A Longitudinal/Cross-Sectional Study of the Impact of *Mathematics in Context* on Student Mathematical Performance

Student Attitude Inventory

(Working Paper #7)

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Shafer, M. C., Wagner, L. R., & Davis, J. (1997). *Student attitude inventory* (*Mathematics in Context* Longitudinal/Cross-Sectional Study Working Paper No. 7). Madison, WI: University of Wisconsin-Madison.

The development of this instrument was supported by a grant from the National Science Foundation #REC-9553889 and by the Wisconsin Center for Education Research, School of Education, University of Wisconsin-Madison. Any opinions, findings or conclusions are those of the author(s) and do not necessarily reflect the views of the supporting agencies.

Description of Student Attitude Inventory

The Student Attitude Inventory was designed to characterize the attitudes of middle-school students toward mathematics and toward themselves as learners of mathematics. The Student Attitude Inventory is composed of two sections: statements rated on a Likert scale, and open-response items. The first section of the Student Attitude Inventory is a set of statements written to reflect important constructs related to students' attitudes and beliefs about mathematics and themselves as learners of mathematics. The statements were grouped into seven subscales: effort to succeed in mathematics, interest in and excitement about mathematics, confidence in learning mathematics, communication of mathematical ideas, usefulness of mathematics, general perceptions about mathematics and learners of mathematics, and attribution of success and failure in perceptions of mathematics. The statements on the attitude instrument are collections of items used in previous research on student attitudes (Dossey, Mullis, Gorman, & Latham, 1994; Fennema & Sherman, 1986; Kloosterman & Stage, 1992; Schoenfeld, 1989). These items were reworded to update the terminology and to facilitate their use with younger audiences than those for which they were originally intended. New items were also composed to reflect current constructs of import within the reform movement, (e.g., technology, communication, collaboration). Each subscale consist of from 5–16 statements worded to show eiher positive or negative attitudes relevant ‘to the context’ of the subscale.

Following Schoenfeld (1989), each statement was accompanied by a 4-point Likert scale indicating student level of agreement: “very true," “sort of true,” “not very true,” “not true at all.” The direction of the scoring weights assigned to the response categories depends on whether a particular statement was worded favorably or unfavorably (Edwards & Porter, 1972). If a statement was worded favorably, scoring weights assigned to the four categories would be 1 for "Very True," 2 for "Sort of True," 3 for "Not Very True," and 4 for "Not True at All." If a statement reflected a “negative” attitude, the direction of the scoring weights was reversed (e.g., "Not True at All" received a score of 1, and so on). Thus a reflected “negative” attitude ratings on two related but contradictory statements should have resulted in approximately the same score. Computing the mean score of the subscale provided an overall indication of the individual's attitudes with respect to a particular subscale. In this attitude inventory, students had relatively low scores if their responses to students reflected a positive attitude and relatively high scores if their responses reflected a negative attitude to a given subscale. Conversely, students will have relatively high scores.

Pilot-test. Initially, 75 statements reflecting the beliefs represented in the seven subscales were written. Nine educators (classroom teachers, professors, and graduate students) then read through the 75 statements and sorted them into subscales. Statements categorized into subscales with 79% or more agreement maintained their initial placement in the subscales. Items with less than 79% agreement were reworded, moved to a different subscale, or dropped. Sixty-five items remained and were randomly distributed throughout the inventory with efforts made to avoid using items from the same subscale in succession. The instrument was then pilot-tested in both reform and conventional elementary- and middle-school classrooms to test for reliability. A time limit was not given for completing the inventory; administration typically took between 20 and 30 minutes. Inter-item correlation, squared multiple correlation, and reliability (Cronbach’s alpha) were calculated for each subscale after a given item was removed from it. As a result, the inventory was pared down to 60 Likert-scale items.

Subscales

Effort. The effort subscale measured students' belief that with sufficient effort, anyone could learn mathematics and improve their mathematical abilities. The subscale included the following statements:

2. If I try hard, I can do well in math.
21. If a problem we worked on in math doesn't get solved during class, I still think about it after class is over and try to figure it out even if the teacher didn't tell me to.
33. If I don't understand a math problem, I give up without trying very hard to figure it out.
43. If I can't solve a math problem right away, I give up after a few minutes.
46. If I have trouble figuring out a problem right away, I don't like to stop working on it until I get an answer that makes sense.
58. I try not to do more work in math than I have to.

Interest in and excitement about learning mathematics. The interest subscale measured students' enjoyment of learning mathematics. The subscale included the following statements:

1. I like mathematics.
10. I like learning new things in math.
13. Math is so hard to do, it isn't any fun.
17. I don't understand why some people seem to think math is fun.
24. I like to work on new math problems that are different from others that I have worked on before.
34. Math is my favorite class.
51. Mathematics is boring.
57. Learning mathematics is not interesting to me.

Confidence. The confidence subscale measured students' confidence in their abilities to learn mathematics and perform well on mathematical tasks. The subscale included the following statements:

9. I usually do not know the answers to the questions my teacher asks in math class.
18. I'm not the type of person who does well in math.
25. I don't get worried if my first plan to solve a problem doesn't work, since I know many ways to try to figure problems out.
31. Even if I don't understand a math problem right away, I know I will be able to figure it out if I work at it.
42. I am certain that I can do well in math classes that I will take later on in school.

Communication. The communication subscale measured students' beliefs about the importance of communication in developing mathematical understanding, both for the individual and for shared understanding in the classroom community. The subscale also measured students' beliefs about the teacher's interest in student ideas about mathematical content. The subscale included the following statements:

12. My classmates contribute important ideas which help me understand mathematics.
23. I have many chances during math class to answer questions and explain my ideas to my teacher and classmates.
29. I don't take part in discussions during math class very often.
32. I can learn a lot by working with other people to solve math problems.
35. Being able to explain your ideas clearly is an important part of learning mathematics.
47. I like to share my ideas during class discussions in math.
56. My teacher thinks my ideas about math.

Usefulness of mathematics. The usefulness subscale measured students' beliefs about the relevance of mathematics to daily life and about the usefulness of mathematics in helping people to acquire and succeed in jobs. The subscale included the following statements:

5. When I finish school, mathematics will not be important in my life.
15. Mathematics helps me make sense of things in the world.
19. Mathematics is important only because it is a subject I have to take in school.
26. I never see mathematics being used except when I'm in math class.
40. Knowing mathematics is not necessary in getting a good job.
50. I would like a job that uses mathematics often.
52. I work hard at mathematics because I know that it will be useful for me.
60. Mathematics is useful in everyone's life.

General perceptions. The general perception subscale measured attitudes related to calculator use, the nature of mathematics (problem solving versus facts or rules), the learning of mathematics (the importance of understanding a concept versus arriving at an answer), and connections of mathematics to other school subjects. One item related to confidence (Item 3) and two items related to effort (Items 11 and 37) were also included in the general perception subscale. When these items were included in the effort and confidence subscales, the reliability of each subscale was compromised. These items, however, were not deleted from the attitude inventory because of their significance in characterizing student attitudes toward mathematics.

Two items per concept were included in the general perceptions subscale to assure consistency of student responses (e.g., "Anyone who works hard enough can be good at math, no matter how hard a person works" and "Some people are just naturally good at math and some are just not"). Taken together, the items on the general perception subscale form a profile of a student's general conceptions of mathematics. The results in the general perception subscale, however, cannot be aggregated across items because the individual items cover a wide range of tangentially related conceptions; a mean score for the subscale would not yield meaningful results.

The general perceptions subscale measured students' beliefs about the nature of mathematics and the role of calculators in problem solving and in supporting accurate calculations. The subscale included the following statements:

3. I feel sure that I'm able to learn new ideas in math class.
4. In mathematics, you can discover new ways of solving problems that the teacher or your classmates may not have thought of.
16. It's okay if I solve a math problem differently than my classmates do.
11. Anyone who works hard enough can be good at math.
37. No matter how hard a person works, some people are just naturally good at math and some are just not.
53. Knowing how to solve a problem is as important as getting the answer.
38. Answering questions correctly in math means only giving a number.
27. Understanding why an answer is right is not as important as getting the right answer.
49. It really doesn't matter if you understand a math problem or how you get an answer as long as the answer you get is right.
55. Mathematics is mostly learned by memorizing facts and rules.
44. When my teacher asks a question, I will get it right if I had memorized the correct rule or fact.
45. If you have to use a calculator to solve a problem, you don't really understand how to do the problem.
6. If I use a calculator to solve a problem, I can be sure it will always give me the right answer.
20. Mathematics is not related to any of my other school subjects.
39. Each new math topic I study is not related to ones I have learned before.
28. Mathematics is more difficult to understand than other subjects.

Attribution. The attributions subscale measured students' beliefs about the internal factors (ability and effort) or external factors (teacher or luck) that influenced their success and failure in mathematics. This subscale was composed of 10 items in four categories that characterized students' beliefs about the causes of their success or failure in mathematics. The ability category included items that elicited students' attribution of success or failure related to innate possession or lack of skill, talent, or the capacity to understand mathematics. The effort category was composed of items that measured the student's attribution of success or failure related to time and effort invested in studying mathematics and the student's attention to accuracy. The teacher category contained items that indicated whether a student attributed success or failure to the teacher's partiality toward that student. The luck category included items that related to students' attribution of success or failure to chance. Two items per category were included in the attributions subscale (see Table 1) to assure consistency of student responses (e.g., "When I do well in math, it's because the teacher likes me" and "When I don't do well in math, it's because the teacher doesn't like me"). Two additional items (Items 8 and 54) were included as fillers to support the results of the effort and luck categories.

Table 1
Categorization of Items in the Attribution Subscale

Attribution	Success	Failure
Teacher	14. When I do well in math, it's because the teacher likes me.	36. When I don't do well in math, it's because the teacher doesn't like me.
Ability	7. When I do well in math, it's because I'm naturally a good math student.	22. When I don't do well in math, it's because I'm not good at math.
Effort	41. When I do well in math, it's because I have worked hard.	59. When I don't do well in math, it's because I haven't studied hard enough.
Luck	30. When I do well in math, it's because I was lucky.	48. When I don't do well in math, it's because I was unlucky.

Fillers:
54. When I do well in math, I'm never sure how it happened.
8. When I don't do well in math, it's because I was careless.

Similar to the general perception subscale, the results of the attribution subscale cannot be aggregated across items. The individual items measured attribution of success or failure in relation to four distinct constructs. Furthermore, items worded to reflect a "negative" attitude were not reverse-scored. In the case of attribution, the response to a particular item indicates whether the student attributes success or failure in mathematics to a particular cause. For two related items that are compatible, one coded for success and one coded for failure, we expect the scores to be the same. Aggregating the results into a mean score for the subscale would not yield meaningful results.

Open-Response Items

In the second section of the Student Attitude Inventory, four open-ended items were included to allow students to provide more extensive answers on their ideas about mathematics and its uses outside of school. For Item 1, students listed words they associated with "mathematics." For Item 2, students listed occupations besides teaching that they believed required the use of mathematics. For Item 3, students described ways they used mathematics outside of class. For Item 4, students described other ways people might use mathematics. Responses for Item 4 did not reveal any information different from Item 2. Therefore, responses to Item 4 were not coded or summarized. Responses from students in Grades 5, 6, and 7 were similar across grade levels. Because of the amount of time and resources used to code and synthesize responses to Items 1–3 for the first year of the study, responses to these items and Item 4 were not summarized for the second and third years of the study.

Administration in the Study

In the first year of the study, the Student Attitude Inventory was administered in September and May. The fall administration of the inventory was used as background information. The spring administration from the first study year was used as background information for the second year, in combination with the results of the inventory for students who began the study in the second year. The spring administration from the second study year was used as background information for the third year. The final administration of the Student Attitude Inventory occurred in the spring of the third study year. The results of this administration will be used for comparison purposes.

References

Dossey, J., Mullis, I., Gorman, S., & Latham, A. (1994). How school mathematics functions: Perspectives from the NAEP 1990 and 1992 assessments (Report No. 23-FR-02). Washington, DC: Office of Educational Research and Improvement.

Edwards, A., & Porter, B. (1972). Attitude measurement. In W. H. Barber, J. Crawford, A. L. Edwards, O. J. Harvey, D. C. McClelland, F. McDonald, C. Kielsmeier, B. Porter, C. D. Spielberger & P. A. Twelker (contributors), *The affective domain: A resource book for media specialists*. Washington, DC: Gryphon House.

Fennema, E., & Sherman, J. (1986). Fennema–Sherman mathematics attitudes scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal for Research in Mathematics Education*, *7*(5), 324–326.

Kloosterman, P., & Stage, F. (1992). Measuring beliefs about mathematical problem solving. *School Science and Mathematics*, *92*(3), 109–115.

Schoenfeld, A. (1989). Explorations of students' mathematical beliefs and behavior. *Journal for Research in Mathematics Education*, *20*(4), 338–355.

Student Attitude Inventory

The Student Attitude Inventory was designed to elicit information related to seven subscales including effort to learn mathematics, interest and excitement about mathematics, and general perceptions of the nature of mathematics.

The Student Attitude Inventory will take one (45-minute) class period to administer. When you administer the assessment, please read the instruction page aloud as the students follow along. (The instruction page is on the booklet cover.) In Part I, students circle the number under the answer that tells best what they think or feel for each statement. In Part II, students complete four open-response questions.

All students should indicate the date they completed the inventory. In the event a student is no longer in your class, please indicate that on the booklet and return the booklet with the class set. We have enclosed a few extra booklets for you in case your class enrollment has changed. If students use the extra booklets, please make sure that name, school, and teacher blanks are completed.

If students are absent on the days you administer the inventory, please arrange for these students to complete the inventory as soon as possible after they return to school.

Enclose the questionnaires (both completed and unused copies) in the provided envelopes for mailing to Madison.

We appreciate the work you have done in gathering information during the *Mathematics in Context* Longitudinal Study. We thank you for your continued participation and support.

Sincerely,

The Staff of the *Mathematics in Context* Longitudinal Study

Student Attitude Inventory

Student Name ____

Teacher Name ____

School ____

Date ____

On the following pages you will find some statements about math. This is NOT a test. There are no right or wrong answers. Your teacher will not see your answers, and your answers will not affect your grade. We are interested in your opinions and your ideas about math, so answer the questions as honestly as you can.

DIRECTIONS:

Part I:
You will be asked to tell how much you agree or disagree with statements about math. Each statement is followed by four numbers. For each statement, decide which answer best shows how you feel. Then, circle the number under the answer that tells best what you think or feel. Circle only one number for each statement.

Sometimes you might be given a statement such as:

	very true	sort of true	not very true	not true at all
Red is a beautiful color.	1	2	3	4

If you think this statement is very true, circle the number 1.
If you think this statement is sort of true, circle the number 2.
If you think this statement is not very true, circle the number 3.
If you think this statement is not true at all, circle the number 4.

Here is a practice question for you.

Suppose you are given the statement:

	very true	sort of true	not very true	not true at all
It is more fun to play outdoors than indoors.	1	2	3	4

If you think that this statement is very true, circle the number 1.
If you think that this statement is sort of, but not always, true, circle the number 2.
If you think that this statement is not very true, but you don't disagree with it entirely, circle the number 3.
If you think that this statement is not true at all, circle the number 4.

Think carefully about each statement, but do not spend too much time on any one statement. If you are not sure of an answer, skip it and come back to it once you have answered all the other questions. However, make sure you answer ALL the questions. Remember to choose the answer that tells best how YOU feel about each statement. The only right answers are the ones that you believe are true.

Part II:
You will be asked a question about mathematics. Please give a short answer for each question. You do not have to write in complete sentences.

Part I. Select the answer that tells best how you feel about each statement. Circle only one answer for each statement.

		very true	sort of true	not very true	not true at all
1.	I like mathematics.	1	2	3	4
2.	If I try hard, I can do well in math.	1	2	3	4
3.	I feel sure that I am able to learn new ideas in math class.	1	2	3	4
4.	In mathematics, you can discover new ways of solving problems that the teacher or your classmates may not have thought of.	1	2	3	4
5.	When I finish school, mathematics will not be important in my life.	1	2	3	4
6.	If I use a calculator to solve a problem, I can be sure it will always give me the right answer.	1	2	3	4
7.	When I do well in math, it's because I'm naturally a good math student.	1	2	3	4
8.	When I don't do well in math, it's because I was careless.	1	2	3	4
9.	I usually do not know the answers to the questions my teacher asks in math class.	1	2	3	4
10.	I like learning new things in math.	1	2	3	4
11.	Anyone who works hard enough can be good at math.	1	2	3	4
12.	My classmates contribute important ideas which help me understand mathematics.	1	2	3	4
13	Math is so hard to do, it isn't any fun.	1	2	3	4
14.	When I do well in math, it's because the teacher likes me.	1	2	3	4
15.	Mathematics helps me make sense of things in the world.	1	2	3	4

		very true	sort of true	not very true	not true at all
16.	It’s okay if I solve a math problem differently than my classmates do.	1	2	3	4
17.	I don’t understand why some people seem to think math is fun.	1	2	3	4
18.	I’m not the type of person who does well in math.	1	2	3	4
19.	Mathematics is important only because it is a subject I have to take in school.	1	2	3	4
20.	Mathematics is not related to any of my other school subjects.	1	2	3	4
21.	If a problem we worked on in math doesn’t get solved during class, I still think about it after class is over and try to figure it out even if the teacher didn’t tell me to.	1	2	3	4
22.	When I don’t do well in math, it’s because I’m not good at math.	1	2	3	4
23.	I have many chances during math class to answer questions and explain my ideas to my teacher and classmates.	1	2	3	4
24.	I like to work on new math problems that are different from others that I have worked on before.	1	2	3	4
25.	I don’t get worried if my first plan to solve a problem doesn’t work, since I know many ways to try to figure problems out.	1	2	3	4
26.	I never see mathematics being used except when I’m in math class.	1	2	3	4
27.	Understanding why an answer is right is not as important as getting the right answer.	1	2	3	4
28.	Mathematics is more difficult to understand than other subjects.	1	2	3	4
29.	I don’t take part in discussions during math class very often.	1	2	3	4

		very true	sort of true	not very true	not true at all
30.	When I do well in math, it's because I was lucky.	1	2	3	4
31.	Even if I don't understand a math problem right away, I know I will be able to figure it out if I work at it.	1	2	3	4
32.	I can learn a lot by working with other people to solve math problems.	1	2	3	4
33.	If I don't understand a math problem, I give up without trying very hard to figure it out.	1	2	3	4
34.	Math is my favorite class.	1	2	3	4
35.	Being able to explain your ideas clearly is an important part of learning mathematics.	1	2	3	4
36.	When I don't do well in math, it's because the teacher doesn't like me.	1	2	3	4
37.	No matter how hard a person works, some people are just naturally good at math and some are just not.	1	2	3	4
38.	Answering questions correctly in math means only giving a number.	1	2	3	4
39.	Each new math topic I study is not related to ones I have learned before.	1	2	3	4
40.	Knowing mathematics is not necessary to get a good job.	1	2	3	4
41.	When I do well in math, it's because I have worked hard.	1	2	3	4
42.	I am certain that I can do well in math classes that I will take later on in school.	1	2	3	4
43.	If I can't solve a math problem right away, I give up after a few minutes.	1	2	3	4

		very true	sort of true	not very true	not true at all
44.	When my teacher asks a question I will get it right if I have memorized the correct rule or fact.	1	2	3	4
45.	If you have to use a calculator to solve a problem, you don't really understand how to do the problem.	1	2	3	4
46.	If I have trouble figuring out a problem right away, I don't like to stop working on it until I get an answer that makes sense.	1	2	3	4
47.	I like to share my ideas during class discussions in math.	1	2	3	4
48.	When I don't do well in math, it's because I was unlucky.	1	2	3	4
49.	It really doesn't matter if you understand a math problem or how you get an answer as long as the answer you get is right.	1	2	3	4
50.	I would like a job that uses mathematics often.	1	2	3	4
51.	Mathematics is boring.	1	2	3	4
52.	I work hard at mathematics because I know that it will be useful for me.	1	2	3	4
53.	Knowing how to solve a problem is as important as getting the answer.	1	2	3	4
54.	When I do well in math, I'm never sure how it happened.	1	2	3	4
55.	Mathematics is mostly learned by memorizing facts and rules.	1	2	3	4
56.	My teacher thinks my ideas about math are important.	1	2	3	4
57.	Learning mathematics is not interesting to me.	1	2	3	4
58.	I try not to do more work in math than I have to.	1	2	3	4
59.	When I don't do well in math, it's because I haven't studied hard enough.	1	2	3	4
60.	Mathematics is useful in everyone's life.	1	2	3	4

Part II. Please give a short answer to each of the following questions in the space following the question. You do not have to write in complete sentences.

1. List words that you think of when you hear “mathematics.”

2. List jobs besides teaching that require mathematics.

3. Describe how you use mathematics outside of class.

4. Describe other ways people might use mathematics.