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

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MSRI & SFSU

MathFest 2012

SAN FRANCISCO MATH CIRCLE

Goals/Outline of Talk

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

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:

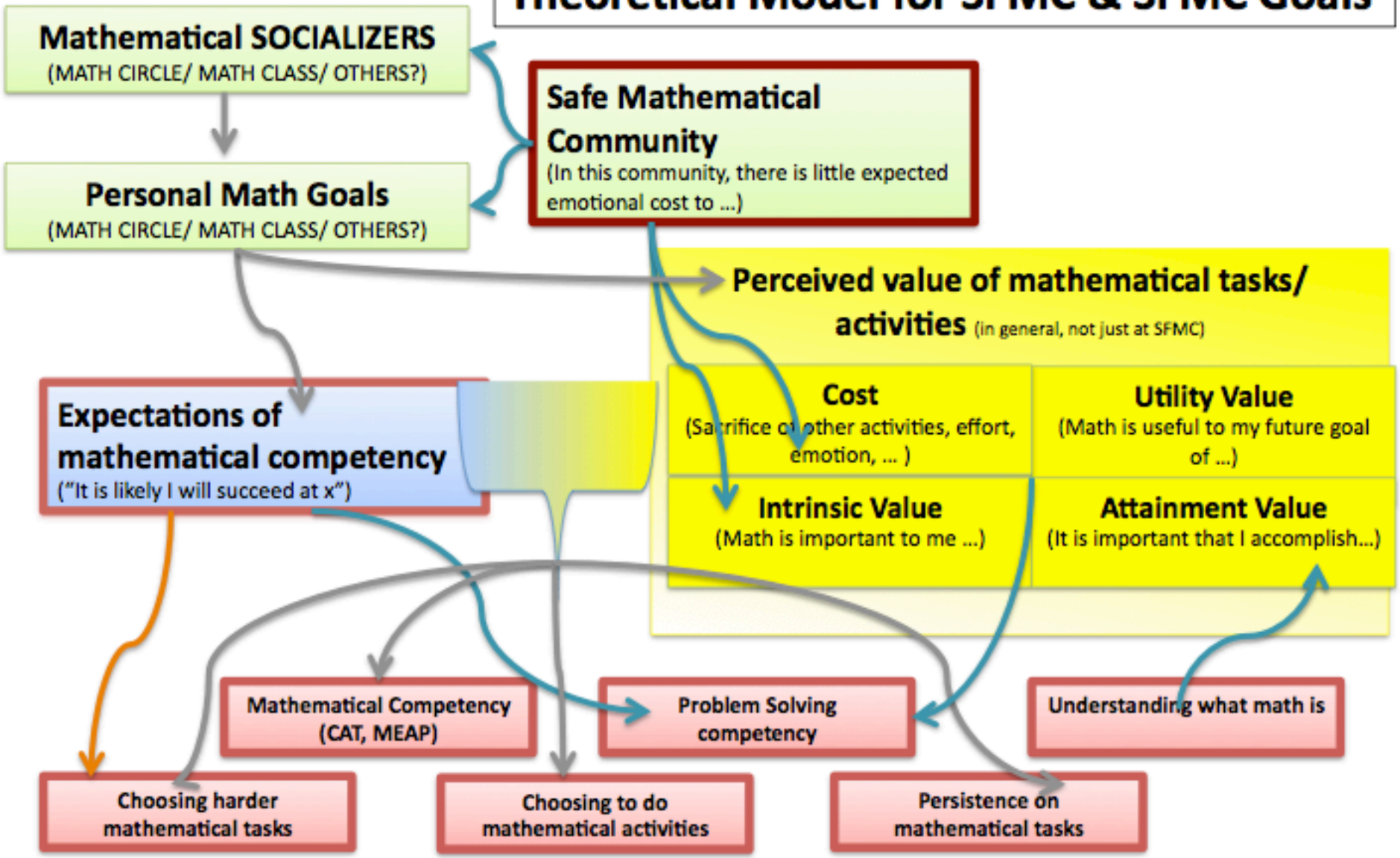
- increased individual mathematical competency;
- increased problem solving competency;
- individual students choosing to do mathematical activities;
- individuals students choosing to explore harder mathematical tasks;
- increased persistence on mathematical tasks;
- an increased understanding of what math is.

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
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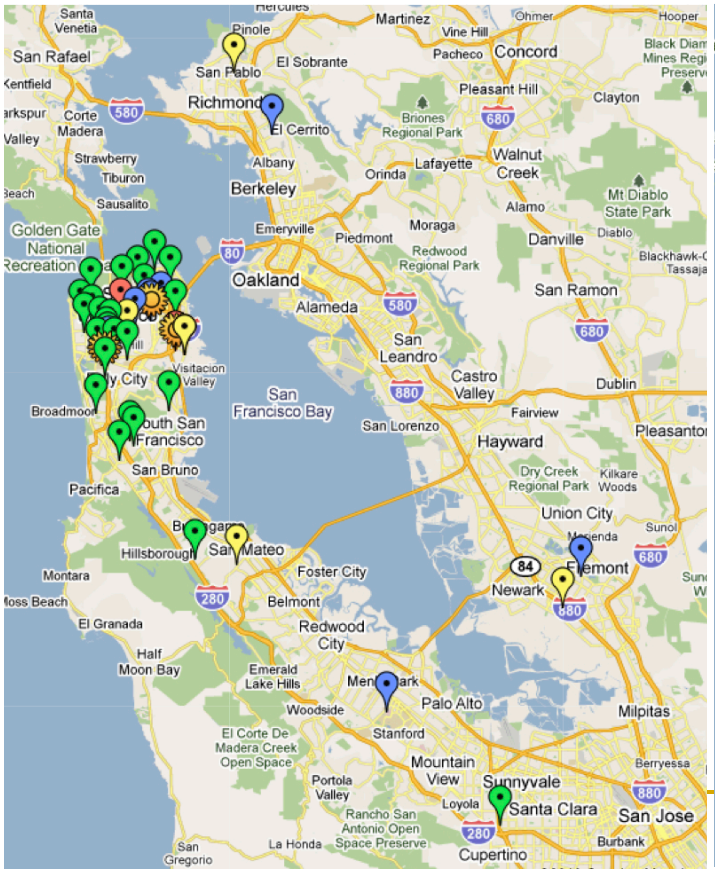
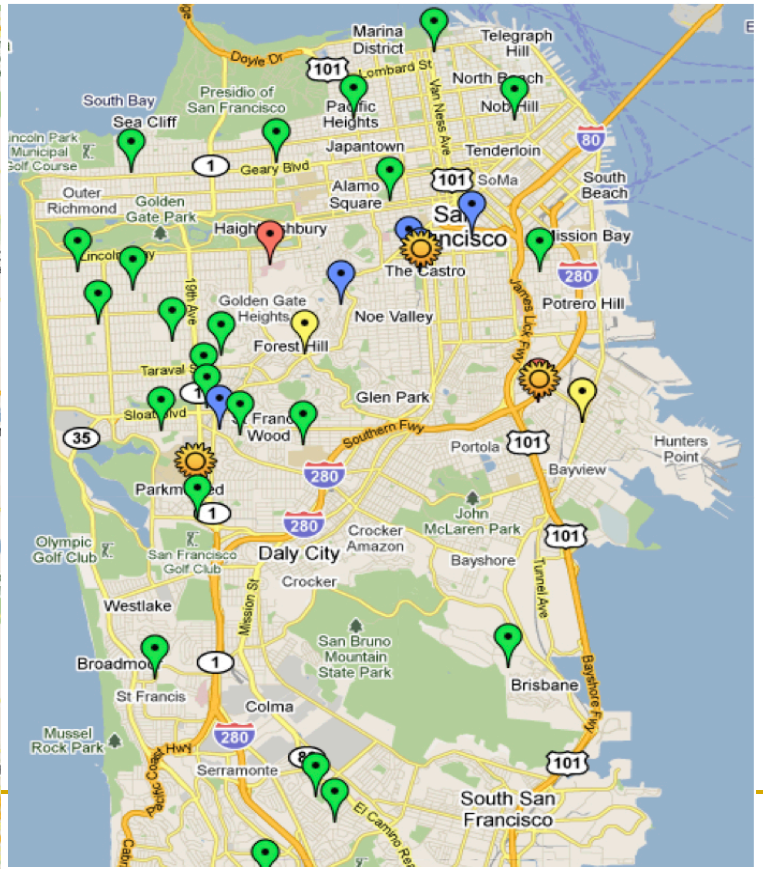
Boxes	A theoretical construct	Need to definite it, in a sentence (if applicable) followed by a paragraph of citations for who researched it.
	SFMC GOAL	

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 …)





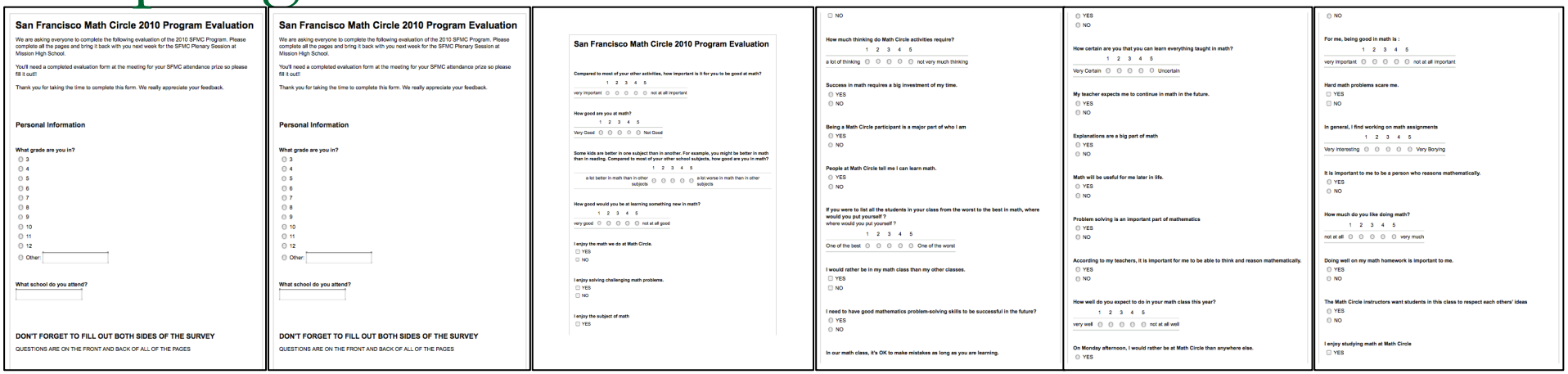
SFSU students & teachers

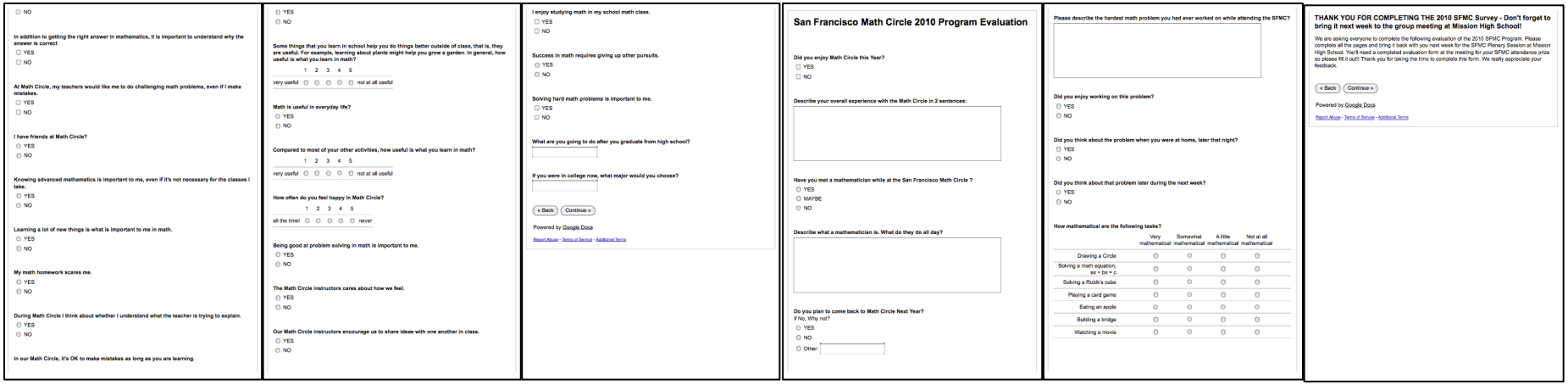
Mission students & teachers

Bayview students & teachers

SFSU teachers

Spring 2010 Evaluation Form

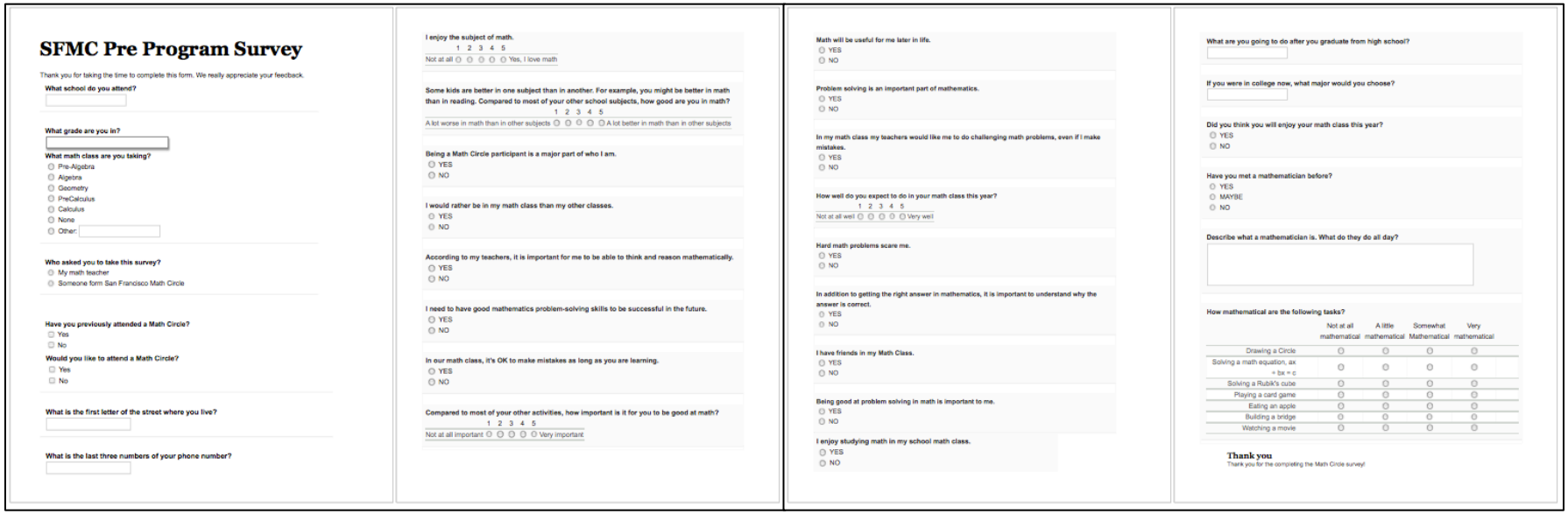




12 PAGES – 6 pages front/ back

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
- PreCalculus
- Calculus
- None
- Other:

Who asked you to take this survey?
- My math teacher
- Someone form 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	○	○	○	○
Solving a math equation, $ax + bx = c$	○	○	○	○
Solving a Rubik's cube	○	○	○	○
Playing a card game	○	○	○	○
Eating an apple	○	○	○	○
Building a bridge	○	○	○	○
Watching a movie	○	○	○	○

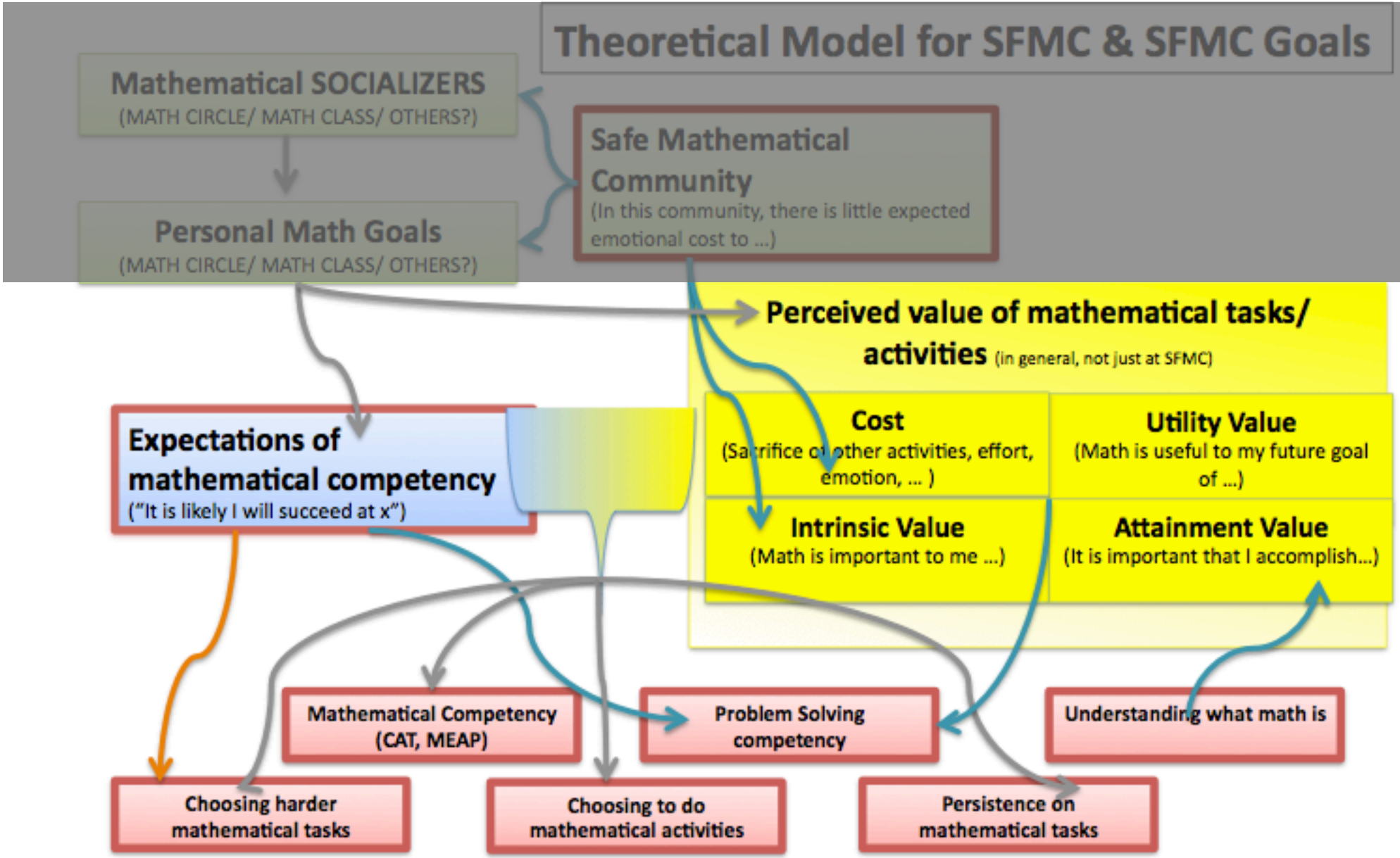
Thank you

Thank you for the completing the Math Circle survey!

2 pages – 1 front/ back

Given to SFMC, $(CM)^2$, SFUSD teachers, OEBMC – 300+ responses

Theoretical Model for SFMC & SFMC Goals



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	SFMC GOAL	

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.

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.

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.

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.

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.

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?

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.

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.

Perceived Value of Mathematical Tasks/ Activities

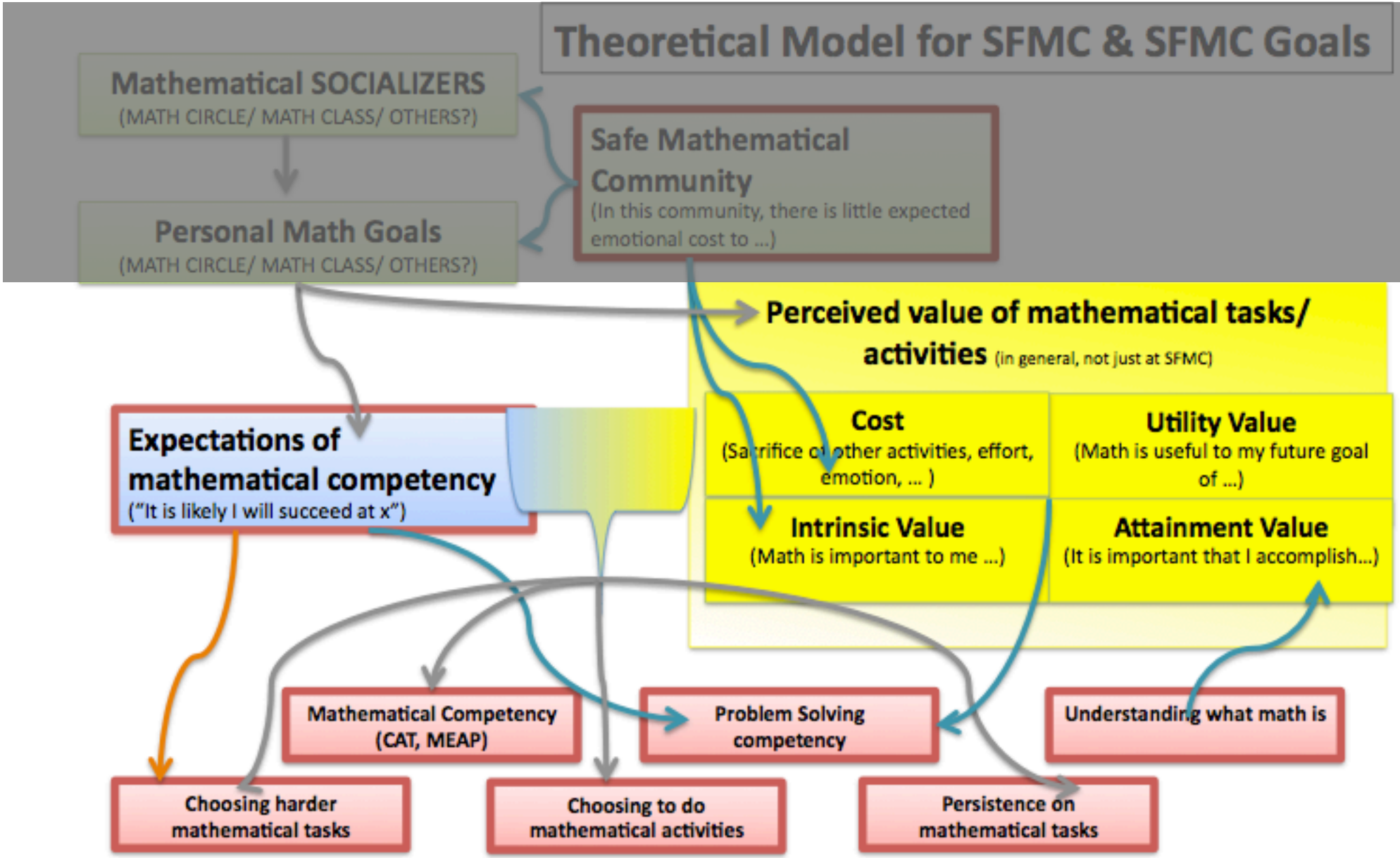
Value: Cost

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	

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

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.

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

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.

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

Thank you very much!

Do you have any questions?

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mathcircles.org