified non-MC
    - 27 identified as Math Circle.
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## Perceived Value of Mathematical Tasks/ Activities

### Value: Interest

enjoyment the individual gets from performing the task.

### **Evaluation Questions**

- **Q:** I enjoy the subject of math.
  
  - **Q:** I enjoy studying math in my school math class.
-

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## Perceived Value of Mathematical Tasks/ Activities

### Value: Interest

enjoyment the individual gets from performing the task.

### **Evaluation Results**

- Interest in math increased over the course of the year
  - Students in Math Circle, both pre and post survey, have the highest interest in mathematics.
-



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## Perceived Value of Mathematical Tasks/ Activities

### Value: Utility

how the task relates to future goals.

### **Evaluation Questions**

- **Q:** Math will be useful for me later in life.
  - **Q:** I need to have good mathematics problem-solving skills to be successful in the future.
-

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## Perceived Value of Mathematical Tasks/ Activities

### Value: Utility

how the task relates to future goals.

### **Evaluation Results**

- Math Circle participants rank higher in the Utility compared to other participants
  - MC ranked this task value highest in the survey.
  - Students who come into the Math Circle in the Fall 2011 returned with the understanding of the Utility of mathematics.
-

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## Perceived Value of Mathematical Tasks/ Activities

### Value: Attainment,

the importance to the self of doing well on a task.

#### **Evaluation Questions**

- **Q:** Being good at problem solving in math is important to me.
  - **Q:** It is important to me to be a person who reasons mathematically.
  - **Q:** In addition to getting the right answer in mathematics, it is important to understand why the answer is correct.
  - **Q:** Compared to most of your other activities, how important is it for you to be good at math?
-

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## Perceived Value of Mathematical Tasks/ Activities

### Value: Attainment,

the importance to the self of doing well on a task.

#### **Evaluation Results**

- All students responded that it was both important to have the correct answer and to understand why the answer is correct.
    - This is something that stuck with the students over the summer and supports a long-term attitudinal change of the students.
  - The Math Circle students (compared to others) were the only group that improved their task value related to Attainment.
-



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## Perceived Value of Mathematical Tasks/ Activities

### Value: Cost

the accumulated negative aspects of engaging in the task, and the amount of effort required to succeed at the task.

### Evaluation Questions

- **Q:** I would rather be in my math class than my other classes.
  - **Q:** Hard math problems scare me.
-

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## Perceived Value of Mathematical Tasks/ Activities

### Value: Cost

the accumulated negative aspects of engaging in the task, and the amount of effort required to succeed at the task.

### **Evaluation Results**

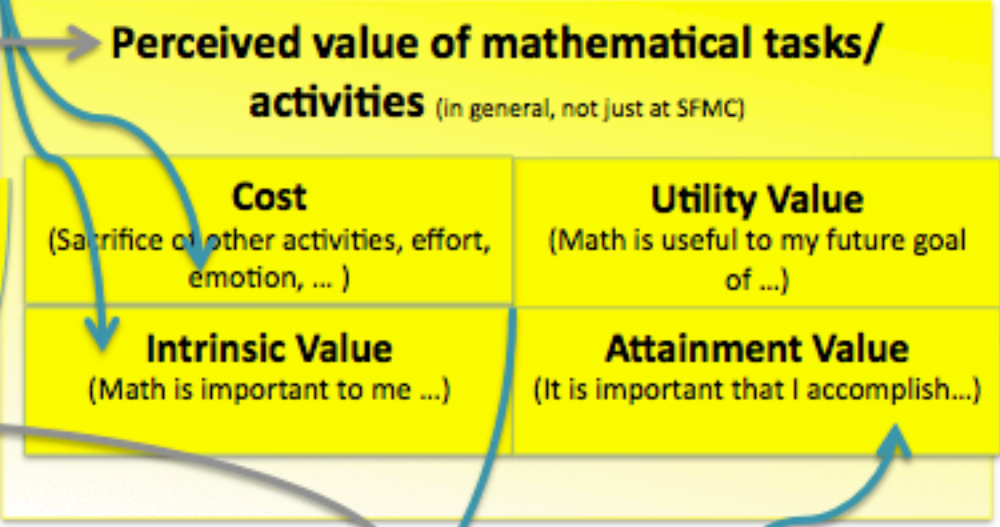
- For most students, their scores increased for the Cost task value. This means that students had a reduced negative impact from their participation in math over the course of the year.
  - It should be noted that all students had less appreciation for their Math classes at the end of the year.
-

# Theoretical Model for SFMC & SFMC Goals

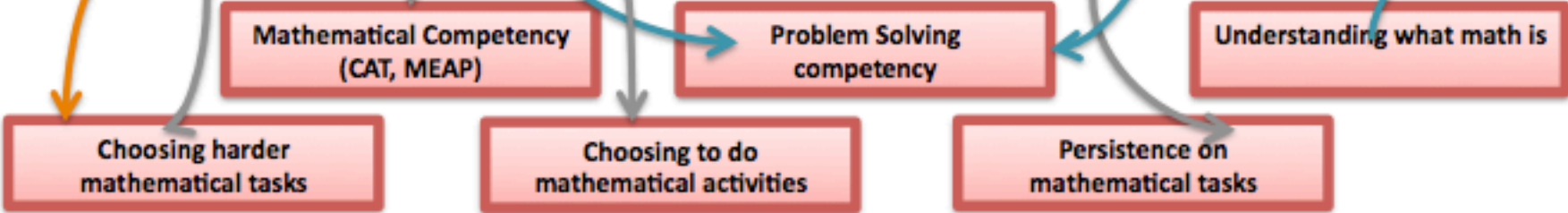
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	SFMC GOAL	

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# Nature of Mathematics

## **Evaluation Questions**

- **Q:** Have you met a mathematician before?
  - **Q:** Describe what a mathematician is. What do they do all day?
  - **Q:** Problem solving is an important part of mathematics
-



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# Nature of Mathematics

## **Evaluation Results**

- Surprisingly, in this question set the students identified in Math Circle responded more negatively that they had not met a mathematician before (3.59) and more positively (3.83) that they had met a mathematician at San Francisco Math Circle. Overall their responses show that they have had more exposure to craft of mathematics and have gained a larger understanding of the field.
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# Nature of Mathematics

## **Describe a Mathematician**

- I think they are a group of men that they only know how to solve the unsolved problems in math
  - I'm sure their daily activities vary. You expect me to answer, "they're old, boring and do math, " however, they are not exactly all like that, even if they do practice math as a career
  - They helped us solving challenging problems
  - MATH. EAT. SLEEP
  - A mathematician teaches and solves math problems. Also they can try and find new theorems
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# Safe Mathematical Community

## **Evaluative Questions**

- **Q:** Being a Math Circle participant is a major part of who I am.
  - **Q:** In our math class, it's OK to make mistakes as long as you are learning.
  - **Q:** In my math class my teachers would like me to do challenging math problems, even if I make mistakes.
  - **Q:** I have friends in my Math Class.
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# Safe Mathematical Community

## **Evaluation Results**

- Students indicate it is safe to make mistakes while learning
  - Math Circle students indicate that it is important to think and reason mathematically
  - All Math Circle students indicate: In my math class my teachers would like me to do challenging math problems, even if I make mistakes.
  - Math Circle students have friends in Math Class
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**Thank you very much!**

**Do you have any questions?**

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