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ABSTRACT

This study was conducted to explore the views of the absentee partner by examining students' perspectives of education reform, specifically with regard to their experience with instruction in a school district committed to K-12 mathematics reform. Survey data for this study were drawn from the responses of 1,176 elementary and secondary education students on a locally-developed mathematics attitude survey. Academic self-efficacy was examined in light of the instructional strategies reported by students to be used most frequently in classrooms. While there are several significant relationships between self-efficacy and the instructional strategies used in the classroom, students' grade levels are strongly related to their levels of academic self-efficacy and the presence of reform-inspired instructional strategies. (Contains 15 references.) (ASK)

WHAT STUDENTS HAVE TO SAY ABOUT MATHEMATICS: EDUCATION REFORM & STUDENTS' REALITY

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Introduction

The nation's education reform agenda is replete with references to goals for students. Education reform, if successful, is meant to foster independent learners, critical thinkers, effective problem solvers, as well as socially responsible individuals. Much of the reform rhetoric addresses standards, assessments, curriculum, and professional development, i.e., district and/or teacher-level inputs to the system. Generally, talk about results is limited to discussion of student achievement, i.e., the attainment of high academic standards. Lost to the reform conversation has been the voice of the student. This study was conducted to explore the views of the absentee partner by examining students' perspectives of education reform, specifically in regards to their experience of instruction in a school district committed to mathematics reform.

Theoretical Framework

How people behave is often affected by their beliefs about their capabilities. These beliefs help determine what individuals do with the knowledge and skills they have. The perspective of the study we conducted benefits from the central suppositions of academic self-efficacy within social cognitive theory (Bandura, 1986). More specifically, the study was designed to examine the role academic self-efficacy in mathematics plays in relation to students' views of their academic achievement and their experience of mathematics instruction. Prior research in this area shows that mathematics performance and math self-efficacy are strongly correlated (Hackett, 1985; Hackett & Betz, 1989; Randhawa & Beamer, 1992; Pajares & Miller, 1994; Williams, 1994;

Pajares & Kranzler, 1995; Schunk, 1996). Other studies demonstrate that student avoidance of math courses has its roots in elementary and middle school and generally begins to manifest itself in high school (Pajares & Miller, 1994). Some propose that if self-efficacy assessments were to begin early in students' academic careers, inaccurate perceptions could be identified early and appropriate interventions undertaken (Pajares & Miller, 1994).

Studies have shown that specific instructional strategies can influence student self-efficacy beliefs (Anderson et al., 1992; Hojnacki & Grover, 1992; Crow, 1993; Shawaker & Dembo, 1996; Kushman, 1997). These studies have utilized various surveys and scales to measure self-efficacy. For example, a mastery learning experiment, conducted by Anderson (1992), demonstrated that implementation of mastery learning had an effect on students' self-concept of ability. In this experiment, student perception of ability went from average to above average after implementation of mastery learning. Similarly, a brief examination of the Scope, Sequence and Coordination Project (SS&C) for science reform by Crow (1993) indicated that students were more interested in science as a result of this project. Shawaker (1996) also found gains in self-efficacy beliefs from fifth, sixth and seventh graders in Los Angeles schools after instructional employment of specific learning strategies.

Since we saw the students' perceptions as critical to our understanding of how change was being interpreted and acted upon, we also explored related research and incorporated it in the design of the study. A few research studies on students' views of education reform have surfaced. Hojnacki and Grover (1992) found that overall, students had a favorable attitude toward mathematics upon implementation of reform. Surprisingly however, they found that fourth grade

students typically held less positive attitudes towards math than the younger students studied (second and third graders). They rationalize that possibly the longer students are exposed to negative classroom experiences prior to reform, the more difficult it may be to change attitude. In other words, one year of the mathematics reform had less impact on the more "ingrained attitudes" of the older students (fourth graders) than the younger students (second and third graders).

The Hojnacki and Grover study took the measurement of student self-efficacy one step further through interviews with students. The student voice illuminated this study when the researchers garnered answers to the following questions "What do you like most about math class?" and "What bothers you most about math class?" The most common student response to the first question was "math is fun!" and to the second "nothing". These two statements summarize student view of math class in this project succinctly.

Additional studies that explore the voice of students involved in education reform are limited. Kushman (1997) however, summarized the views of over 1,000 students from different schools across the country in relation to education reform, from an impressive conglomerate of case studies. Kushman found that "students were aware of the reform, interested in their education and future and were eager to tell the researchers what was on their minds".

Lessons from student words indicated that their interpersonal relationships with educators were more important than academics in helping them learn. Students listed the following terms as important for effective learning "respect, helping, caring, understanding and safety". Students

also verbalized the need for educators to understand that they have various learning styles. As Kushman states "what helps one student, hinders another". Finally, it was found that success to students continues to be defined in traditional terms. A majority of students defined good learners as "passive and compliant" (good grades, good behavior, conforming to school rules, etc.). They did not define good learners as critical thinkers and lifelong learners, as reformers expected.

Students from only one school defined themselves as learners, rather than good students. This community focused more on the importance of learning than the importance of rewards. Kushman asserts that students define successful learners based on what they hear from the entire community around them (educators, parents, peers, mass media), therefore the entire fabric of the community must be reformed if we want a society of true learners.

Listening to what students have to say is indeed rare in the literature. "Most schools treat (students) as products of school restructuring, rather than active participants who can offer important insights and ideas" (Kushman, 1997). Kushman's findings that students are both articulate and aware of the reforms in their schools challenge us to take the time to hear what they have to say. Anderman, Maehr and Midgley (1996) suggested that student perceptions of school and the adoption of personal goals could be associated with policy and practice choices commonly made by schools. In addition to this association, students' perceptions regarding the purposes of schools, and ultimately the purposes they come to adopt in approaching school tasks, are a construction within the school context. These are likely attributable to specifiable actions

taken by teachers and administrators, a part of the culture of school that probably can be changed.

Hojnacki and Grover (1992) remind us that as we embark in this endeavor, it is important to keep in mind that although students may have more positive attitudes toward mathematics, this does not automatically indicate that they will have increased achievement. As an example, they cite studies by McKnight et al. (1987) and Stevenson et al. (1990) which found that although U.S. students have better attitudes toward math then Asian students, they have lower achievement.

Methods & Data Sources

This study was conducted in a school district committed to K-12 mathematics reform. For the past five years their curriculum and professional development efforts have been focused on aligning classroom instruction with the NCTM standards. The study was designed to examine two issues: 1) students' perceptions of themselves as mathematics learners, and; 2) their views of mathematics classroom as reform progresses. Survey data for this study were drawn from the responses of 1,176 elementary and secondary education students on a locally-developed mathematics attitude survey. This survey was administered to 348 fourth grade, 331 sixth grade, 294 eighth grade, and 203 tenth grade students last year as part of the district's annual evaluation of the mathematics curriculum. The entire district population of each grade (excluding absentees) was surveyed. The instrument was created by local teachers in consultation with university faculty. It consisted of 26 questions in three substantive areas: 1) student demographics, 2) students' academic self-concept in mathematics, and 3) perceptions of various instructional strategies.

A multi-method approach was used: a quantitative approach to analyze the survey data and a qualitative approach to explore the preliminary findings in more depth.

Initially, a factor analysis was conducted to cluster the survey questions into groups representing a single underlying construct. A factor score for each factor, which was converted to a z-score, was calculated for each student. Students were then grouped into one of three clusters for the classroom instructional strategies factor, defined as traditional, innovation, and mixed strategies classrooms. Chi-Square tests of significance were conducted to determine if relationships existed between the type of instruction and students' self-efficacy. Analysis of the survey data guided our thinking for the qualitative analysis.

To explore the findings derived from the quantitative analysis, two focus groups were conducted with six students each from two 4th grade classrooms. Classes were selected in relation to the second factor derived from the factor analysis conducted with the survey data. The classrooms were defined as "traditional" and "innovative"; these descriptions were generated from a composite of items and then presented to a principal of a participating school. Based on the descriptions, she selected two teachers whose instructional strategies were most reflective of the descriptions. Focus group interview protocols were then developed to explore the three variables that were found to be significantly different between the two groups. These focus groups were audio as well as video taped. The intent of these data collection activities was three-fold: 1) to serve as a validation of the survey findings through participant checks (Guba & Lincoln, 1989); 2) to explore the findings derived from the survey in more depth, and, most importantly 3) to

give students' voice to the survey findings. The final purpose was intended to enliven what was learned about the students' views, bringing their own words to the researchers' analyses (Van Maanen, 1988). An iterative analysis of focus group data generated exemplars of students' views of reform-inspired mathematics. The intent of the exemplars is to illuminate the key findings of the survey research.

Findings

Scale Development: Fourth Grade Students The intent of the factor analysis for this study was to identify a set of survey items that would aid in explaining mathematics self-efficacy. In this data set two factors emerged. The first factor, Self-Efficacy, was viable with an overall consistency reliability of .74. The second factor, Instructional Strategies, was questionable with an overall consistency reliability of .60. Three variables (noted with an asterisk) were removed from the second factor to increase the overall reliability. Table 1 presents the factor structure loadings and item-total correlations.

Scale Development: 6^{th}, 8^{th}, and 10^{th} Grade Students. For this data set two factors also emerged. The first factor, Self-Efficacy, was viable with an overall consistency reliability of .79. The second factor, Instructional Strategies, was somewhat weaker with an overall consistency reliability of .67. Table 2 presents the factor structure loadings and item-total correlations.

Table 1

Common Factor Structure for Instructional Strategies and Self-Efficacy for 4th Grade Students

	Loading[a]	Item-total r[b]
Instructional Strategies		
I work on math projects requiring more than a single day's work.	.51	.53
I work with hands-on manipulatives (such as cubes, spinners, geometric solids)	.47	.53
I practice using basic math skills.	.49	.52
I solve math problems in small groups (2-6 students)	.36	.55
I practice doing math problems that relate to the real world.	.39	.53
I do work that involves memorizing math facts.	.44	.54
Math will be important for as an adult.	.43	.54
Math is useful in everyday problems.	.38	.54
I am asked to write about math.	.27	.56
I am asked to explain the way I solve math problems.	.30	.55
I find my math class challenging.*	.38	.56
I use a calculator.*	.28	.56
The material in this year's class is:*	.27	.58
Almost all or all new to me. Mostly new to me. Mostly repeated from previous years. Almost all or all repeated from previous years.		
I use math skills in science, reading, and writing.	.41	.54
Self-Efficacy		
I enjoy math.	.73	.66
I am good at math.	.67	.67
I usually understand what we are doing in math class.	.55	.74
I look forward to learning more about math.	.67	.70
Doing math makes me nervous or upset. (reverse coded)	.56	.74
I consider myself to be a(n): Excellent math student Good math student Fair math student Poor math student	.68	.69

Note. N = 343.

[a]Factor loadings > .25 are considered appreciable.

[b]Each value is a Pearson product-moment correlation with the respective item excluded from total factor score.

Table 2

Common Factor Structure for Self-Efficacy and Instructional Strategies for 6th, 8th, and 10th Grade Students

	Loading[a]	Item-total r[b]
Instructional Strategies		
I work on math projects requiring more than a single day's work.	.50	.64
I work with hands-on manipulatives (such as cubes, spinners, geometric solids)	.44	.64
My teachers relate math to other subjects.	.47	.64
I solve math problems in small groups (2-6 students)	.51	.64
I practice doing math problems that relate to the real world.	.45	.64
I am asked to write about math.	.47	.64
I am asked math questions that make me think.	.45	.65
I do work that involves memorizing math facts.	.43	.65
I practice using basic math skills.	.50	.64
I use a calculator.	.43	.66
I use a computer to do math.	.40	.65
I use a computer to look for information.	.40	.65
Self-Efficacy		
I enjoy math.	.79	.74
I am good at math.	.74	.75
I usually understand what we are doing in math class.	.73	.76
Math is useful in everyday problems.	.59	.78
Math will be important for me as an adult.	.65	.77
I look forward to taking more math classes.	.75	.75
What grades do you usually earn in math class?	.64	.82

Note. N = 748.

[a]Factor loadings > .35 are considered appreciable.

[b]Each value is a Pearson product-moment correlation with the respective item excluded from total factor score.

Chi-Square Analysis. Student self-efficacy was examined in light of the instructional strategies reported to be used most frequently in the classroom. Each student received a total score on the Instructional Strategies factor calculated as a sum of individual item scores. Each total score was

converted to a z-score. Based on the z-scores, students were classified as receiving mathematics instruction that was mostly innovative (z-score ≥ 1) or mostly traditional (z-score ≤ -1).

To determine if there was any relationship between the type of instruction received (innovative or traditional) and student self-efficacy (high or low), a chi-square test of significance was calculated for each variable in the self-efficacy factor as well as by grade level. The findings revealed several significant relationships between academic self-efficacy and instructional approaches. Above all, the students' grade level is strongly related to their level of academic self-efficacy and the presence of reform-inspired instructional strategies. That is, younger students exhibited higher levels of mathematics self-efficacy; and, reform-related instruction was more evident in the earlier grades. Therefore, the analysis of the relationship between academic self-efficacy and instructional approaches was conducted for each grade level separately.

Table 3

Chi-square Tests of Significance between Grade Level and Self-Efficacy Variables

- I enjoy math. $\chi^2 (6, \underline{N} = 816) = 51.37, \underline{p} < .001$
- I am good at math. $\chi^2 (6, \underline{N} = 813) = 46.19, \underline{p} < .001$
- I usually understand what we are doing in math class. $\chi^2 (6, \underline{N} = 813) = 50.80, \underline{p} < .001$
- Doing math makes me nervous or upset. $\chi^2 (6, \underline{N} = 809) = 25.86, \underline{p} < .001$
- Math is useful in everyday problems. $\chi^2 (6, \underline{N} = 811) = 99.73, \underline{p} < .001$
- Math will be important for me as an adult. $\chi^2 (6, \underline{N} = 811) = 115.42, \underline{p} < .001$
- I look forward to taking more math classes. $\chi^2 (6, \underline{N} = 807) = 55.02, \underline{p} < .001$

Table 4

Chi-square Tests of Significance between Grade Level and Instructional Strategies Variables

- I solve math problems in small groups (2-6 students). χ^2 (6, N = 806) = 42.42, p < .001
- I work on math projects requiring more than a single day's work. χ^2 (6, N = 801) = 77.93, p < .001
- I am asked to write about math. χ^2 (6, N = 809) = 63.71, p < .001
- My teachers relate math to other subjects. χ^2 (6, N = 801) = 25.70, p < .001
- I practice doing math problems that relate to the real world. χ^2 (6, N = 800) = 26.99, p < .001
- My teacher does all of the talking. χ^2 (6, N = 805) = 36.07, p < .001
- I use a calculator. χ^2 (6, N = 807) = 157.98, p < .001
- I use a computer to do math. χ^2 (6, N = 797) = 43.15, p < .001
- I use a computer to look for information. χ^2 (6, N = 804) = 21.40, p < .01
- I work with hands-on manipulatives (such as cubes, spinners, geometric solids). χ^2 (6, N = 810) = 32.80, p < .001

In classrooms where innovative instructional strategies were used frequently, students were more likely to report: (a) enjoying mathematics, (b) being good at mathematics, and (c) looking forward to learning more about math. For example, for 4th grade students, four items exhibited a significant level of association with the factor, instructional strategies. The four items that were significant included students enjoying mathematics χ^2 (2, N = 126) = 15.41, p < .001; being good at math χ^2 (2, N = 126) = 10.34, p < .01; looking forward to learning more about math χ^2 (2, N = 126) = 10.78, p < .01; and describing their mathematical performance (excellent, good, fair, or poor math student) χ^2 (3, N = 126) = 8.82, p < .05. For sixth grade students, only one item

exhibited a significant level of association with the factor, instructional strategies. The item that was significant included students enjoying mathematics $\chi^2(3, \underline{N} = 118) = 8.25$. $\underline{p} < .05$. For eighth grade students, three items exhibited a significant level of association with the factor, instructional strategies. The items that were significant included students looking forward to taking more math classes $\chi^2(3, \underline{N} = 101) = 10.92$, $\underline{p} < .05$; viewing math as important to them as an adult $\chi^2(3, \underline{N} = 102) = 7.73$, $\underline{p} < .06$; and feeling that doing math does not make them nervous or upset $\chi^2(3, \underline{N} = 102) = 12.23$, $\underline{p} < .01$. There were no items that exhibited a significant level of association with the factor, instructional strategies, for tenth grade students.

For each of the items that exhibited a significant level of association with the factor, instructional strategies, odds ratios were calculated to determine the strength of the association. The results showed that fourth grade students in innovative classrooms were about seven times more likely to enjoy mathematics as compared to fourth grade students in traditional classrooms. They were nearly ten times more likely to believe that they were good at math. Eighth grade students in innovative classrooms were four times as likely to look forward to taking more math classes as compared to tenth grade students in traditional classrooms. They were also about four times as likely to view math as important to them as adults as compared to their peers in traditional classrooms were. Table 5 presents the odds ratios for items that exhibited significant levels of association between the self-efficacy variables and the factor, instructional strategies.

Table 5
Odds Ratios for Self-Efficacy Survey Items

Grade Level	Self-Efficacy Variables	Odds Ratio
4th	I enjoy math.	7.18
4th	I am good at math.	9.69
4th	I look forward to learning more about math.	5.72
4th	I consider myself to be a(n): Excellent math student Good math student Fair math student Poor math student (comparing excellent to poor)	8.80
6th	I enjoy math.	1.08
8th	I look forward to taking more math classes.	4.36
8th	Math will be important for me as an adult.	3.94
8th	Doing math makes me nervous or upset.	2.16

The analysis of data generated from the two fourth grade focus groups was intended to illuminate the 4th grade survey results that indicated that students in innovative classrooms:

1) are more likely to enjoy mathematics,

2) have more positive views of themselves as mathematics learners, and

3) are more likely to want to pursue study of mathematics in the future.

Exemplars derived from the qualitative analysis support and give voice to the survey research results. Each of the above were explored through a series of open-ended questions. The focus groups produced the following:

- Enjoyment of Mathematics

The 'Innovative' Classroom

The children from the innovative classroom described their experiences with mathematics as "fun." They described their class:

> "It's fun and our teachers, they like make up activities that have to do with it and they make it better than just sitting there doing your own math."

> "Mr _ is the best teacher in the world. He makes math fun!"

Probing the students' definition of "fun" revealed that they enjoyed being actively involved in mathematics and seeing its connections to real life issues. One student shared:

> "We got to measure our head in centimeters and it was pretty cool. And now we have a graph up in our hallway by our room that shows, we put the information on the back of these circle things and we drew our faces on the front of 'em. And now there's a graph out in our hallway that has all of the faces."

When asked about the teacher's role in this instructional process, he described the teacher as a facilitator.

> "The teacher was helping people, the groups... the teacher (was) helping them measure their heads."

The 'Traditional' Classroom

Some students in traditional classrooms had different feelings about mathematics; while some felt unchallenged, others felt overwhelmed, and some were bored.

> "Sometimes I don't like it because it's too easy and I like more of a challenge..."

> "Last year I had a really easy teacher, she didn't give us a lot of homework and we were doing real fun stuff. And then this year, Miss _, we got a lot of homework. Like last night we had two math sheets, two reading sheets, and we had spelling 3 times each. It's hard."

> "I had this packet for, um, to do and it was multiplication and it wasn't, I didn't like doing it but it wasn't really hard. I mean I'm OK with it and everything, it's just that it sorta bores me."

Those in the traditional classroom tended to describe their learning experiences as involving rote memorization and speed.

> "We were just doing Whiz Kids ...you either have to add or subtract numbers and you get four minutes and you try to get them all done and all right."

When probed about the teacher's role during this learning activity, they described her as a monitor.

> "Well mostly I think she's watching the clock."

- Views of Themselves as Mathematics Learners

The 'Innovative' Classroom

The students tended to express stronger beliefs in their capacity to achieve and be successful in mathematics. Even a student who did not see himself as strong in math based on his grades, still had confidence that he could succeed, even after experiences of failure.

> "Sometimes I get good grades but sometimes I get 'F', but sometimes it just makes me feel bad. But I'm like 'well, maybe I'll have better luck next paper'. But I feel I'm still good at math, but I don't think I'm one of the best."

The 'Traditional' Classroom

Students in the traditional classroom tended to respond with frustration and internalized their experiences of failure.

> "I forgot my place holder lots of times. And so, our teacher on my hand she put a zero for the place holder and I felt kinda embarrassed."

> "...whenever we did fractions it was hard because I didn't get it...I couldn't figure out what went into what. It was really hard. I got frustrated. And everything, I wasn't clicking with it."

- Desire to Pursue Study of Mathematics in the Future

This issue seemed more difficult for 4th grade students to grasp. Perhaps this is related to developmental issues and their as yet undeveloped capacity to plan and look towards the future.

While findings were less robust in regards to this issue, some children were able to explore their thoughts about future study. In the 'innovative' classroom, some children saw practical advantages of continuing the study of mathematics. One said that "almost everything you do involves math. Like if you buy something you have to add it up and see how much it is." However, most children, regardless of their classroom setting, had difficulty grasping the meaning of studying mathematics in the years ahead. Most of them did not recognize that they would have choices in this regard.

Conclusions

Education reform, if successful, is meant to foster independent learners, critical thinkers, effective problem solvers, as well as socially responsible individuals. Furthermore, lost to the reform conversation has been the voice of the student. Since how people behave is often affected by their beliefs about their capabilities and these beliefs help determine what individuals do with the knowledge and skills they have, this study examined students' perceptions of themselves as learners. Academic self-efficacy was examined in light of the instructional strategies reported by students to be used most frequently in the classroom.

While there are several significant relationships between self-efficacy and instructional strategies used in the classroom, the students' grade level is strongly related to their level of academic self-efficacy and the presence of reform-inspired instructional strategies. That is, younger children exhibited higher levels of mathematics self-efficacy; and reform-related instruction was more evident in the earlier grades. In addition, in classrooms where innovative instructional strategies were used frequently, students were more likely to report enjoying

mathematics, feeling they were good at mathematics, and looking forward to learning more about math.

It is important to keep in mind that although students may have more positive attitudes toward mathematics, this does not automatically indicate they will have increased achievement. On the other hand, prior research shows that mathematics self-efficacy and mathematics performance are strongly correlated.

Educational Importance

This study speaks to many educational audiences. It alerts reform advocates of the complexity of change within the K-12 education system, with particular focus on the difficulties at the secondary level. It addresses issues important to educational practitioners, such as those responsible for curriculum and professional development, by clarifying the need to emphasize efficacy early on in students' careers. Most importantly, it speaks to all involved in educational change about the forgotten voice of the student and confirms the value of their inclusion in the conversation and action.

References

Anderman, E. M., Maeher, M. L. & Midgley, C. (1996). School reform and the transition to middle school. Paper presented at the Annual Meeting of the American Educational Research Association, New York, NY.

Anderson, S. A., Barrett, C., Huston, M., Lay, L., Myr, G., Sexton, D. & Watson, B. (1992). A master learning experiment. Yale, MI: Yale Public Schools. (ERIC Document Reproduction Service No. ED 348 668)

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall.

Crow, L. (1993, April). Formative and summative assessment of a reform project: Models of change. Paper presented at the annual meeting of the National Association for Research in Science Teaching (NARST), Atlanta, GA. (ERIC Document Reproduction Service No. ED 365 551)

Hackett, G. (1985). Role of mathematics self-efficacy in the choice of math-related majors of college women and men: A path analysis. Journal of Counselling Psychology, 32, 47-56.

Hackett, G. & Betz, N. E. (1989). An exploration of the mathematics self-efficacy/mathematics performance correspondence. Journal for Research in Mathematics Education, 20, 263-271.

Hojnacki, S. K. & Grover, B. W. (1992, April). Thinking mathematics: What's in it for the students? Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA. (ERIC Document Reproduction Service No. ED 355 095)

Kushman, J. W. (Ed.). (1997, February). Look who's talking now: Student views of learning in restructuring schools. Portland, OR: Northwest Regional Education Lab. (ERIC Document Reproduction Service No. ED 404 752)

Pajares, F. & Kranzler, J. (1995). Role of self-efficacy and general mental ability in mathematical problem-solving: A path analysis. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Pajares, F. & Miller, M. D. (1994). The role of self-efficacy and self-concept beliefs in mathematical problem-solving: A path analysis. Journal of Educational Psychology, 86, 193-203.

Randhawa, B. S. & Beamer, J. E. (1992). Gender similarities in a structural model of mathematics achievement. Social Sciences and Humanities Research Council of Canada, Ottawa, (Ontario).

Schunk, D. H. (1996). Self-evaluation and self-regulated learning. Paper presented at the Graduate School and University Center, City University of New York, New York, NY.

Shawaker, P. & Dembo, M. H. (1996). The effects of efficacy-building instruction on the use of learning strategies. Paper presented at the annual meeting of the American Educational Research Association, New York, NY. (ERIC Document Reproduction Service No. ED 395 301)

Van Maanen, J. (1988). Tales of the field: On writing ethnography. Chicago: the University of Chicago Press.

Williams, J. E. (1994). Gender differences in high school students' efficacy-expectation/performance discrepancies across four subject matter domains. Psychology in the Schools, 31, 232-237.

Appendix A

Student Mathematics Attitude: Grade 4
1997-98

I am asked to explain the way I solve math problems.	38%	60%	3%
I do work that involves memorizing math facts.	78%	20%	3%
I solve math problems in small groups (2-6 students).	15%	63%	22%
I work on math projects requiring more than a single day's work.	16%	51%	32%
I am asked to write about math.	18%	50%	32%
I use math skills in science, reading and writing.	24%	57%	19%
I practice using basic math skills.	58%	37%	5%
I practice doing math problems that relate to the real world.	33%	52%	15%
My teacher does all of the talking.	32%	47%	21%
I use a calculator.	4%	67%	29%
I use a computer to do math.	3%	19%	78%
I work with hands-on manipulatives (such as cubes, spinners, geometric solids).	23%	62%	15%

I enjoy math.	56%	36%	8%
I am good at math.	57%	40%	3%
I usually understand what we are doing in math class.	66%	30%	3%
Doing math makes me nervous or upset.	13%	29%	58%
Math is useful in everyday problems.	70%	26%	5%
Math will be important for me as an adult.	90%	8%	3%
I look forward to learning more about math.	63%	29%	9%
I find my math class challenging.	35%	43%	22%

I consider myself to be a:	Excellent math student	24%
	Good math student	59%
	Fair math student	15%
	Poor math student	2%
The material in this year's class is:	Almost all or all new to me.	9%
	Mostly new to me.	50%
	Mostly repeated from previous years.	31%
	Almost all or all repeated from previous years.	11%

Student Mathematics Attitude: Grade 6
1997-98

[redacted]				
I am asked math questions that make me think.	52%	[illegible]	[illegible]	[illegible]
I do work that involves memorizing math facts.	38%	30%	20%	12%
I solve math problems in small groups (2-6 students).	16%	21%	27%	37%
I work on math projects requiring more than a single day's work.	7%	15%	31%	47%
I am asked to write about math.	8%	14%	26%	51%
My teachers relate math to other subjects.	22%	28%	26%	24%
I practice using basic math skills.	39%	27%	19%	15%
I practice doing math problems that relate to the real world.	32%	29%	19%	20%
My teacher does all of the talking.	32%	22%	22%	25%
I use a calculator.	13%	27%	24%	37%
I use a computer to do math.	5%	4%	11%	80%
I use a computer to look for information.	16%	13%	17%	55%
I work with hands-on manipulatives (such as cubes, spinners, geometric solids).	12%	21%	31%	35%

I enjoy math.	22%	55%	17%	7%
I am good at math.	20%	67%	9%	5%
I usually understand what we are doing in math class.	27%	58%	11%	3%
Doing math makes me nervous or upset.	6%	12%	32%	51%
Math is useful in everyday problems.	51%	33%	12%	4%
Math will be important for me as an adult.	69%	24%	5%	2%
I look forward to taking more math classes.	20%	47%	20%	13%
I find my math class challenging.	17%	41%	28%	14%

What grades do you usually earn in math class?	Mostly A's	18%
	About half A's and half B's	33%
	Mostly B's	19%
	About half B's and half C's	16%
	Mostly C's	5%
	About half C's and half D's	5%
	Mostly D's	1%
	Mostly below D	3%
The material in this year's class is:	Almost all or all new to me.	7%
	Mostly new to me.	49%
	Mostly repeated from previous years.	32%
	Almost all or all repeated from previous years.	12%

Student Mathematics Attitude: Grade 8
1997-98

I am asked math questions that make me think.	58%			
I do work that involves memorizing math facts.	36%	37%	17%	10%
I solve math problems in small groups (2-6 students).	15%	22%	38%	25%
I work on math projects requiring more than a single day's work.	4%	23%	50%	23%
I am asked to write about math.	2%	9%	39%	51%
My teachers relate math to other subjects.	15%	32%	29%	24%
I practice using basic math skills.	31%	31%	20%	18%
I practice doing math problems that relate to the real world.	20%	35%	24%	22%
My teacher does all of the talking.	44%	25%	15%	16%
I use a calculator.	52%	29%	12%	8%
I use a computer to do math.	7%	8%	15%	70%
I use a computer to look for information.	19%	24%	18%	40%
I work with hands-on manipulatives (such as cubes, spinners, geometric solids).	7%	17%	27%	49%

I enjoy math.	15%	46%	25%	13%
I am good at math.	21%	55%	20%	5%
I usually understand what we are doing in math class.	18%	57%	20%	5%
Doing math makes me nervous or upset.	4%	17%	45%	35%
Math is useful in everyday problems.	30%	51%	14%	5%
Math will be important for me as an adult.	48%	41%	9%	2%
I look forward to taking more math classes.	14%	43%	31%	13%
I find my math class challenging.	16%	50%	22%	12%

What grades do you usually earn in math class?	Mostly A's	18%
	About half A's and half B's	21%
	Mostly B's	11%
	About half B's and half C's	21%
	Mostly C's	12%
	About half C's and half D's	7%
	Mostly D's	6%
	Mostly below D	4%
The material in this year's class is:	Almost all or all new to me.	19%
	Mostly new to me.	54%
	Mostly repeated from previous years.	19%
	Almost all or all repeated from previous years.	9%

Student Mathematics Attitude: Grade 10
1997-98

[redacted]				
I am asked math questions that make me think.	55%			
I do work that involves memorizing math facts.	36%	36%	17%	10%
I solve math problems in small groups (2-6 students).	25%	13%	19%	43%
I work on math projects requiring more than a single day's work.	9%	11%	25%	55%
I am asked to write about math.	4%	6%	15%	76%
My teachers relate math to other subjects.	9%	24%	30%	37%
I practice using basic math skills.	37%	20%	23%	20%
I practice doing math problems that relate to the real world.	15%	32%	24%	29%
My teacher does all of the talking.	55%	19%	16%	11%
I use a calculator.	46%	23%	17%	13%
I use a computer to do math.	4%	14%	26%	57%
I use a computer to look for information.	18%	15%	18%	50%
I work with hands-on manipulatives (such as cubes, spinners, geometric solids).	6%	8%	32%	54%

I enjoy math.	8%	42%	30%	22%
I am good at math.	14%	49%	23%	14%
I usually understand what we are doing in math class.	17%	43%	26%	14%
Doing math makes me nervous or upset.	8%	16%	41%	36%
Math is useful in everyday problems.	12%	48%	28%	13%
Math will be important for me as an adult.	23%	55%	14%	9%
I look forward to taking more math classes.	10%	27%	36%	28%
I find my math class challenging.	19%	46%	24%	11%

What grades do you usually earn in math class?	Mostly A's	12%
	About half A's and half B's	18%
	Mostly B's	11%
	About half B's and half C's	23%
	Mostly C's	13%
	About half C's and half D's	12%
	Mostly D's	5%
	Mostly below D	7%
The material in this year's class is: .	Almost all or all new to me.	23%
	Mostly new to me.	54%
	Mostly repeated from previous years.	17%
	Almost all or all repeated from previous years.	7%

Appendix B

Survey Instruments

Student Mathematics Attitude Survey '97-'98

This survey asks about your views about math. This information will be used to continually improve the teaching and learning of mathematics in this district. This is one piece of a district-wide mathematics program evaluation.

Please show your answer to each question by placing an "x" in the box or circling the number of your choices. This survey is intended to find out your views about your mathematics experiences. There are no right or wrong answers. The surveys are anonymous and will not be used by your teacher for any grading purpose.

1. Are you: ☐ Boy ☐ Girl

2. I consider myself to be a:

Excellent math student	☐
Good math student	☐
Fair math student	☐
Poor math student	☐

3. How many years have you been a student in this district (including this year)?

☐ Less than 1 year ☐ 1 to 3 years ☐ More than 3 years

Please indicate how you feel about each of the following statements:

	Strongly Agree		Strongly Disagree
4. I enjoy math.	☺	😐	☹
5. I am good at math.	☺	😐	☹
6. I usually understand what we are doing in math class.	☺	😐	☹
7. Doing math makes me nervous or upset.	☺	😐	☹
8. Math is useful in everyday problems.	☺	😐	☹
9. Math will be important for me as an adult.	☺	😐	☹
10. I look forward to learning more about math.	☺	😐	☹
11. I find my math class challenging.	☺	😐	☹

In my current math class:	Often	Sometimes	Never
12. I am asked to explain the way I solve math problems.	☺	😐	☹
13. I do work that involves memorizing math facts.	☺	😐	☹
14. I solve math problems in small groups (2-6 students).	☺	😐	☹
15. I work on math projects requiring more than a single day's work.	☺	😐	☹
16. I am asked to write about math.	☺	😐	☹
17. I use math skills in science, reading, and writing.	☺	😐	☹
18. I practice using basic math skills.	☺	😐	☹
19. I practice doing math problems that relate to the real world.	☺	😐	☹
20. My teacher does all of the talking.	☺	😐	☹
21. I use a calculator.	☺	😐	☹
22. I use a computer to do math.	☺	😐	☹
23. I work with hands-on manipulatives (such as cubes, spinners, geometric solids).	☺	😐	☹

Please mark an "x" in the appropriate box.

24. The material in this year's class is:

- ☐ Almost all, or all new to me.
- ☐ Mostly new to me.
- ☐ Mostly repeated from previous years.
- ☐ Almost all, or all repeated from previous years.

Thank you for your help.

Student Mathematics Attitude Survey '97-'98

This survey asks about your views about math. This information will be used to continually improve the teaching and learning of mathematics in this district. This is one piece of a district-wide mathematics program evaluation.

Please show your answer to each question by placing an "x" in the box or circling the number of your choices. This survey is intended to find out your views about your mathematics experiences. There are no right or wrong answers. The surveys are anonymous and will not be used by your teacher for any grading purpose.

1. What grade are you in? ☐ 6 ☐ 8 ☐ 10

2. Are you: ☐ Male ☐ Female

3. What grades do you usually earn in math class?

Mostly A's	☐
About half A's and half B's	☐
Mostly B's	☐
About half B's and half C's	☐
Mostly C's	☐
About half C's and half D's	☐
Mostly D's	☐
Mostly below D	☐

4. How many years have you been a student in this district (including this year)?

☐ Less than 1 year ☐ 1 to 3 years ☐ More than 3 years

Please indicate how you feel about each of the following statements:

	Strongly Agree	Agree	Disagree	Strongly Disagree
5. I enjoy math.	1	2	3	4
6. I am good at math.	1	2	3	4
7. I usually understand what we are doing in math class.	1	2	3	4
8. Doing math makes me nervous or upset.	1	2	3	4
9. Math is useful in everyday problems.	1	2	3	4
10. Math will be important for me as an adult.	1	2	3	4
11. I look forward to taking more math classes.	1	2	3	4
12. I find my math class challenging.	1	2	3	4

In my current math class:	Less than 3 Times per Year	At least Once per Marking Period	2-3 Times per Month	More Than Once per Week
13. I am asked math questions that make me think.	1	2	3	4
14. I do work that involves memorizing math facts.	1	2	3	4
15. I solve math problems in small groups (2-6 students).	1	2	3	4
16. I work on math projects requiring more than a single day's work.	1	2	3	4
17. I am asked to write about math.	1	2	3	4
18. My teachers relate math to other subjects.	1	2	3	4
19. I practice using basic math skills.	1	2	3	4
20. I practice doing math problems that relate to the real world.	1	2	3	4
21. My teacher does all of the talking.	1	2	3	4
22. I use a calculator.	1	2	3	4
23. I use a computer to do math.	1	2	3	4
24. I use a computer to look for information.	1	2	3	4
25. I work with hands-on manipulatives (such as cubes, spinners, geometric solids).	1	2	3	4

Please mark an "x" in the appropriate box.

26. The material in this year's class is:

- ☐ Almost all, or all new to me.
- ☐ Mostly new to me.
- ☐ Mostly repeated from previous years.
- ☐ Almost all, or all repeated from previous years.

Thank you for your help.

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