Mathematics Attitudes and Perceptions Survey, MATH 110

Questions:

The first version of the survey consists of 39 statements. They are categorized in six categories:

A. Relations to real world
B. Need to understand formulas or procedures
C. Dependence on procedures
D. Confidence
E. Exploration in problem solving
F. Independence in learning

Some of the statements do not belong to any of the categories. The following table shows the category each statement belongs to and the summary of student and expert responses.

Table 1: Students responses in the pre- (Sept 2010) and the post- (Apr 2011) survey. The expert (graduate students + faculties) responses are included for comparison. A: agree; DA: disagree; shaded: opposite perceptions between students and experts.

	Cate-gory	Statements	M110 pre		M110 post		Expert	
			A	DA	A	DA	A	DA
1	D	An obstacle to learning math is having to memorize all the necessary information.	50%	26%	53%	27%	5%	77%
2		When I am solving a math problem, I try to predict what would be a reasonable answer.	68%	17%	66%	12%	95%	0%
3		It is useful for me to do lots and lots of problems when learning math.	81%	5%	91%	1%	73%	14%
4	D	After I study a topic in math and feel that I understand it, I have difficulty solving problems on the same topic.	54%	27%	54%	24%	0%	82%
5	D	Knowledge in math consists of many disconnected topics.	29%	38%	23%	47%	9%	68%
6	F	When I solve a math problem, I find an example that looks like the problem given and follow the same steps.	84%	2%	79%	2%	64%	14%
7		I find that reading the text in detail is a helpful way for me to learn math.	38%	29%	39%	36%	59%	0%
8	C	There is usually only one correct approach to solving a math problem.	8%	72%	11%	72%	0%	100%
9	B	I'm satisfied if I can do the exercises for a math topic, even if I don't understand how everything works.	35%	52%	38%	42%	5%	95%
10	F	I cannot learn math if the teacher does not explain things well in class.	83%	7%	79%	6%	5%	82%
11	D	I do not expect math formulas to help my	34%	46%	27%	38%	0%	73%

		understanding of the ideas; they are just for doing calculations.						
12	A	I study math to learn things that will be useful in my life outside of school.	31%	34%	28%	46%	45%	36%
13	E	If I get stuck on a math problem on my first try, I usually try to figure out a different way that works.	66%	11%	64%	8%	91%	9%
14		Nearly everyone is capable of understanding math if they work at it.	65%	14%	70%	13%	73%	9%
15	F	Understanding math means being able to recall something you've read or been shown.	46%	27%	45%	19%	9%	73%
16		To understand math I talk about it with friends and other students.	59%	22%	53%	32%	86%	9%
17	D	If I am stuck on a math problem for more than five minutes, I give up or get help from someone else.	40%	40%	34%	36%	0%	95%
18	D	If I don't remember a particular formula needed to solve a problem on a math exam, there's nothing much I can do to come up with it.	41%	33%	33%	42%	0%	95%
19	C	In doing a math problem, if my calculation gives a result very different from what I'd expect, I'd trust the calculation rather than going back through the problem.	9%	72%	15%	65%	0%	95%
20	B	In math, it is important for me to make sense out of formulas and procedures before I can use them correctly.	65%	13%	69%	14%	91%	5%
21	E	I enjoy solving math problems.	33%	34%	33%	42%	95%	0%
22	A	Mathematical formulas express meaningful relationships among measurable things or amounts.	58%	8%	63%	5%	73%	0%
23	A	Learning math changes my ideas about how the world works.	28%	39%	35%	39%	86%	9%
24	C	To learn math, I only need to memorize solutions to sample problems.	11%	79%	7%	84%	0%	100%
25	A	Reasoning skills used to understand math can be helpful to me in my everyday life.	59%	16%	53%	16%	100%	0%
27	B	It is a waste of time to understand where math formulas come from.	17%	58%	15%	55%	0%	100%
28	E	I find carefully analyzing only a few problems in detail is a good way for me to learn math.	29%	36%	28%	42%	64%	14%
29	E	I can usually figure out a way to solve math problems.	37%	34%	39%	22%	82%	0%
30	A	School mathematics has little to do with what I experience in the real world.	46%	22%	42%	26%	27%	45%
31	E	There are times I solve a math problem more than one way to help my understanding.	40%	33%	39%	37%	100%	0%
32		Being good at math requires talent.	57%	18%	59%	14%	55%	18%

33		It is possible to explain mathematical ideas without using equations.	53%	16%	70%	10%	82%	9%
34	A	To understand math, I sometimes relate my personal experiences to the topic being studied.	19%	62%	19%	60%	45%	36%
35	B	When I am solving a math problem, if I can see a formula that applies I don't worry about the underlying concepts.	47%	27%	38%	33%	0%	86%
36	D	If I get stuck on a math problem, there is no chance that I will figure it out on my own.	21%	47%	26%	48%	0%	100%
37	E	When learning something new in math, I relate it to what I already know rather than just memorizing it the way it is presented.	54%	15%	55%	11%	100%	0%
38	D	I avoid solving math problems when possible.	40%	35%	45%	30%	5%	91%
39	C	To prepare for a math test, I only need to memorize solutions to examples.	6%	83%	8%	84%	0%	95%
40	D	I think it is unfair to expect me to solve a math problem that is not similar to any example given in class or the textbook, even if the topic has been covered in the course.	58%	20%	55%	22%	0%	91%

Attitude shifts from pre- to post-survey:

We introduce the "category score" as an index of how students are compared with the expert mathematicians in terms of perceptions and attitudes for each category. For each statement, the responses "strongly agree", "agree", "neutral", "disagree" and "strongly disagree" are assigned scores of either respectively 2, 1, 0, -1, -2 or -2, -1, 0, 1, 2, where positive scores are aligned with expert responses. To calculate the category scores, the scores for all statements in each category are summed up and normalized to a scale of -1 to 1. A positive category score represents an expert-like perception, whereas a negative score represents a novice-like perception. The category scores for a sample of experts are shown in the following table as a reference.

Table 2: Category scores from a group of graduate students, post-doctoral fellows and faculties

Categories	Scores
Relations to real world	0.36
Need to understand formulas or procedures	0.73
Dependence on procedures	0.84
Confidence	0.62
Exploration in problem solving	0.61
Independence in learning	0.23

The following graph shows the shifts of the average category scores from the beginning (from the pre-survey in Sept 2010) to the end of the course (from the post-survey in Apr 2011). Data from Math 184 were included for comparison.

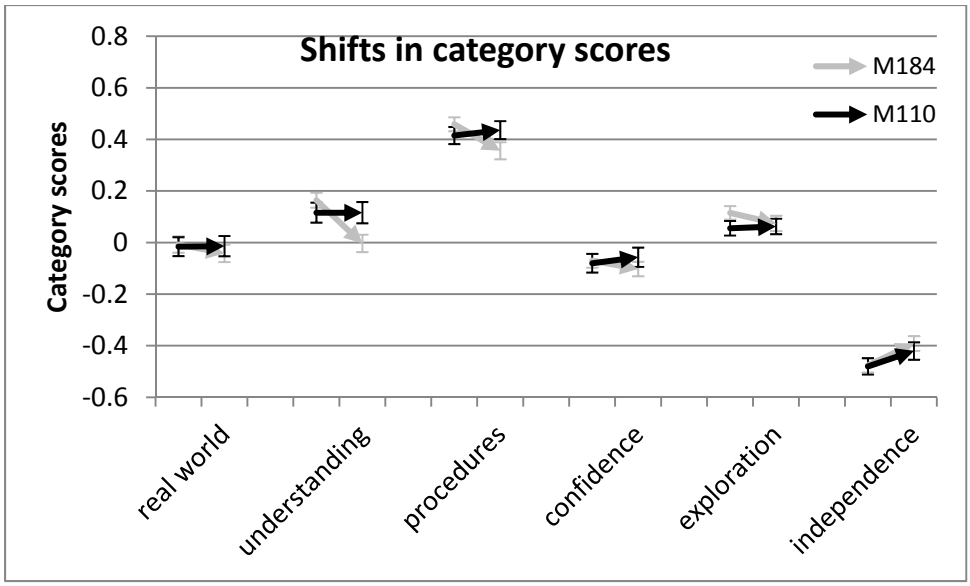

Figure 1: Shifts in student perceptions and attitudes from the beginning to the end of the course: (Math 110: Sept 2010 – Apr 2011, N=84; Math 184: Sept 2010 – Nov 2010, N=112)

On average there were no significant shifts in student perceptions and attitudes in Math 110, contrary to Math 184 where downshifts were observed in some categories. However, the shifts among strongly-performed students and weakly-performed students were different. The following graph shows the shifts in category scores for students who received above-median final grades versus those who received below-median final grades.

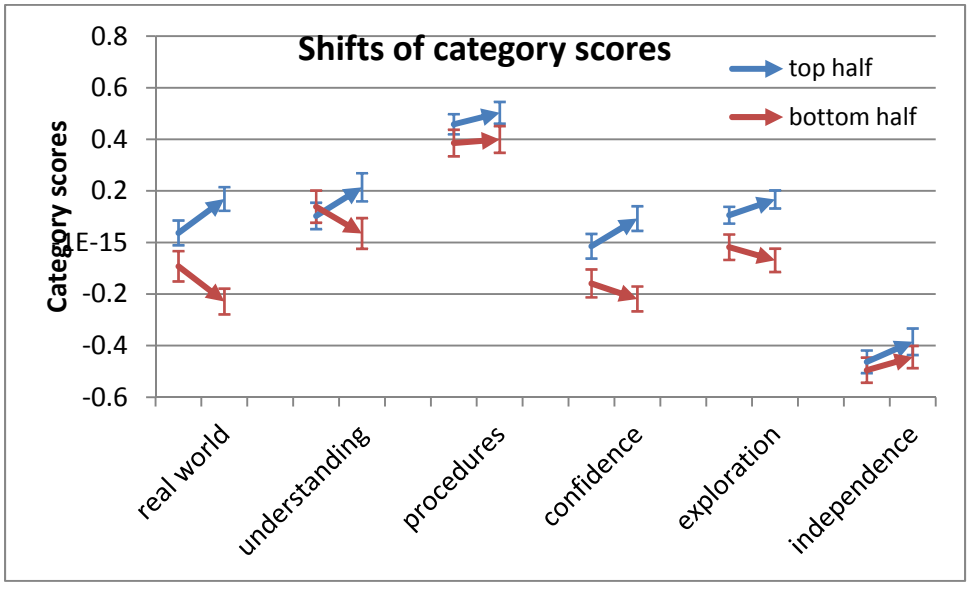

Figure 2: Shifts of student perceptions and attitudes in Math 110 from the beginning to the end of the course. Blue arrows: students who received final grades above the class median (top half, N=45); Red arrows: students who received final grades below the class m

Students with above-median final grades tended to have perceptions and attitudes shifted toward the expert-like direction, whereas those with below-median final grades tended to do the opposite in some

categories. In many cases, stronger-performing students started with more expert-like behaviours then weaker-performing students did, and the gaps between those two groups of students widened after the completion of the course.

Final grades versus attitudes:

Figure 2 suggests that students who perform better tend to have more expert-like attitudes than those who perform worse. It becomes interesting to see how the attitudes are related to course performance. The following table shows the correlation between the category scores in the post-survey and the final grades.

Table 3: The correlation coefficients, r, between the category scores and the final grades

Categories	Correlation coefficient with final grades
Relations to real world	0.44
Need to understand formulas or procedures	0.21
Dependence on procedures	0.13
Confidence	0.45
Exploration in problem solving	0.40
Independence in learning	0.11

Attitudes towards relating math with the real world, confidence and attitudes towards problem solving correlate best with final grades. If we separate the students into two groups based on their attitudes, we see that those with more expert-like attitudes (above-median category scores) tend to received higher final grades than those with more novice-like attitudes (below-median category scores). The following figure shows the average final grades of the two groups of students for each category. The largest differences in final grades again lie in the categories of attitudes towards relating math with real world (11.1 ± 2.5), confidence (12.8 ± 2.3) and attitudes towards problem solving (9.3 ± 2.5).

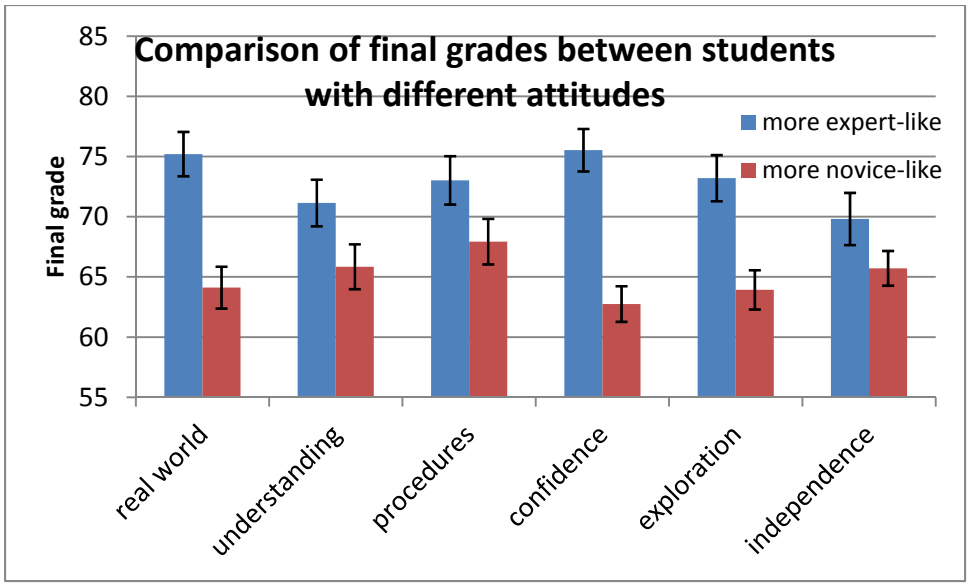

Figure 3: Comparison of the average final grades by categories between students who received category scores above the median score (more expert-like) and those who received category scores below the median score (more novice-like).