English or Math: math proficiency is a better predictor of attitudes toward statistics

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Method

The study recruited 176 participants, including both international and domestic students, to investigate the relationship between English and math proficiencies and attitudes toward statistics. Participants were screened for completeness, validity, and attentiveness, with a final sample of 60 participants included in the analysis.

The study measured age, self-reported English proficiency, self-reported math proficiency, relevance of statistics to future careers, and demographic variables such as international status. English proficiency was categorized into lower and upper levels, while math proficiency was categorized into low, medium, and high levels. Career relevance was categorized into four levels.

Participants completed a questionnaire designed to assess their demographics, English and math proficiencies, and attitudes toward statistics. The questionnaire was designed to be completed within 10 minutes and was administered online.

The questionnaire included items such as age, self-rated English proficiency, self-rated math proficiency, relevance of statistics to future careers, and demographic information. Participants were asked to rate their English and math proficiencies on a scale from 1 to 10, with higher scores indicating higher proficiency. They were also asked to indicate the relevance of statistics to their future career on a scale from 1 to 10.

This study received approval from the Research Ethics Board at the University of Toronto. Participants provided informed consent, and all data were anonymized to ensure confidentiality. Participants were informed of their right to withdraw from the study at any time without penalty.

Result

All descriptive, correlation, and between-subject ANOVA analyses were done by Excel.

Descriptive Analysis

For descriptive analysis of demographic information (participant ID, age, and student status), independent variables (English proficiency, math proficiency, and relevance of statistics to future career), and dependent variables (affect cognitive, value, and difficulty), please refer to Table A1, A2, and A3 in Appendix A.

Correlation Analysis

Correlation analysis between math proficiency and affect:

Hypothesis: H_0: There is no relationship between math proficiency and affect; H_1: There is a relationship between math proficiency and affect.

Result: there are positive correlation between math proficiency and affect, $r(58) = 0.402$, rejecting the null hypothesis.

Correlation analysis between English proficiency and difficulty:

Hypothesis: H_0: There is no relationship between English proficiency and difficulty; H_1: There is a relationship between English proficiency and difficulty.

Result: there is a weak positive correlation between English proficiency and difficulty, $r(58) = 0.203$, rejecting the null hypothesis.

Correlation analysis between affect and cognitive:

Hypothesis: H_0: There is no relationship between affect and cognitive; H_1: There is a relationship between affect and cognitive.

Result: there is a strong positive correlation between affect and cognitive, $r(58) = 0.781$, rejecting the null hypothesis.

Between-subject ANOVA

The difference in affect across different math proficiency groups:

We set the hypothesis as such: H_0: There is no difference in affect across different math proficiency groups. H_1: There is at least one difference in affect across different math proficiency groups. We get the result that the effect of math proficiency was significant, $F(2,57) = 8.29$, $p < 0.05$, suggesting a difference in affect between low ($M = 3.11$, $SD = 1.18$), medium ($M = 4.03$, $SD = 1.00$), and high ($M = 3.34$, $SD = 0.77$) math proficiency groups.

The difference in cognitive across different math proficiency groups:

We set the hypothesis as such: H0: There is no difference in cognitive across different math proficiency groups. H1: There is at least one difference in cognitive across different math proficiency groups. We get the result that the effect of math proficiency was significant, $F(2,57) = 15.03$, $p < 0.05$, suggesting a difference in cognitive between low ($M = 3.52$, $SD = 1.50$), medium ($M = 5.01$, $SD = 0.92$), and high ($M = 5.32$, $SD = 0.77$) math proficiency groups.

The difference in value across different math proficiency groups:

We set the hypothesis as such: H0: There is no difference in value across different math proficiency groups. H1: There is at least one difference in value across different math proficiency groups. We get the result that the effect of math proficiency was not significant, $F(2,57) = 2.60$, p

> 0.05, suggesting no significant difference in value between low (M = 4.94, SD = 1.09), medium (M = 5.49, SD = 0.62), and high (M = 5.42, SD = 0.72) math proficiency groups.

The difference in difficulty across different math proficiency groups:

We set the hypothesis as such: H0: There is no difference in difficulty across different math proficiency groups. H1: There is at least one difference in difficulty across different math proficiency groups. We get the result that the effect of math proficiency was significant, $F(2,57) = 6.47$, $p < 0.05$, suggesting a difference in affect between low (M = 2.72, SD = 0.30), medium (M = 3.44, SD = 0.20), and high (M = 3.57, SD = 0.20) math proficiency groups.

The difference in affect across different English proficiency groups:

We set the hypothesis as such: H0: There is no difference in affect across different English proficiency groups. H1: There is at least one difference in affect across different English proficiency groups. We get the result that the effect of English proficiency was not significant, $F(2,57) = 0.24$, $p > 0.05$, suggesting no difference in affect between lower (M = 3.72, SD = 0.80) and upper (M = 3.92, SD = 1.32) English proficiency groups.

The difference in cognitive across different English proficiency groups:

We set the hypothesis as such: H0: There is no difference in cognitive across different English proficiency groups. H1: There is at least one difference in cognitive across different English proficiency groups. We get the result that the effect of English proficiency was not significant, $F(2,57) = 0.36$, $p > 0.05$, suggesting no difference in cognitive between lower (M = 4.45, SD = 1.27) and upper (M = 4.75, SD = 1.41) English proficiency groups.

The difference in value across different English proficiency groups:

We set the hypothesis as such: H0: There is no difference in value across different English proficiency groups. H1: There is at least one difference in value across different English proficiency groups. We get the result that the effect of English proficiency was not significant, $F(2,57) = 0.47$, $p > 0.05$, suggesting no difference in value between lower ($M = 5.16$, $SD = 0.89$) and upper ($M = 5.38$, $SD = 0.83$) English proficiency groups.

The difference in difficulty across different English proficiency groups:

We set the hypothesis as such: H0: There is no difference in difficulty across different English proficiency groups. H1: There is at least one difference in difficulty across different English proficiency groups. We get the result that the effect of English proficiency was not significant, $F(2,57) = 0.54$, $p > 0.05$, suggesting no difference in difficulty between lower ($M = 3.14$, $SD = 0.72$) and upper ($M = 3.38$, $SD = 0.99$) English proficiency groups.

Data visualization

For data visualization, please see Appendix B.

Discussion

With the data given, we analyzed to see if there were any correlations between different groups and found out there were positive correlations between math proficiency and affect, English proficiency and difficulty, and affect and cognitive. Through between-subject ANOVA, we can find differences in each dependent variable, except in value, across different math proficiency groups; we find no find differences in each dependent variable in the English proficiency groups. Overall, the findings suggest that math proficiency is a better predictor of attitudes toward statistics compared to English proficiency.

Reference

Schau, C., Stevens, J., Dauphinee, T. L., & Vecchio, A. D. (1995). The development and validation of the survey of antitudes toward statistics. Educational and psychological measurement, 55(5), 868-875.

Schau, C. (2003, August). Students' attitudes: The "other" important outcome in statistics education. *In Proceedings of the joint statistical meetings* (pp. 3673-3681).

Appendix A

Table A1

Descriptive Analysis of Demographic Characteristics of the Sample

Demographic/ Descriptive analysis	**Participant ID**	**Age**	**Frequency counts**	**International students (Intl=1) or domestic students (Intl=2)**
Average	50.4333	20.6833	Number of international students: 21	
Median	49.5	20		
Standard deviation	29.1532	2.93715	Number of domestic students: 39	
range	Max: 98 Min: 1	Max: 32 Min: 18		

Table A2

Descriptive Analysis of Independent Variable

Descriptive analysis: IV	**English**	**Math**	**Career**
Average	8.816667	6.0333	5.716667
Median	10	6	6
Standard deviation	1.4671	1.8500	2.394143

Range	Max:10 Min: 5	Max: 8 Min: 1	Max: 10 Min: 0
Frequency counts	Lower: 27 Upper: 33	Low: 20 Med: 20 High: 20	A: 14 B: 13 C: 17 D: 16

Table A3

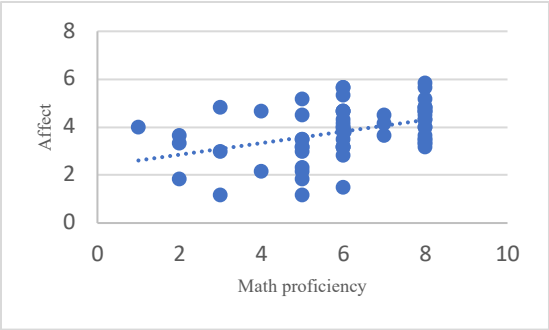
Descriptive Analysis of Dependent Variable

Descriptive analysis: **DV**	**Affect**	**Cognitive**	**Value**	**Difficulty**
Average	3.827778	4.613889	5.283333	3.27381
Median	4	4.666667	5.333333	3.428571
Standard Deviation	1.113167	1.348952	0.854667	0.878779
Range	Max: 5.833333 Min: 1.166667	Max: 6.833333 Min: 1	Max: 6.888889 Min: 2.333333	Max: 5.142857 Min: 1.142857

Appendix B

Figure B1

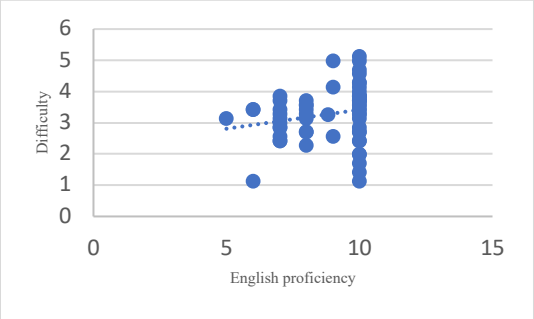
Correlation between math proficiency and affect



Note: The scatterplot demonstrates a positive correlation between math proficiency and affect.

Figure B2

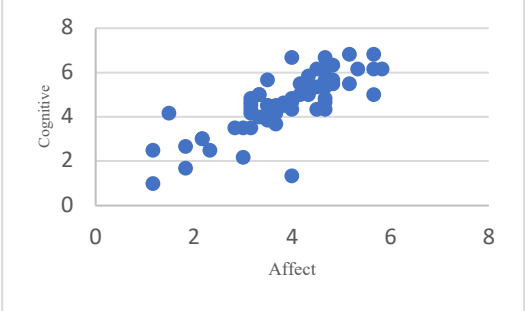
Correlation between English proficiency and difficulty



Note: The scatterplot demonstrates a positive correlation between English proficiency and difficulty.

Figure B3

Correlation between math proficiency and affect and cognitive



Note: The scatterplot demonstrates a positive correlation between affect and cognitive.

Figure B4

The difference in affect across different math proficiency groups

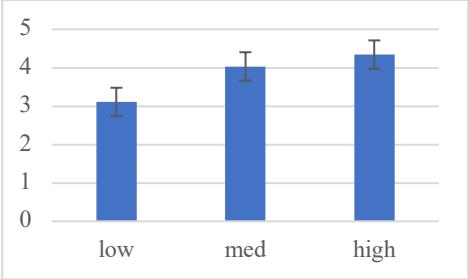


Figure B5

The difference in cognitive across different math proficiency groups