The Supplementary Material *Math's Mate* and Implications of Research on its Use, Effectiveness, and Success

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INTRODUCTION

She had her head down for a minute or two, writing neat rows, with plusses and minuses and plenty of numbers. A quick scribble revealed the number “14” on her paper, and she said it with a sigh as she looked up at me with one eyebrow raised. At first I said nothing, and almost immediately she went back to her notebook, scribbling over the neat rows with a thick, zig-zagged pencil mark and began a new row of plusses, minuses and numbers.

“Two?” she said after a few moments, but this time reading right from her paper.

“How did you get two?” I asked calmly and with a small smile starting at one corner of my mouth.

“I don’t know,” she paused. “It’s wrong, I know it.”

“I didn’t say it was wrong, I asked how you got it.”

She looked down, almost at her notebook, but not quite—more off in the distance beyond her notebook. I could see her matching her thumb to each finger on her hand, and silently mouthing words as she counted.

“No I *am* right. It’s two because the first time I just added, but I shouldn’t have because there was a minus, so now I subtracted. ‘Six plus minus eight’ is two.” She seemed more confident this time, but my hesitation clued her in.

“I’m wrong again aren’t I?”

This wasn’t the first time she was battling her intuition over an arithmetic problem. Time and time again, despite practice, I watched her grapple with basic addition and subtraction, and nothing I’ve tried has permanently combated this setback.

OVERVIEW OF RESEARCH STUDY

Background Information

I have long suspected that many students navigate through elementary school lacking the mathematical skills they need to be prepared for more advanced math courses. Through investigative research, I have discovered studies that show that students in high school and lower levels of schooling do indeed have unsatisfactory abilities in mathematics. Looking at the literature about this topic indicates that American students have trouble not only with difficult topics but with simpler topics as well, such as are encountered in arithmetic. This is especially troubling since the study of arithmetic leads to algebra, and algebra is the gateway to more advanced studies in mathematics. How can students begin to be interested in calculus, statistics or any of the areas of applied mathematics if they have experienced failure as early as arithmetic?

It has become very clear to me, through my individual and group tutoring experiences, my observations of students in classrooms, and my student teaching experiences, that student problems in arithmetic are a major problem in the American educational system, and the literature on this topic supports these observations. The widespread student problems associated with the development of arithmetic skills and conceptual understanding have plagued mathematics educators for years and as a result, many companies have created special programs to either supplement or even replace the standard junior high school and high school curricula.

One such set of materials is called *Math's Mate*, an Australian program created in 1995 to supplement the regular mathematics curriculum in Australia. *Math's Mate* has

also been adopted by many American schools and is currently available for the United States for grades 5 through 10.

Math's Mate

Math's Mate was created in 1995 by Australian physics and mathematics teacher Joe Wright in response to the increasing difficulties he noticed his high school students having with the mathematics curriculum. Some of the difficulties he noticed were:

- students not retaining information from past years;
- students relying on the teacher to have the answers and check work;
- the lack of parental involvement in their children's schooling;
- the need for reinforcement of classically difficult concepts like fractions, working with zero, and negative numbers; and
- the increasing demand to let students use calculators.

Despite *Math's Mate* being a foreign program developed to address the needs of Australian students who are following Australia's mathematics curriculum, the literature on student problems in mathematics shows that the problems Australian students face are very similar to the problems in learning mathematics faced by American students[i]. Through email correspondences with the creator of *Math's Mate*, Joe Wright[ii] as well as a telephone interview with Kathy Frick, an American *Math's Mate* coordinator who taught in Australia for one year and then returned to the states with the program[iii], I have learned more about the purpose, goals, and inner workings of *Math's Mate*.

The basic structure of *Math's Mate* is a skills-based homework program. Skills-based simply means that the program practices the same topics, techniques, and types of problems. Each week, students are assigned a sheet from their *Math's Mate* workbook, to

be completed on their own at home. After completing a section of weekly sheets, students chart their scores in their workbooks. Over time, they can notice trends they are having with a skill, as every same-numbered problem on every worksheet practices the same skill laterally.

For example, every problem numbered 5 practices addition of large numbers, and every problem numbered 19 practices unit measurement. Once a difficulty is diagnosed for a particular skill, the student can go to the internet to download a free copy of a *Skill Builder* from the *Math's Mate* website, which can provide further practice for that particular skill. Long and short term memory are supposedly increased through repeated, cyclic review of these skills,. The creator set the following goals for this homework program:

1. increase parental involvement;
2. be fair;
3. allow all student to achieve a satisfying degree of success;
4. give some focus to areas of common student weakness;
5. motivate students to attempt to overcome their own areas of weakness;
6. help teachers to keep track of individual student strengths and weaknesses;
7. help students to see their own progress;
8. give teachers an indication of the effort individual students are prepared make;
9. be manageable by teachers who in many cases are already overworked; and
10. be consistent in quality, format, and expectations.

The increased focus on parental involvement; out of classroom use; and student responsibility for completion, correction, diagnosis of difficulties and follow-up of work

are qualities that make *Math's Mate* stand apart from other supplementary programs. As far as I was able to determine from my communications with *Math's Math* creator Joe Wright, my conversation with *Math's Mate* American coordinator Kathy Frick, and from my review of the literature, there is currently no formal research being carried out on the use, availability, success, and implications of using *Math's Mate* in and out of the classroom.

THE RESEARCH QUESTIONS

Looking over the goals that Mr. Wright has set out for the *Math's Mate* program, I developed a sense of what I could find out from surveying teachers about how these goals are being met. Using these goals as a guideline, framing questions steer the direction of the project, refine its purpose, and ultimately investigate the extent to which *Math's Mate* was being used beneficially by American teachers and also what, if any, problems they were finding with this program. I also hoped that this research would enable me to learn how *Math's Mate* could be used to address at least some if not all of the arithmetic difficulties I had seen in my own tutoring, school observation, and student teaching experiences.

The research questions I developed to guide this project in general and help in the development of the teacher survey were:

- To what extent does using the *Math's Mate* materials increase the capabilities of students to answer correctly, understand, and eventually master basic arithmetic skills and concepts and more complex arithmetic abilities in grades 7 and up?

- What are the advantages and/or disadvantages to using *Math's Mate* as a supplement to the regular curriculum materials?
- To what extent and in what ways does *Math's Mate* help to address the pervasive difficulties late elementary, middle, and high school students have in arithmetic, marked by their voiced discomfort and continuing written computational errors?
- What other supplementary materials exist and are being used by teachers in the United States and how does *Math's Mate* compare to them in terms of content, instructional approach, usefulness, and any other ways?
- Does *Math's Mate* assess the ability of students to master arithmetic concepts? What is the proof of mastery this program provides?
- Do students recognize the need for using this program—for reinforcement of skills, cyclic review, ensuring that mathematics education is an ongoing process—in their classroom?
- How does working outside of the classroom affect a students' success in arithmetic?
- How do teachers define success in and mastery of arithmetic?

METHODOLOGY

In order to answer these research questions, I knew that I would have to gather data not only from teachers currently using the *Math's Mate*, but also from teachers who had used it in the past and may have stopped using it for any number of reasons. Opinions from both groups of teachers would be needed to determine if *Math's Mate* was

achieving its stated goals. To both get access to and responses from teachers quickly and easily, and have a chance to follow up and converse with them, I knew that the research methods needed two parts: a survey with consent form and an interview.

The survey would allow teachers to share their opinions and methods of use of *Math's Mate* in a straightforward way, giving me enough information to answer the questions that guided my research and also draw some conclusions that could be followed up in the interview. The interview would serve to clarify responses to the survey, delve more deeply into topics mentioned in the survey, and answer new questions that arose from the analysis of the surveys. If unexpected yet interesting findings resulted from the surveys, they could be partly addressed and some of my own theories could be checked with real opinion from the interview.

The construction of the survey allowed it to be completed quickly yet provoke some thought and reflection about the use of *Math's Mate* in the classroom. It consisted of 24 questions, ranging from basic informational questions about the teacher, school, and student population; to questions rating the use and effectiveness of *Math's Mate* on a five-point scale; to open-ended responses designed to allow for participant opinion and comments not addressed in the survey directly[iv]. To encourage participation, consent forms to the potential participants suggested that it would take no longer than 20 minutes to complete the survey. The consent form also clearly stated that participants could opt-out of being a candidate for the interview portion, which would encourage more teachers, already busy with their own school workload, to participate in just the survey portion if that is all their time allowed for[v]. Interviews would only be conducted with participants who had taken and returned the survey, signed the consent form, and also agreed to be

interviewed. The preliminary goal was to receive fifteen surveys back and go further with two to three of those participants with a phone interview.

Through the *Math's Mate* regional contact and distributor, Nancy Constable, of Learning Cycles LLC, compiled a list of schools in the Northeastern United States that were using or had in the past used *Math's Mate*, outlining the contact person at the school, phone number, address, and school level (elementary, middle, or high school). Originally, Ms. Constable planned to be the primary correspondent for inquiring about interested participants and distributing the surveys and consent forms to the main contact people at the schools with whom she had working relationships. However, because of a business trip, she was unable to commit to these duties early on in the process.

Using the compiled list of contacts, I found email addresses of the contact people, and I then sent each of these contact people a brief summary of the project and purpose, and the survey and consent form in the body of the email. Those interested people—teachers, math department heads, assistant principals—then inquired if their staff, current or past users of *Math's Mate*, would be interested in participating in this research project. These potential participants would then contact me directly with their completed materials to ensure that no teacher would be penalized in any way for their decision to participate or not participate in this study.

Of the 28 schools on the list with contact people, 25 were located in Massachusetts; two were located in New York City; and one was located in New Hampshire. Contact was made with sixteen of these schools based on the availability of email addresses for administrators and listed contacts from their websites. The location

breakdown of the sixteen selected and contacted schools consisted of fourteen from Massachusetts, one from New Hampshire, and one from New York City.

Of these sixteen schools, five contacts responded with interest. Upon her return, Ms. Constable also sent out three emails of information, two to contacts I had already contacted and one to a school for which I was unable to find an email address. One of these contacts responded to me with interest. Mrs. Constable also visited three schools, leaving a master copy of the consent form and survey for the main contact person.

A rough estimate of the total number of teachers who have used and are using the *Math's Mate* program in the Northeast region that Learning Cycles distributes to is 500, from 71 different schools. For unknown reasons, exact numbers are not kept and it also is difficult to estimate the number of teachers currently using *Math's Mate*, since school sizes vary and materials ordered do not necessarily reflect how many teachers are using the product. It is unknown how many teachers use *Math's Mate* in the 16 schools contacted. However, Ms. Constable estimated that 26 teachers in the three schools she visited were eligible to participate in the survey. As of the writing of this report a total of seven consent forms and accompanying surveys have been returned and one follow-up telephone interview has been conducted.

The idea of the follow-up interview was two-fold, as mentioned previously: to provide clarification for the responses received in the surveys and also to delve more deeply and more broadly into the feelings teachers have about their use of *Math's Mate* in ways that were not possible in the survey. Because only two schools using *Math's Mate* were in my geographical area, I knew that the follow-up interviews would have to be conducted by telephone rather than face-to-face.

One phone interview was conducted after selecting one teacher from an early pool of survey respondents. Because of time constraints in turning in this research report, it was later decided that no additional interviews could be conducted. Consequently it was impossible to look for common features or responses from all the interviews and make general comments from them. However, some interesting comments made in the one follow-up interview and these comments will be discussed in a later section.

DESCRIPTION OF RESPONDENTS

With seven surveys returned, there was only a small population of respondents to focus on. As shown in Figure 1, the first comparison is between time frame and whether or not the respondents have or had used *Math's Mate* in their classroom.

		Past	
		Has Used	Has Not Used
Present	Using MM	4	1
	Not Using	2	0

Figure 1

Out of the seven respondents, four had used *Math's Mate* and were currently using it as well; two had used *Math's Mate* in the past but were not currently using it; and one was using *Math's Mate* now but had never used it before.

Since a teacher's number of years of experience might have some relationship to their use of or feelings about *Math's Mate,* collecting data on this variable was also important. Separating the groups into gender serves as a tool to describe who responded.

Shown in Figure 2 is a comparison of male respondents and female respondents in terms of the range of years teaching and average years teaching.

	Female	Male
Number of Respondents	6	1
Range of Experience in Years	3 to 32	18
Average Years of Experience	15	18

Figure 2

Even though only one of the seven respondents was male, it appears from Figure 2 that the years of experience for the male respondent was not substantially different from the years of experience of the six female respondents who have an average of 15 1/3 years of experience and a range from 3 to 32 years of experience. In a more expansive study, more conclusions might have surfaced based on gender. Yet, even in such a small survey, it is notable that the vast majority of respondents were females.

Figure 3 shows a break-down of the kinds of schools these teachers work in, based on their own opinion of the location of the school and the majority student population. The question gave a list of nine descriptions, listed in the following way "rural, suburban, urban; socioeconomic status: low, medium, high; public, private, charter." Then it asked respondents to "describe the communities represented by the majority of students at the school in which they use *Math's Mate*" by circling the terms provided. An additional "other" section was included that allowed for respondents to better describe their school in their own words if the given descriptors were not accurate for their school. However, no teachers responded to that section.

Public Suburban Schools		Private Urban Schools	
Frequency	SES	Frequency	SES
4	medium	1	high
1	low + medium		
1	low + medium + high		

Figure 3

There were a total of six public schools, and all were suburban. There was one school identified as private and it was also the only urban school. Of the six public, suburban schools, four teachers identified the majority of their student population to be of a medium socio-economic status; one teacher described the students as equally low and medium SES; one teacher indicated that the students fit all three descriptions offered: low, medium, and high socio-economic status. The school identified as a private, urban school was also the only school whose students were described as from a high SES.

Finally, the respondents reported the number of years they have been using *Math's Mate* in their classroom. The responses to this question ranged from one to five years and Figure 4 shows the frequency of each response. As is easily seen from Figure 4, five of the seven respondents have been using *Math's Mate* for only one or two years while the remaining two respondents have been using it for five years.

number of years using Math's Mate	1	2	3	4	5
number of teachers	3	2	0	0	2

Figure 4

RESEARCH RESULTS AND INTERPRETATION

The data described above in Figures 1 through 4 in the previous section are descriptive of the respondents in terms of variables such as gender, number of years

of teaching experience, type and geographical location of school, and socio-economic status of the student population. In this section I will look at and analyze the survey responses to questions about the teachers' uses of and perceptions about *Math's Mate*. In doing so, I not only present the results of the individual survey questions, but attempt to discern patterns and relationships among the responses. These are presented, for the benefit of the reader, as individual observations.

Observation 1

One of the sections of the survey asks about the usefulness of *Math's Mate* through six questions, numbered (8) through (13). The particular statements posed to respondents for each question number were as follows:

(8) I see *Math's Mate* as a means for student to practice and reinforce older material.

(9) I see *Math's Mate* as a means for student to gauge their understanding of a topic.

(10) I see *Math's Mate* as a means for students to re-teach themselves older material.

(11) I see *Math's Mate* as a means to help me assess where students need help most.

(12) I see *Math's Mate* as a means to help students, already successful in the skills presented, gain mastery of arithmetic.

(13) I see *Math's Mate* as a means to assign homework.

For each of these six questions the respondents indicated the extent to which they either agreed or disagreed with the given statement. I used a scale of one to five with one being strongly in agreement, 3 being neutral, and 5 being strongly in disagreement. Figure 5 shows the responses to the statements, organized by question number and rating, and listing the total number of responses given for each rating. Note that each statement

says something positive about the use of *Math's Mate*, so that a lower number represents a belief that *Math's Mate* is useful for the particular educational objective specified while a higher number represents a belief that *Math's Mate* is not useful for the particular educational objective specified.

		Response				
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Question Number	#8 : students practice and reinforce older material	4	2	0	1	0
	#9: students gauge their understanding of a topic	3	0	3	1	0
	#10: students re-teach themselves older material	3	0	1	2	1
	#11: helps me assess where students need help most	3	3	0	1	0
	#12: helps students already successful gain mastery of arithmetic	1	2	2	2	0
	#13: a means to assign homework	0	0	1	2	4

Figure 5

The responses to the individual questions in Figure 5 provide some interesting information. For example, the responses to Question 8 show that six out of the seven respondents think that *Math's Mate* is really good at getting kids to practice older material from past classes, and reinforce those skills. The responses to Question 9, however, show that while three of the teachers think *Math's Mate* helps students see whether or not they understand each topic presented on the sheets, another three teachers do not have strong feelings either way about this aspect of *Math's Mate*.

The next question, number 10, asks about how students take responsibility of re-teaching themselves older material. The responses to this question were also quite varied with three of the responses positive, three negative, and one neutral. Finally, most

teachers responded positively to Question 11, most responded negatively to Question 13, and there was an almost even split on Question 12.

From the collected data it appears that most of the respondents believe that *Math's Mate* is great at reinforcing old material from past math classes, and it is also successful at helping the teacher assess the skills with which each student needs the most help. Using *Math's Mate* to have students gauge their own understanding of a certain topic and mastering arithmetic were not seen as strong points of *Math's Mate* by most of the respondents. Having students use *Math's Mate* to re-teach themselves older material was a split topic amongst the responders. Finally, using *Math's Mate* as an easy way to assign homework was not something teachers thought the product was good for.

Although the responses to these six questions are useful individually, the findings become more interesting when compared to the responses given by these teachers to other questions in the survey. For example, consider the one respondent who, for Question 8, answered "disagree" when all the others responded with a "strongly agree" or "agree." It turns out that this respondent also gave the "strongly disagree" in Question 10 and the lone "disagree" in Question 11. By looking at this respondent's answers to other questions, especially the open-responses, the reasoning for her lower ratings of *Math's Mate* becomes clearer.

The response for Question 21, which reads "If you've used both *Math's Mate* and one or more other supplementary programs, what is *Math's Mate* providing you or your students that the other supplementary programs did not?" leads to some easy conclusions about this respondent's reasoning for her opinions about *Math's Mate*. She writes, "I find

Math's Mate to be sort of an annoyance. About the only positive thing is that the format makes it easy to track/monitor skills gaps."

She also reveals in another response that "many of the problems pertain to topics we have not yet covered in class. Everyone gets these wrong and/or stops attempting to answer these particular questions after a certain amount of time." She also suggests that *Math's Mate* seems better for younger students, and students who don't have basic skills by ninth grade, the grade in which she uses the *Math's Mate* program. Yet, a slight contradiction is that she believes her students' understanding of arithmetic at the beginning of the year was a "broad range, many with very weak basic skills."

This might suggest that *Math's Mate* may have been more successful in the beginning of the year, when the students were displaying weak skills. Yet, she thinks that the topics covered are at times too hard for her students, which is why they do not complete the *Math's Mate* sheets and may be a point of frustration for her. Also, the level of *Math's Mate* she uses for her ninth-grade students is both the eighth and ninth grade editions of *Math's Mate.*

The inconsistency of these answers across questions leads me to be cautious in trying to read too much into her responses. She thinks *Math's Mate* is good for younger students, but the eighth and ninth grade materials are too hard for her ninth graders. This might suggest that at a certain level, maybe entering U.S. high school level, the *Math's Mate* worksheets become a bit more challenging on purpose, or present more advanced problems that serve as a preview to high school-level math.

Another piece of information that leads to more questions is that this teacher is using *Math's Mate* for the first time this year and has the least amount of teaching

experience of all respondents. This may explain her "annoyance" with the product; it takes time to really learn to use and feel comfortable with any materials, and this includes supplementary materials. Also, there are many ways that *Math's Mate* might be used just for certain things in the classroom, and may not serve every aspect of its goals for her students. Adjusting to this new classroom material and being a generally new teacher may have had an effect on her opinions of the product, especially when the other respondents have a range of 11 to 32 years of teaching experience.

Other criticisms of *Math's Mate* include ineffective assessment of some skills. One teacher referred to the low level of difficulty of some of the addition problems, and operations on fractions—they are easy enough that students with very low skill levels in these areas could still get the questions correct. Another teacher wonders about assessing skills solely on what students complete at home. Although concerned that students might answers to questions without really being taught how or why by their parents, the teacher counters this worry with in-class assessments, but only three to four times per year.

Observation 2

Some clarification can be made in regards to why most of the other respondents thought that, as shown by their answers to Question 8, *Math's Mate* was great for reviewing older material but not so much for providing students a chance to re-teach the material to themselves, as explored in Question 10. Figure 6 below compares the United States grade level of the students with whom the respondents were using *Math's Mate* with the actual level of *Math's Mate* they use, as self-reported by the respondents.

Student Grade Level	Math's Mate Grade Level
8	9 gold
7, 8	6, 7, 8
9	9
9, 10	9, 10
9, 10	9, 10
9	8, 9
7	7

Figure 6

Notice that two of the teachers, both from suburban public schools, one with a medium SES student population and one with students from all three SES levels, use below-grade level *Math's Mate* in addition to the actual grade-level *Math's Mate.* One teacher, from a private, urban, high SES school uses the higher-level 9 gold series *Math's Mate* for students in 8th grade. Although the majority of teachers use at-grade level *Math's Mate* materials, someone not familiar with the actual worksheets and content of *Math's Mate* might think that the adjustment of the program from Australian to American curricula could have caused the difference in expectations or difficulty from one system to the other. Another conclusion is that these teachers may feel that just presenting *Math's Mate* problems on the sheet to students is not enough for them to be able to actually re-teach themselves the material.

However, the teacher using the higher-level Math's Mate with students mentioned in response to the following question, "Are there other statements that also (or better) reflect your views on the use of Math's Mate as a supplement to the regular curriculum in your classroom?" that sometimes, Math's Mate serves as an introduction or preview of a particular topic. So it is not that the other booklet levels are necessarily too easy—this teacher uses the program in a specific way, sometimes to challenge students.

Looking at the responses to Question 19, which asks "Have you used *Math's Mate* at more than one grade level? Do you consider it more appropriate for one or more grade levels as compared to others? If so, please describe where you think it is most appropriate and why," gives some more perspective of what grade levels *Math's Mate* is most successful. One teacher asserted that it is "more appropriate for middle and 9th-10th graders. This is when students need to reinforce basic skills." Others had used the materials in other grades, and two teachers thought about the use of *Math's Mate* for consecutive years. "I've only used it in 7th grade, but the years when it was most successful was when the students had the program in 5th and 6th grades as well," said one of the suburban public school teachers, who has been using the program for five years; another teacher, also from a suburban public school but with only one year of experience with *Math's Mate* conjectured, "I have seen *Math's Mate* being used at the middle school, grade 6 level. I think it works very well there—if students follow the program from grades 6-10 it would prove to be more helpful!"

This is where an interview with some of the teachers would have been quite useful. A follow-up interview would allow the posing of questions like "why do you think *Math's Mate* is not appropriate for younger students than middle school?" or "why hasn't your school system worked at getting *Math's Mate* into consecutive classrooms?" Fortunately, in the one interview I did carry out, the conversation moved in this direction.

This interview was with the teacher from the private, urban, high SES school who used the 9 gold *Math's Mate* program with 8th grade students. After suggestions from the teacher, the school began a trial run with *Math's Mate* in the 6th, 7th, and 8th grade classes from January 2005 to June 2005. The school then decided to continue use of *Math's Mate*

because a follow-up evaluation provided positive feedback and the program was deemed good for all levels of math. *Math's Mate* is being used with 4th through 8th graders this year (2005-2006) and the interviewee stated in the survey, "it is too early to determine for sure, but we have seen an uptick in our students' standardized test scores."

Observation 3

One of the initial questions posed in this research study was whether there would be any relationship between such variables as teacher use of supplementary programs other than *Math's Mate,* the length of time the respondents had been teaching, and their feelings about the usefulness and effectiveness of *Math's Mate.* Figure 7 below is a comparison between the responses to Question 6 — "Have you ever used supplementary materials in your classroom other than Math's Mate?" — and the range of years of teaching experience for those individuals who responded with each answer.

	Yes	No
Used Materials other than Math's Mate	5	2
Range of Years of Teaching	3 to 19	19 to 32

Figure 7

It is obvious from just glancing at this chart that the less-experienced teachers had used other supplementary materials, whereas the more and most experienced teachers had not used other supplementary materials in the classes in which they used *Math's Mate.* If there was a larger set of data from which to draw generalizations, looking at this comparison might mean that teachers with more experience don't feel the need to use a

lot of supplementary materials or that they simple create their own supplementary materials instead of using commercially produced ones.

But looking at what the teachers thought about other supplementary materials they had used Question 20 asks "If you answered "yes" to question # 6 [Have you ever used supplementary materials in your classroom other than *Math's Mate*?], what did you like and/or dislike about the other supplementary materials you may have used?" one of the teachers classified her self-created problem sets as supplementary material. The complaint from one teacher about other materials is that "they cover only one skill at a time—*Math's Mate* covers a variety of skills weekly." A different teacher stated that "other supplementary materials provide more examples of one specific problem type that vary in such a way that you can diagnose a misconception within a concept. *Math's Mate* don't—except longitudinally."

Observation 4

The chart in Figure 8, below, compares several factors to the responses to the question "How often do you use *Math's Mate* in your classroom?" Options given were "frequently" (more than once per week), "often" (at least once every two weeks), "occasionally" (once a month), "rarely" (once every 2-3 months) and "never," and the survey asked respondents to circle answers. All teachers responded with either "frequently" or "often." Separated by the frequency of use, this chart has the calculations for the average number of years of teaching experience and average number of years using *Math's Mates.*

	Frequently (more than once per week)	Often (at least once every two weeks)
Male	0	1
Female	2	4
Average Years of Teaching Experience	9.5	18.2
Average Number of Years Using Math's Mate	5	1.4

Figure 8

Interestingly, the frequent users of *Math's Mates* had less experience teaching but the most experience with *Math's Mates.* More experienced teachers used *Math's Mates* less often and had been using it for a much shorter length of time.

Some of the questions that this raised were: Are more experienced teachers less willing to devote class time to the program? Are less experienced teachers more open to using a supplemental program in the classroom and keeping on top its management? Have they discovered more advantages to using the product as they have used *Math's Mates* for consecutive years? Have they changed the way they use *Math's Mates* in comparison to its suggested use to better accommodate their classroom?

Question 18 in the open-response section asks just that. "Do you use *Math's Mates* differently now than you did when you first started using it? If so, for what purpose(s)?"

The two teachers who had the most experience with *Math's Mates* and used it most frequently have both reported making adjustments to the way they use the product, to get maximum benefit. This first description of modifications comes from a 7th grade teacher in a public, suburban, low/medium SES school.

> I collect the homework and test results sheets and then make up individual packets for each student that have more practice problems in the content areas where they show the greatest weakness. I also pass on the results sheets to their eighth grade teachers to give them some information about their students.

Taking the results and assessment section of *Math's Mates* and actually using them to create a new, focused review packet certainly steps up the importance of *Math's Mates* in seeing where students need help and also following up to increase their skills. This teacher also says that "I mainly incorporated *Math's Mates* because Connected Mathematics Project [curriculum used in the class] does not provide skill practice. Students enter 7th grade lacking basic skills. This program lets me provide review and not re-teach." Getting a solid basis of mathematical skills—she later mentions decimals and fractions as a huge problem for her students—is very important to this teacher, and she puts forth more effort than required to get these basics up to par.

The other frequent user also comes from a public, suburban school with students representing all three levels of SES. Her use of *Math's Mates* takes on a whole new level, also valuing the assessment component of *Math's Mates* sheets but involving more mathematics.

> I have adjusted the student self-assessment part of the program by having students analyze and graph each term's progress and then create an action plan where they have to state how they are going to improve their weak areas during the next term… I also see *Math's Mates* as a way to develop IEP goals for special education students.

The level of use here shows not only proficiency in how the teacher is supposed to use *Math's Mates* to its fullest extent, but also mastery of what kinds of implications the results can provide for the student as far as assessment and goal-making goes. In addition, this teacher also comments, "I see *Math's Mates* as a way to inform parents of the skills which their student needs further assistance with." Later, she comments that the accuracy of the assessment sections makes them a tool to describe student progress during parent conferences.

These alterations to the program make them much better tools for the teachers who have been using them for the longest. These ideas sound like the beginnings of where the *Math's Mates* products will take these teachers and their students, as they are both very satisfied with the outcomes thus far from using the program in their classes.

ASSESSMENT OF METHODOLOGY

Because of time constraints, the intent of using follow-up phone interviews to explore and clarify responses on the surveys was not possible and only one such interview could be conducted. However, in a future study, the use of a phone interview would be preferred to follow up the responses given in the survey. The amount of unknown and much more specific information that was revealed in the single phone interview that was conducted was not only shocking, but clarified the tone of the respondent's survey. It also offered a chance to rephrase certain questions from the survey that were misunderstood or skipped so that a maximum amount of useful information could be retrieved to compare with other participants, whether or not they participated in the interview as well.

In trying to determine if any of the survey questions could be omitted in a future study, there were a few things to note. First, some respondents interpreted certain questions differently from what I had intended but I was still able to obtain the information I sought by looking at the responses to other questions. Consequently it may be possible, if I wanted to use this survey again, to reduce its length by merging certain questions instead of leaving them as separate questions.

Overall, there are no questions I would have simply omitted from the survey, despite my desire to shorten the survey to encourage more participants to take part. However, there are some additions I would make to sections or questions. One addition would be to add a question similar to Questions 8 through 13 but relating to increased parental involvement in their child's math education.

Questions such as numbers 20 and 21, which only refer to teachers who had used supplementary materials, would be added to. My own assumptions as a math teacher were that I thought that all teachers used supplementary materials in some way, and would reference them in these portions. Yet, this was not the case. I would adjust these questions in the future so that teachers who did not use other supplementary materials would still have a reason to answer the questions. Also, I would rephrase some questions so that the chances of a respondent leaving a response section blank would be reduced. Maybe the respondent would have to write at least a few words in response to an initial question. It seems shorter questions, with multiple parts to them, do a much better job at extracting information from teachers.

Another alteration I would make if I were to embark further into this project would be the time frame and the expectations of responses. Teachers already have a lot of work to do at any given time of year. The spring time, with midterms and quarter grades, testing and spring or holiday breaks, added extra battles that I was not expecting setting out on the research. Also, it took much longer and much more contact than I expected between those interested to get responses back from teachers and school districts. Most administrators did not respond to emails, and phone calls placed as follow up were very hard to get returned at a time when I also was not busy

Additionally, interested schools and contact people may have received the information and initially responded positively to me about their own interest, but the actual teachers receiving, completing, and returning the surveys takes a lot more effort on the part of the initial contact person than I anticipated, and their enthusiasm may not reflect the teacher population's enthusiasm. The low number of respondents could mean a disinterest in *Math's Mate*, a disinterest in participating in surveys in general, an unwillingness to be a part of the phone interview, not fully understanding the terms of being a participant, lack of clear communication about deadlines for the surveys to be returned, good intentions but being swamped by other work, and the fact that the contact made was from an outsider—someone they simply do not know and/or likely do not trust.

One suggestion I overlooked that may have validated the legitimacy of my research and increased teachers' willingness to participate was to have the *Math's Mate* people write a letter of support of the research project that could have been included in the emailing of the survey and other information. Whether or not it would be from Joe Wright, the creator of *Math's Mate*, and from the distributor, Learning Cycles LLC, is also another clarification that could be made. In a future study, it is also certain that I would send out hard-copy mailings simultaneously with the emailing to ensure that even those people not checking their email would get a chance to look over the material. I would also make certain that although the endorsement of the *Math's Mate* creator and/or distributor was included, that does not mean only respondents with positive comments would be preferred to respond. It is a shame I did not consider the idea earlier because I was concerned about deadlines that ended up getting altered anyway, due to the expanded timeline necessary to get a sufficient number of surveys back.

Finally, the greatest contribution to a future study would be to complete the phone-interview process and actually have more qualitative data from specific respondents to contrast with the quantitative data. Although questions I asked in the sole completed interview were sufficient enough to get interesting answers[vi], having the time to look at a lot of surveys and then conduct the interview prepared to get very specific questions answered would have been much more beneficial. Additional questions I would pose in the interviews would include:

(1) What affect has using *Math's Mate* had on the confidence level of your students in mathematics over the course of the year(s)?
(2) What are the most pervasive problems you think all students have in mathematics? Are these problems being addressed by *Math's Mate*? How do you know?
(3) For teachers who had used *Math's Mate* at one time and were not using it now, what were the factors that made you discontinue its use?
(4) Many of the other respondents varied in their opinions of *Math's Mate* usefulness in helping students gain mastery of arithmetic. Can you defend your response? What topics do you categorize as arithmetic? What does mastery of arithmetic mean to you?
(5) Is *Math's Mate* in place across grade levels in your school or school system? If not, would you like to see it? What factors helped or would help you and/or the administration at your school come to this decision?

Interview questions like these would add to the conversation with each interviewee started in the survey, and are also reflective of my analysis of other participant's surveys. Hearing out what other teachers opinions are of certain types of responses would be very useful in gaining perspective from the opinions of those who have used the program.

SUMMARY

The effectiveness of the *Math's Mates* supplementary program was studied by surveying teachers who are using or have used the product in their mathematics classrooms. Due to limitations of time in order to submit this report by the end of this semester responses were obtained from only seven individuals. An analysis of these seven surveys showed that the teachers surveyed believe that *Math's Mates* is excellent for review and reinforcement of older material. The way in which the program allows students to track the correctness of answers longitudinally is also very helpful for teachers in assessing the skills or topics with which a student is having difficulties. There was also a positive relationship between the frequency of use of *Math's Mates* during the school year and the number of years the teacher had been using *Math's Mates.*

Teachers who were more experienced with the program, but not necessarily had more overall teaching experience, were more inclined to alter the ways they used the assessment materials to suit their students and their own needs and develop *Math's Mates* as a tool for diagnosing student areas of weakness, and sharing that information with parents and future teachers. One teacher also used the assessment portion of *Math's Mates* to help students become more responsible for their own learning, by creating a

written action plan outlining what they would do in the next term to work on the areas of weakness that the *Math's Mates* structure exposed.

Clearly a good number of my own questions were answered; however, many of the more in-depth questions remain unanswered. The small number of respondents, the inability to complete a full phone-interview schedule, and therefore the lack of conclusive data are all factors that led to the lack of decisive answers. Hopefully, in a future project, these questions and more will be answered fully. Despite some of these shortcomings, the information revealed through the project is certainly useful in a personal nature, for those involved in the work of mathematics education, and for the specific community of *Math's Mate* users, distributors, and editors.

CONCLUSIONS

Proposals for the usage of the findings of this project include: direct adaptations to the *Math's Mate* program, suggestions for refining the targeted audience, and revisiting the issue of arithmetic difficulties of middle and high school aged students.

First, because of the suggestions of the survey participants, I believe some adaptations could be made to the program to increase the effectiveness of achieving its goals. Parent involvement is surely a plus to this program, as expressed in the survey responses; to further stress the importance of their presence in their student's education, a more detailed parent information packet could be sent home in addition to the standard letter included in the Teacher Resource Book for each *Math's Mate* level. This packet might detail the importance of monitoring but not directly aiding the student's completion

of their weekly *Math's Mate* sheet, offering small narratives of situations that parents may commonly find themselves in, and giving a space to provide feedback, possibly on the weekly *Math's Mate* sheet, from parents to the teacher. Offering helpful, guiding words to say if their student is struggling could help parents resist the urge just to give their child the answers to help them feel successful. Also, presenting the opportunity to have a continued, written conversation between parents and teacher could simply initiate a relationship on a small but documented scale.

To help teachers who are just starting the *Math's Mate* program in their classroom becoming quickly proficient in using it as a tool for assessing areas of weakness, a new sheet could be created for the teacher, similar to the end of term grid and assessment sheets the students use. In addition to the worksheet record used to keep track of student completion of the assigned sheet, teachers could collect student grids and compile them on a master grid. One suggestion is that, for each question number, teachers would bubble in an appropriate range—say "one to four students", "five to nine students", "ten to fourteen students", and "over fifteen students"—that tallies how many students got more than half of those questions wrong during the term. Although many teachers may create their own adaptation of this kind of "master grid", having it already accessible to new users might increase the use of *Math's Mate* to assess student skill area weaknesses. This early success with use of the program might also lead to retaining teachers who use the program so that the there are more teachers using the program for longer periods of time, and therefore using the program more frequently in the classroom as suggested by the research.

Also, because many teachers responded that prominent areas of student weakness were operations on decimals and fractions, more questions could be added, some topics replaced, or later questions altered to include more practice of these skills and to give greater emphasis to this common area of misconception. Slightly increasing the level of difficulty of decimal and fraction problems could be an alternative to more practice, or an addition to it.

Secondly, getting a more targeted audience of potential clients could help expand the use of the program beyond the 26 schools I was able to get contacts for. The distribution companies like Learning Cycles, LLC and even the overarching *Math's Mate* publisher and creator, may want to collect data about who is using their product. Including a simple, short survey in the form of a postcard in every shipment, or having a small form included in the billing process for every order could help tally the amount of schools, teachers, and students using their product. Additionally, more information about what kinds of schools *Math's Mate* is being used in could be gathered by using a similar format to the one I used in my survey—asking respondents to circle predetermined descriptors or fill in an "other" option.

The advantage of having this data would be to target new schools for recruitment, and provide data to them to encourage the use of the program there if similar schools are using *Math's Mate* successfully. Another targeted audience might be teachers with 10 years of experience or less, as the research showed that there could be a relationship between average years of experience to the willingness to adapt and more effectively use the program in the classroom. Less tenured teachers who have more professional

development requirements may also find the program useful in accomplishing some of their goals.

Finally, deciding "the extent to which *Math's Mate* materials increase the capabilities of students to answer correctly, understand, and eventually master basic arithmetic concepts and more complex arithmetic abilities in grades 7 and up" has revealed some gains in student ability as far as the teachers can tell thus far. The usefulness of *Math's Mate* as a tool for the teachers turned out to a greater focus in the survey, yet they do believe that cyclic review is the answer to getting students to work on skills that are lacking while simultaneously not taking up precious class time for instruction of new material. The ways that *Math's Mate* addresses the pervasive difficulties that middle and high school students have is through the consistent review of material and visual aid of grids to show students where skill weaknesses are. This is illuminating that the use of such a program is tied to the belief that students aren't coming into middle and high school with the skills they need.

Is the only solution to continue supplementing student skill-weaknesses with the *Math's Mate* program? Is combating the previous lack of mathematical understanding that they enter the upper grades with the only solution? Or is there a solution that can be correct in the way mathematics is initially taught in the lower grades, in elementary schools, so that such problems with basic skills will be less pervasive? These resulting questions are not presented for the sole purpose of pedagogical inquiry, but to consider the next plan of action and to continue conversation on the observable status of mathematics education in this country.

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[i] Ingvarson, Lawrence, et al. Investigation of Effective Mathematics Teaching and Learning in Australian Secondary Schools. Commonwealth of Australia, 2004.

[ii] Wright, Joe. "Math's Mate" email to investigator of speech given by program creator. 11 Nov. 2005.

[iii] Frick, Kathy. Telephone Interview. 12 Nov. 2005.

[iv] See Appendix, "Survey."
[v] See Appendix, "Consent Form."
[vi] See Appendix, "Phone Interview Questions."

Honors Project Proposal
December 20th, 2005

Teri Gudorp
Prof. Diana Turk

Background Information

Studies have shown that students in high school and lower levels of schooling have unsatisfactory abilities in mathematics. Looking at the literature about this topic indicates that American students, especially, struggle with arithmetic, not only with more difficult concepts, but some of the basics. The study of arithmetic leads to algebra, and algebra is the gateway to more advanced studies in mathematics. How can a student begin to be interested in calculus if they have experienced failure as early as arithmetic?

Whether through private home tutoring, government-funded group tutoring, student observations in classrooms, or student teaching, students are struggling and it becomes more and more obvious with each additional student I encounter. Not only through my experience, but from reading works about the attitudes of students towards mathematics and their performance in it, there is a distinct problem that has been and continues to be forming in our nation. The widespread problems associated with arithmetic of negative numbers and their interactions with other numbers through operations have plagued mathematics educators for years. As a solution, many companies began creating programs to supplement and sometimes replace the curriculums existing for middle and high school mathematics.

One such set of materials is called *Math's Mate*, an Australian program created to supplement the regular mathematics curriculum from 1995. It serves students in U.S. grades 5 through 10.

Related Literature

According to the National Center for Educational Statistics (NCES) and their 2003 *Trends in International Mathematics and Science Study (TIMSS*), "U.S. twelfth graders scored below the international average and among the lowest of the 21 TIMSS nations in both mathematics and science general knowledge in the final year of secondary school."[vi] In addition, the National Council of Teachers of Mathematics (NCTM) also published findings from another study that reflects similar results. "The mathematics skills of U.S. 15-year-olds received lower scores on average than those of students in other participating countries in the 2003 *Program for International Student Assessment (PISA)*."[vi] It is no surprise that my personal observations are consistent with these results. American students are in fact sub-standard in mathematical competency by the end of the mandatory education required in the U.S., and the educational implications start early.

My investigation into the question of how children learn arithmetic and number concepts began with Karen Fuson's article "Research on Learning and Teaching Addition and Subtraction of Whole Numbers"[vi]. It's important for middle school teachers and even high school teachers to understand how students are taught at the elementary level so that they can identify when and why their students are having arithmetic or arithmetic-related problems and attempt to remediate these problems.

The future of higher mathematics is also explored in Derek Holton's "Tertiary Mathematics Education for 2024"[vi]. As a faculty member in the Department of Mathematics and Statistics at the University of Ontago, New Zealand, the author adds the perspective of international University standards. His experience with students entering

University with certain abilities offers insight into what college-age students are coming in with and a projection of where college-level mathematics education is going.

Programs to Enhance Arithmetic Skills other than *Math's Mate*

Many intervention materials that supplement the curriculum and add a variety of options into the normal rotation of homework and class work assignments are already available. Some of them have been created in true response to the problems students have in mathematics, while others acknowledge the marketing capability of a program that promises results to the competitive, consumer-driven public of America. Programs such as *Pre-College Institute*, *Everyday Mathematics*, *VersaTiles*, *Daily Reinforcers*, "*The Learning Equation*," and even the research studies that followed assessing their success, are several different past attempts to address the difficulties students have with arithmetic.

The Pre-College Institute was an intense program offered minority high school students of a NYC school in 1989. Supplementing the current education program for the mathematics curriculum, the program was designed for students whose abilities reflected that they were achieving just at or below (by no more than 3 years) their grade level. The program was created to test the null hypothesis that "no relationship exists between exposure to program activities and changes in mathematics performance or attitude towards science"[vi]. The program functioned on Saturdays and with an abbreviated school-type schedule offering a 55 minute math period, during which students reviewed basic math problems and did level or remedial work with computer programs like MathBlaster and AlgeBlaster. The results of the program showed a correlation between regular attendance in the program and improved achievement in mathematics. This

program obviously required a lot of work, making sure that students were not only supervised but also taught how to use the computer programs and supported through tutoring in trouble areas.

VersaTiles is a manipulative and skills program meant for use in the grade 1 through 8 class room, either in student groups for project-style lessons or individually as the teacher deems appropriate. The main components are Activity Books, the Answer Case, and the dual-sided *VersaTiles* answer tiles: one side containing alphabetic choices and the other a geometric design. By solving problems in the Activity Book, students are practicing whatever skills they need to work on. Then, they look in the answer box on the bottom of the page and match their answer with one given. By placing a tile with the correct answer in the same location in their Answer Case as in their answer box, they fill in the Answer Case with tiles. Then when the lesson is completed correctly, a flip of the answer case will reveal a pattern that matches the pattern shown on the activity page. This program seems as though it would work best with younger students, and also adds a twist to the monotony of doing skills worksheets in class. It also adds the responsibility of checking ones own work and confidence that they as a student hold the answers, not just the teacher checking their work.[vi]

Another program, *Daily Reinforcers,* is recommended for use as a class starter. Available for grades K through 8, each sheet offers three problems: one using mental math, another skill development, and the third a word problem. Used daily, "these activities, which are aligned with NCTM Standards, help students become more proficient in basic math operation and expand their mathematics vocabulary through repeated exposure and practice of these concepts."[vi] It offers additional problems that are

not associated with the textbook, which inevitably reduces repeat questions and formats, and also does not require much work for the teacher.

Finally, "*The Learning Equation" (TLE)* is a program developed in Canada for use in classrooms for grades 7-12. *The Learning Equation* is an interactive, computer-guided learning system produced by ISACSOFT. Touted by the company as "the only product that is positioned to be the world standard and the world leader for computer based software"[vi], the program has been used as remedial curriculum support and also in some schools completely replacing the given curriculum. With user-friendly tutorials and interactive progression through each lesson, the program offers a variety of manipulative materials in computer form so that the ideas behind it are accessible without having to take time to pass out tiles, balances, pictures, worksheets, or other more standard physical manipulative materials. The program can also be formatted to match the curriculum and syllabus one teacher may be using in New York as compared to one in Ontario.

From using programs that provide extra practice as a part of the in-class lesson, using alternative materials to help different types of learners practice in "fun" ways, the use of computers and computer programs during class time, to after-school and weekend tutoring programs, a variety of styles and procedures for supplemental arithmetic curriculums are available for teachers. These are some of the options that have already been explored by these programs in North America, more specifically in the New York State and New York City area. Looking at some of the commonalities between these programs, it is notable that many require a good amount of in-class time, or even extend into non-school hours. Although there is a move in some of these materials towards student responsibility and independence, there is still a quality of teacher-centered

learning in that students rely on the teacher to be instructed and reminded on how to work the materials, rely on the teacher coordinating the use of it for every day, appropriate lesson planning to involve the materials in the course, and also one-on-one daily attention to each struggling student.

Math's Mate

Math's Mate was created in 1995 by Australian physics and mathematics teacher Joe Wright in response to the increasing difficulties he noticed his high school students having with the mathematics curriculum. Some of the difficulties he noticed were: students not retaining information from past years, relying on the teacher to have the answers and check work, lack of parental involvement , reinforcement of classically difficult concepts like fractions, working with zero, and negative numbers, and the increasing demand to let students use calculators. Despite it being a foreign program that addresses the needs of Australian students who are following Australia's curriculum, the problems that Australian students face from my research seem to overlap and coincide with those of American students[vi]. In email correspondences with Mr. Wright[vi] as well as a telephone interview with an American *Math's Mate* coordinator, Kathy Frick, who taught in Australia for one year and then returned to the states with the program[vi], I have learned more about the purpose, goals, and inner workings of *Math's Mate*.

The basic structure of the program is a skills-based homework program. Skills-based simply means that the same types of problems (topics) are practiced every week. Each week, students are assigned a sheet from their *Math's Mate* workbook, to be completed on their own at home. After completing a section of weekly sheets, students

chart their scores in their workbooks. Over time, they can notice trends they are having with a skill, as every same-numbered problem on every worksheet practices the same skill laterally. For example, every problem numbered 5 practices addition of large numbers, and every problem numbered 19 practices unit measurement. Once a problem is diagnosed, the student can go on to download a free copy of a Skill Builder off the *Math's Mate* website, providing further practice for that particular skill. Through repeated, cyclic review of these skills, long and short term memory are increased. The goals that were set for this homework program are as follows:

1. increase parental involvement,
2. be fair,
3. allow all student to achieve a satisfying degree of success,
4. give some focus to areas of common student weakness,
5. motivate students to attempt to overcome their own areas of weakness,
6. help teachers to keep track of individual student strengths and weaknesses,
7. help students to see their own progress,
8. give teachers an indication of the effort individual students are prepared make,
9. be manageable by teachers who in many cases are already overworked,
10. be consistent in quality, format, and expectations.

It is clear that the increased focus on parental involvement, usage out of the classroom, and student responsibility for completion, correction, diagnosing of difficulties and follow-up of work are qualities that make *Math's Mate* stand apart from other programs. Currently there is not any formal research being done on the use, availability, success, and implications of using *Math's Mate* in and out of the classroom.

Working with a private tutoring company, I have encountered a student and their math teacher who use *Math's Mate* as an addition to the classroom curriculum. In accordance with the program, none of my tutoring consisted of helping with the student's Math's Mate assignments, although I looked over the student workbook. In a search to find out more about the program and its potential, I contacted both Joe Wright and Kathy Frick to talk about their experiences.

In the past, the Colorado school system in which Kathy Frick worked had noticed some inconsistencies with student's abilities in math. To address this, the high school tried the Interactive Mathematics Program (IMP), a "four-year program of problem-based mathematics [that] replaces the traditional Algebra I-Geometry-Algebra II/Trigonometry-Pre-Calculus sequence."[vi] Instead of taking advantage of this new structure, Kathy found that many of the advanced students would opt out of the program because their parents were unfamiliar and uncomfortable with the problem based program, often reasoning "that wasn't how I was taught." General consensus of the teachers was that traditional math was more helpful in increasing achievement, as evidenced in the state testing results. The math curriculum used at the middle school is now also a traditional curriculum. After a trial period of three years, a curriculum called Mathscape was dropped because of the lack of strength in teaching basic skills. [vi]

It was later when Kathy traveled to Australia as an exchange teacher that she came across *Math's Mate* while teaching 7th, 8th, and 9th grade abroad. "I fell in love with them, sent them to my middle school in Colorado, and the rest is history. We have sold over 56,000 books this year – and our teachers and parents love it." She also considers the teacher-to-teacher learning program one of its benefits since its intentions were

student centered.[vi] In the phone interview, Kathy also mentioned that prior to traveling abroad, she had been taking turns with fellow teachers at her school in Colorado making math sheets for the same kind of review; so finding *Math's Mate* was not only a time saver but much more complete. She has also noticed that students don't cheat or copy from one another. From seven years of working with *Math's Mate*, she has observed that the program teaches kids and their parents to ask the right questions, encourages students to talk to their peers about the problems they have, and teaches them to find more resources and understand why they need help.

Problem Statement and Methodology

The inability of American secondary and elementary students to satisfactorily demonstrate understanding of basic arithmetic and mathematical concepts has led to numerous attempts to address these problems by a variety of programs, some of them computer-based and some not. These programs seek to supplement the classroom curriculum with a variety of tactics. Yet, research shows that despite these programs American students still lack these skills and understandings and lag behind their international counterparts. One program that may help alleviate some of these problems is *Math's Mate*, new to the United States and offering an alternative instructional approach than those other programs currently being used.

The question that will be investigated in the proposed research is to determine to what extent the use of Math's Mate materials increase the capabilities of students to correctly answer, understand, and eventually master basic arithmetic difficulties and more complex arithmetic difficulties in grades 5 and up.

By using surveys and interviewing teachers who currently use or have used the *Math's Mate* program in their American classroom, I will be able to assess the success of the program in terms of its ease of use, the goals that the teacher and student have and the level of accomplishment of these goals, advancement of student skills in arithmetic and life skills of organization and responsibility, comprehension of material, and a look at into what the advantages and disadvantages (and hopefully suggestions to increase the capabilities) of the program are.

Personal Implications of Research

As I am currently in the stages of preparing to be a middle/high school teacher, I have studied extensively many levels of mathematics and the teaching of the lower, secondary levels of these topics. A teacher should know how to do what he or she is teaching—this fits into the bigger picture of learning, and the absolutely necessary idea of teachers also being learners. From my studies, it is evident that the rudiments of arithmetic are crucial to making the transition to algebra, and after mastering algebra, the next transition to higher mathematics. It is clear from my experience and research that many students who are supposed to have mastered arithmetic have not, and slipped by into the higher math classes only to struggle with computations yet in some cases, understand fully the abstract concepts being developed. . Out of all mathematics, arithmetic is the most applicable to every day life no matter if the student becomes a physicist or mechanic.

This problem is not independent—everything else they will go on to study could be affected as they close the doors of opportunity once opened to them. As a future

teacher, it is my job to help correct problems as they come up, so I must know how these problems developed if I am to help my students overcome them. If all students came to each new level of education with complete mastery of every mathematical topic they studied to date, there would no need for such research. But in reality, 7^{th}, 8^{th}, and 9^{th} graders are coming into classes ill-prepared for the studies ahead. In order to help them succeed, I must not only know where they are now, but how they got here and what they will need to know to continue successfully. This research is the beginning of understanding where my students have come from and what I can do to help them now to get them back on track.

APPENDIX

<u>Survey</u>

SURVEY QUESTION:

To what extent does the skills-based program "Math's Mate" help struggling students master arithmetic concepts as a supplement to a regular mathematics curriculum?

At any time you may contact the investigator, Teri Gudorp, at tlg233@nyu.edu with questions regarding this survey.

Participant's Assigned Number: <u>11</u>
Suggestion: for email correspondent, instead of "circling" an appropriate answer, use the **bold *function in Microsoft Word to distinguish your*** *answer.*

<u>Part One:</u>

1. a. Are you currently using Math's Mate in your classroom? (circle) YES / NO

    If you answered "no,"

    b. Have you ever used Math's Mate in your classroom in the past? YES / NO

If you answered "NO" to **both** 1 a *and* 1 b, then thank you for your time but there is no need for you to continue this survey. Please return the blank survey to the investigator at this time.

- -

If you answered "YES" to either 1a *or* 1b, please continue.

2. a. How many years have you been teaching? ______________________________

    b. How many years have you been using Math's Mate?______________________

3. a. Where do/did you use Math's Mate materials?

____

City, State, (name of school optional)

    b. By circling the terms below, describe the communities represented by the majority of students at the school in which you use/d Math's Mate:

rural, suburban, urban; socioeconomic status: low, medium, high; public, private, charter

Other:_____

4. What gender do you most closely identify yourself with (circle one):
male female neither

5. Please refer to any class in which you've used Math's Mate:

a. student grade level _____

b. basic mathematics curriculum/text used _____

c. Math's Mate level used _____

6. Have you ever used supplementary materials in your classroom other than Math's Mate? (circle) YES / NO [If you answered "yes" to this question, please refer to question #20]

7. How often do you use Math's Mate in your classroom? (Check one box below):

Frequently (more than once a week)	Often (at least once every two weeks)	Occasionally (once a month)	Rarely (1 time every 2-3 months)	Never

Part Two:

Please indicate the extent to which you agree with the following statements (circle your choices), 1 being that you strongly agree, 3 being neutral, and 5 being that you strongly disagree:

8. I see Math's Mate as a means for students to practice and reinforce older material

1 2 3 4 5

9. I see Math's Mate as a means for students to gauge their understanding of a topic

1 2 3 4 5

10. I see Math's Mate as a means for students to re-teach themselves older material

1 2 3 4 5

11. I see Math's Mate as a means to help me assess where students need help most

1 2 3 4 5

12. I see Math's Mate as a means to help students, already successful in the skills presented, gain mastery of arithmetic

1 2 3 4 5

13. I see Math's Mate as a means to assign homework

1 2 3 4 5

14. Are there other statements that also (or better) reflect your views on the use of Math's Mate as a supplement to the regular curriculum in your classroom?

15. How comfortable would you say you are with using Math's Mate materials in your classroom?

very somewhat not at all

16. How satisfied are you with the amount you use or assign the Math's Mate program in and out of class?

very somewhat not at all

17. How satisfied are you with how effectively you use the Math's Mate program?

very somewhat not at all

Part Three - Open-ended questions:

18. Do you use Math's Mate differently now than you did when you first started using it? If so, for what purpose(s)?

19. Have you used Math's Mate at more than one grade level? Do you consider it more appropriate for one or more grade levels as compared to others? If so, please describe where you think it is most appropriate and why.

20. If you answered "yes" to question # 6, what did you like and/or dislike about the other supplementary materials you may have used?

21. If you've used both Math's Mate and one or more other supplementary programs, what is Math's Mate providing you or your students that the other supplementary programs did not?

22. How would you describe the range of students' understanding of arithmetic in your classroom at the beginning of the year in which Math's Mate was being used?

23. How accurately do the Math's Mate materials assess the arithmetic difficulties of your students?

24. Is there anything else related to this topic that you would like to include?

Consent Form

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Fax: 212-995-4198

March 2006

Dear Mathematics Teacher:

I would appreciate your help in a research study I am conducting to assess the extent to which the skills-based program "Maths Mate" helps struggling students to achieve mastery of arithmetic. I am a student in the Department of Teaching & Learning in New York University's Steinhardt School of Education and am doing this research as part of my undergraduate honors project in Mathematics Education. My faculty sponsor is Professor Kenneth Goldberg, Director of the Mathematics Education Program.

If you agree to be in this study, you will be asked to do the following:

- Complete a survey about the classroom in which you use or have ever used Maths Mate and your feelings about its appropriateness and usefulness.
- Decide whether you would be willing to take part in a follow-up telephone interview about the experiences you and your students have had using the Maths Mate program and its effectiveness in helping them to develop their arithmetic skills and understandings.

Participation in this study will take no more than 1 hour of your time: 20 minutes for completing the survey, and 40 minutes for the follow-up telephone interview if you are willing to participate in it.

Although you will receive no direct benefits from participating in this research project, what we learn from it may help us and the Maths Mate company to better understand how Maths Mate can be most appropriately and effectively used to help struggling students develop mastery in arithmetic and be successful in their study of mathematics.

Confidentiality of your research records will be strictly maintained by keeping all completed forms in a locked cabinet accessible only to the investigator. All identifying

information will be removed and, to preserve confidentiality of your identity, a random number will be assigned to you that will be used to track your survey and interview in place of your name.

Participation in this study is voluntary. You may refuse to participate or withdraw at anytime without penalty. You can also do the written survey but not participate in the follow-up telephone interview. Finally, if you do agree to participate, you can still skip any questions on the survey or the follow-up interview that you prefer not to answer.

Nonparticipation or withdrawal will also not in any way affect your services from the Maths Mate program.

If there is anything about the study or your participation that is unclear, or if you have questions or wish to report a research-related problem, you may contact the researcher, Teri Gudorp at (908) 510-3293, tlg233@nyu.edu, 131 3rd Avenue CO-1407B New York, NY 10003; or the faculty sponsor, Dr. Kenneth Goldberg at (212) 998-5213 or kenneth.goldberg@nyu.edu.

For questions about your rights as a research participant, you may contact the University Committee on Activities Involving Human Subjects, New York University, at human.subjects@nyu.edu or (212) 998-4808.

You have received a copy of this consent document to keep.

Agreement to Participate

_____

SUBJECT'S NAME

_____ _____

SUBJECT'S SIGNATURE DATE

Prefferred form of correspondance: (please check)

Email ____ Email address _____

Standard Mail ____ Address _____

_____

Phone Interview Questions

(1) Describe any other teaching positions you have had—have you always worked in the school you are now (private, high SES student population, urban school system)?
(2) How did you discover Math's Mate?
(3) Will you use Math's Mate next year?
(4) What makes you want to continue using Math's Mate?
(5) If you could make any changes to Math's Mate, what would they be? Is there anything you would adjust or dislike?
(6) When you go over the Math's Mate sheet in class, what is it like? Describe the classroom structure.
(7) What goals do you or did you hope to achieve with Math's Mate for yourself?
(8) What goals do you hope have for your students?
(9) What do you think is the connection or correlation between the use of Math's Mate and these goals?
(10) What does "success" mean for an 8^{th} grader in math?
(11) What would you suggest to the parents of your students so that they could start finding success in their kids math work?
(12) How would you describe an Ideal student?
(13) What is your history with mathematics as a student?
(14) What would an ideal Math's Mate student do?
(15) Are there any other comments you have about adjustments or changes to Math's Mate you would like to see?
(16) Would you consider talking to other teachers about your experiences with Math's Mate?