Supplemental Material

CBE—Life Sciences Education

Caughman and Weigel

Supplemental File 1. Math survey Questions based on the MBVI (Andrews et al. 2017).

Question	Strongly Agree	Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat disagree	Disagree	Strongly Disagree
Using Math to understand biology intrigues/would intrigue me	○	○	○	○	○	○	○
It is/would be fun to use Math to understand biology.	○	○	○	○	○	○	○
Using Math to understand biology appeals/would appeal to me.	○	○	○	○	○	○	○
Using Math to understand biology is/would be interesting to me.	○	○	○	○	○	○	○
Math is valuable for me for my life science career.	○	○	○	○	○	○	○
It is important for me to be able to do Math for my career in the life sciences.	○	○	○	○	○	○	○
An understanding of Math is essential for me for my life science career.	○	○	○	○	○	○	○
Math will be useful to me in my life science career.	○	○	○	○	○	○	○
I have/would have to work harder for a biology course that incorporates Math than for one that does not.	○	○	○	○	○	○	○
I worry/would worry about getting worse grades in a biology course that incorporates Math than one that does not.	○	○	○	○	○	○	○
Taking a biology course that incorporates Math intimidates/would intimidate me.	○	○	○	○	○	○	○

Supplemental File 2. Computer Science survey Questions modified from the MBVI (Andrews et al. 2017).

Question	Strongly Agree	Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat disagree	Disagree	Strongly Disagree
Using CS to understand biology intrigues/would intrigue me	○	○	○	○	○	○	○
It is/would be fun to use CS to understand biology.	○	○	○	○	○	○	○
Using CS to understand biology appeals/would appeal to me.	○	○	○	○	○	○	○
Using CS to understand biology is/would be interesting to me.	○	○	○	○	○	○	○
CS is valuable for me for my life science career.	○	○	○	○	○	○	○
It is important for me to be able to do CS for my career in the life sciences.	○	○	○	○	○	○	○
An understanding of CS is essential for me for my life science career.	○	○	○	○	○	○	○
CS will be useful to me in my life science career.	○	○	○	○	○	○	○
I have/would have to work harder for a biology course that incorporates CS than for one that does not.	○	○	○	○	○	○	○
I worry/would worry about getting worse grades in a biology course that incorporates CS than one that does not.	○	○	○	○	○	○	○
Taking a biology course that incorporates CS intimidates/would intimidate me.	○	○	○	○	○	○	○

Supplemental Methods and Results: Confirmatory Factor Analysis

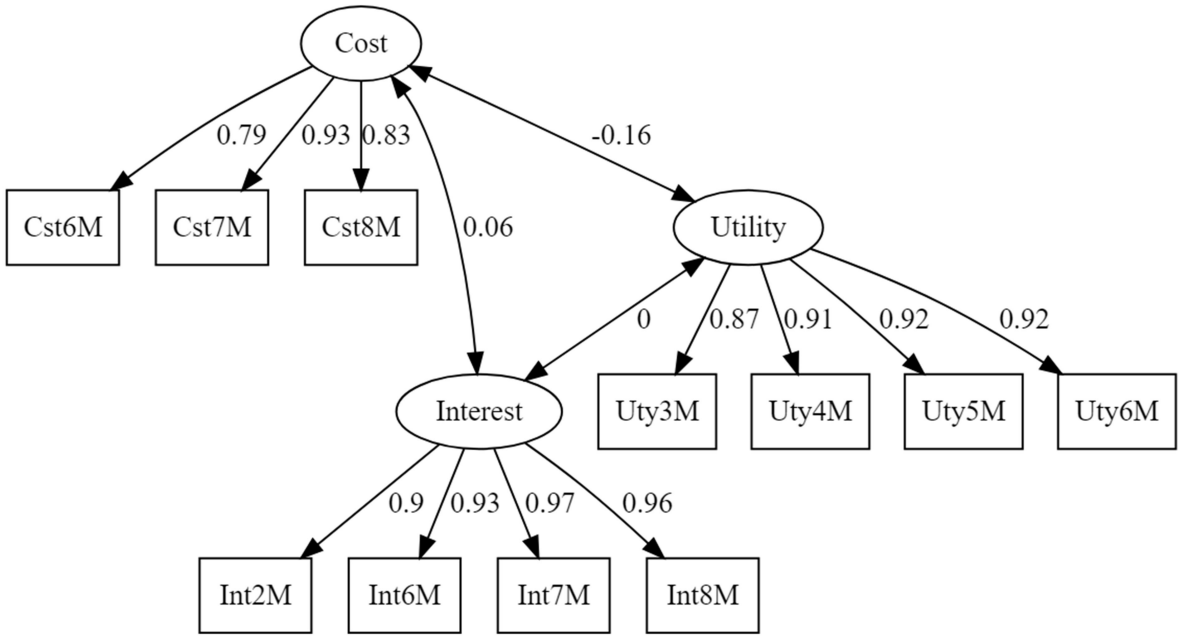
A Confirmatory Factor Analysis (CFA) was completed for the Math and CS survey responses individual using the lavvaan package (Rosseel, 2012) in R (version 4.1.0; R Core Team 2019). To reduce the effects of sample size on the results of our CFA (Kyriazos, 2018), we only used data for which a student answered all of the questions within a construct.

Cutoff scores exceeding 0.9 on the CFI and TIL index, less than 0.8 on the RMSEA and less than 0.05 on the SRMR were used as indicators of good model fit (Supplemental File 5 Below). All four indicators showed the Math CFA model was a good fit and all variables were significant. For CS, the first two indicators showed good fit and the next two were close to the cutoff values. Given this, and that the variables were all significant, we determined that our CS CFA model is also a good fit. A visual representation of the CFA was plotted using the lavvaanPlot package (Lishinski 2021; Supplemental File 6 and 7).

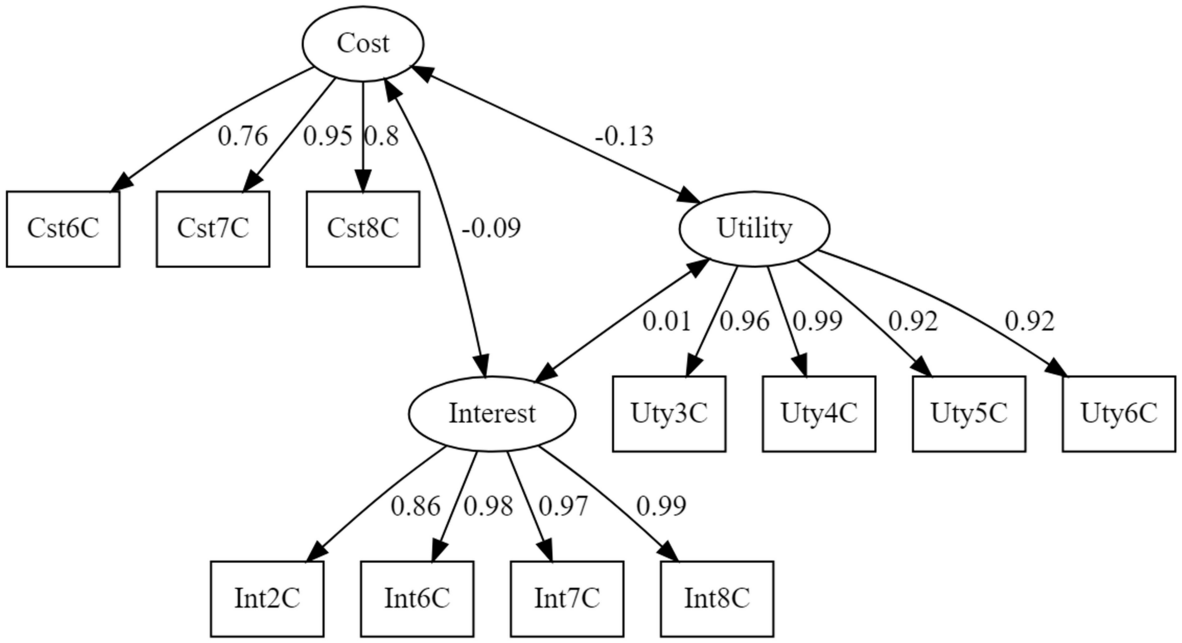
Supplemental File 3. Confirmatory Factor Analysis Goodness of Fit Indicators. Bolded values indicate good fit.

	CFI	TIL	RMSEA	SRMR
Criteria	> 0.9	> 0.9	< 0.8	< 0.05
Model 1: Math	**0.996**	**0.995**	**0.032**	**0.031**
Model 2: CS	**0.979**	**0.972**	0.085	0.057

Supplemental File 4. Confirmatory Factor Analysis on the Math Survey Responses



Supplemental File 5. Confirmatory Factor Analysis on the CS Survey Responses



Supplemental File 6. Results of statistical comparisons for A) CS Background, B) Gender, and C) Race within individual courses. Small sample sizes for categories likely contribute to differences in individual class and combine class p-values and effect sizes

A) CS Background

Comparison	*Combined Course p-value*	*Combined Course effect size*	*Biostats Lecture p-value*	*Biostats Lecture effect size*	*Ecology Lab p-value*	*Ecology Lab effect size*
Interest						
Math	0.09	0.02 (small)	0.23	0.01 (small)	0.30	0.006 (small)
CS	**0.03***	0.04 (small)	0.14	0.03 (small)	0.19	0.3 (small)
Utility						
Math	0.16	0.01 (small)	0.28	0.008 (small)	0.49	0.01 (small)
CS	**0.006***	0.06 (moderate)	0.07	0.05 (small)	**0.03***	0.08 (moderate)
Cost						
Math	**0.03***	0.04 (small)	0.29	0.007 (small)	0.32	0.004 (small)
CS	**0.0003***	0.10 (moderate)	0.26	0.009 (small)	**0.01***	0.12 (moderate)

B) Gender

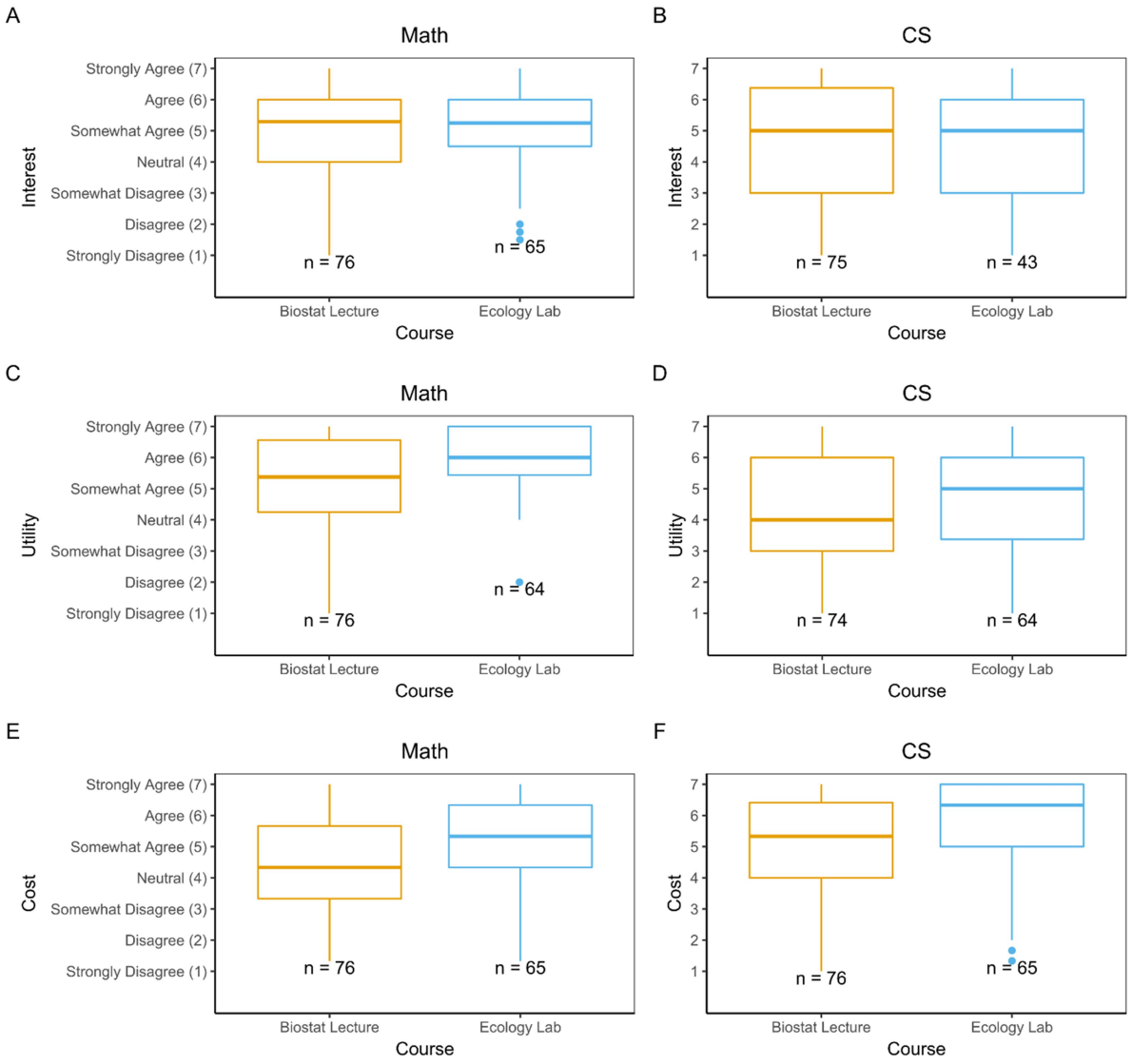
Comparison	*Combined Course p-value*	*Combined Course effect size*	*Biostats Lecture p-value*	*Biostats Lecture effect size*	*Ecology Lab p-value*	*Ecology Lab effect size*
Interest						
Math	**0.005***	0.24 (small)	0.09	0.20 (small)	**0.03***	0.27 (small)
CS	0.06	0.17 (small)	**0.04***	0.24 (small)	0.57	0.09 (small)
Utility						
Math	0.12	0.13 (small)	0.10	0.19 (small)	0.84	0.03 (small)
CS	**0.004***	0.25 (small)	**0.009***	0.31 (moderate)	0.22	0.16 (small)
Cost						
Math	0.94	0.006 (small)	0.38	0.10 (small)	0.63	0.06 (small)
CS	**0.03***	0.18 (small)	**0.005***	0.33 (moderate)	0.47	0.09 (small)

C) Race

Comparison	*Combined Course p-value*	*Combined Course effect size*	*Biostats Lecture p-value*	*Biostats Lecture effect size*	*Ecology Lab p-value*	*Ecology Lab effect size*
Interest						
Math	0.77	0.01 (small)	0.54	0.008 (small)	0.50	0.01 (small)
CS	0.29	0.003 (small)	0.27	0.005 (small)	0.44	0.02 (small)
Utility						
Math	0.59	0.007 (small)	0.92	0.005 (small)	0.30	0.03 (small)
CS	0.48	0.004 (small)	0.86	0.01 (small)	0.54	0.03 (small)
Cost						
Math	0.52	0.005 (small)	0.37	0.01 (small)	0.61	0.0005 (small)
CS	0.33	0.002 (small)	0.52	0,03 (small)	0.11	0.01 (small)

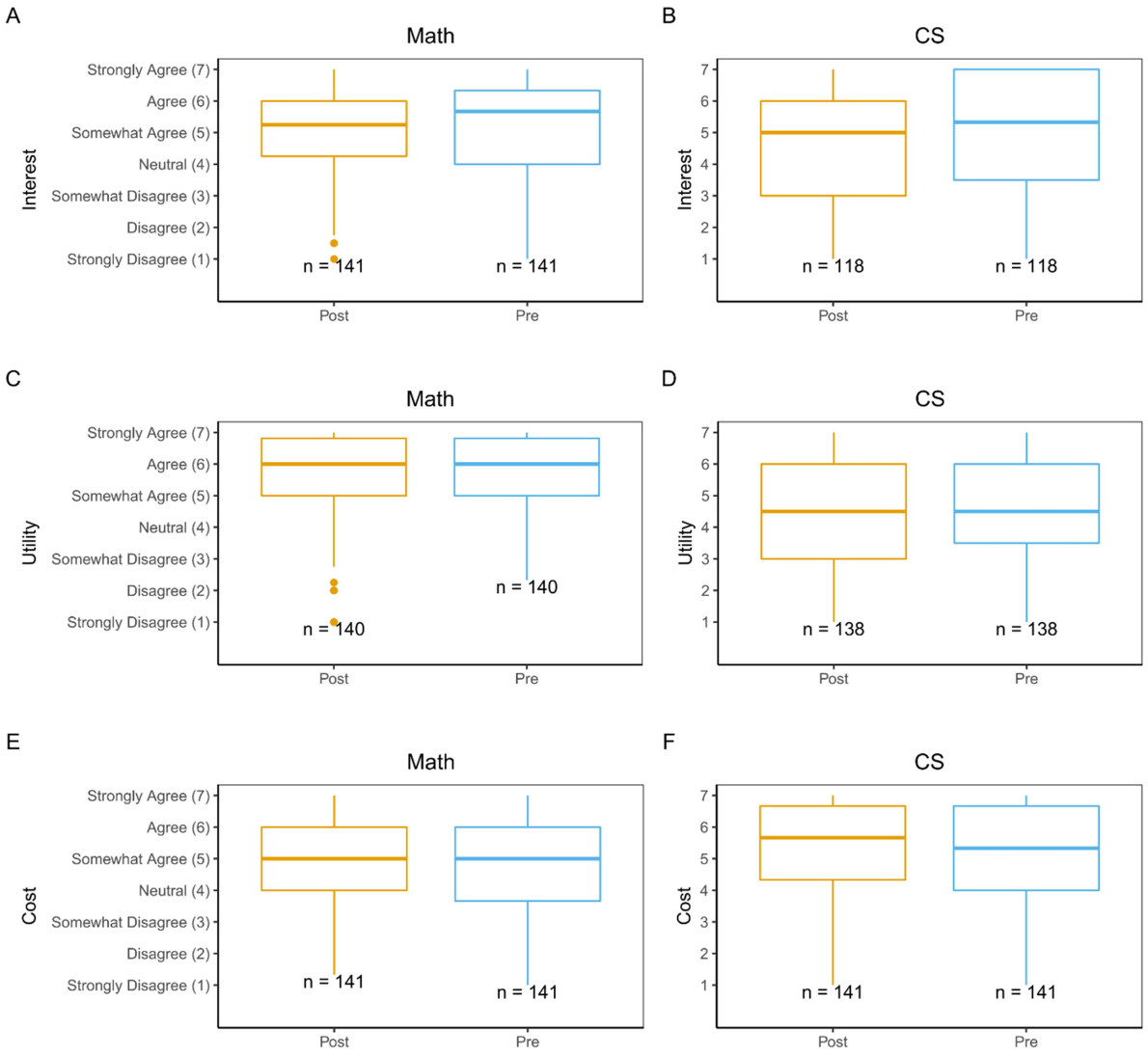
* indicates significance

Supplemental File 7:



Legend: Effects of course on student's Value Scores evaluated by a Wilcoxon rank sum test. A and B) No significant differences existed between courses for student Interest. C and D) Ecology lab students saw significantly higher Utility in using Math in biology, but not CS. E and F) Ecology lab students saw significantly higher costs for using both Math and CS in biological contexts. Questions are scaled from 1 (strongly disagree) to 7 (strongly agree) based on a Likert scale. The dots on the plot signify outliers (± 1.5 * Interquartile Range)

Supplemental File 8:



Legend: Differences between pre and post Value Scores evaluated by a Wilcoxon rank sum test. A and B) No significant differences existed between courses for student Interest. C and D) No significant differences existed between courses for student Utility. E and F) No significant differences existed between courses for student Cost. Questions are scaled from 1 (strongly disagree) to 7 (strongly agree) based on a Likert scale. The dots on the plot signify outliers (± 1.5 * Interquartile Range)

References:

Kyriazos, T. A. (2018). Applied Psychometrics: Sample Size and Sample Power Considerations in Factor Analysis (EFA, CFA) and SEM in General. *Psychology*, *09*(08), 2207–2230.

Lishinski, A. (2021). *lavaanPlot: Path Diagrams for "Lavaan" Models via "DiagrammeR."*

R Core Team. (2019). *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing.

Rosseel, Y. (2012). Lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, *48*(2).