

## Explanation of Stepwise Multiple Regression Methodology and Results

We examined three classes of potential predictors of students' grade: demographic variables, subjective concerns, and student thinking. Demographic variables included gender (dummy coded as male, female, nonbinary), race/ethnicity (Asian, Latinx, White, Mixed, Numerical Minority), generation (first generation, continuing generation, unknown), language (monolingual English, bilingual, other). Subjective concerns included finance, balancing school and work, balancing school and family obligations, balancing school and social life, and balancing school and social media all reported on a 4-point Likert scale. We also included changes (pre-course subtracted from post-course) in historical thinking, civic disposition, and growth mindset as well as post-course levels of each. Table 1 focuses on whether the categorical demographic variables (gender, ethnicity, generation, and language) are significant predictors of the quantitative predictors as well as grade. Table 2 sheds light on the significant relationships among the quantitative variables and grade.

**Table 1.** Here are the significant relationships (measured as PRE, the proportion reduction in error; this is conceptually the same as  $R^2$  in quantitative predictor models) between the demographic predictors and the quantitative predictor variables as well as grade. Typically these simple relationships would be the only ones accessible through dashboard type interfaces.

	Grade	finance college education	balance school and work	balance school and family obligations	balance school and social life	balance school and social media	change in historical thinking	change in civic disposition	change in growth mindset	post-course historical thinking	post-course civic disposition	post-course growth mindset
Gender	0.0072	0.0061	0.0062	0.0288*	0.0115	0.0009	0.012	0.0055	0.0005	0.0234*	0.0048	0.0007
Ethnicity	0.035*	0.0158	0.0141	0.0252*	0.0185	0.0114	0.0108	0.0125	0.0013	0.0325*	0.001	0.0112
Generation	0.0035	0.017	0.0046	0.0488**	0.0044	0.008	0.0117	0.0024	0.0083	0.0038	0.0035	0.0013
Language	0.007	0.0167*	0.0094	0.0234*	0.0222*	0.0062	0.0024	0.0007	0.0008	0.0227*	0.0015	0.0012

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

**Table 2.** Here are the simple correlations (measured as R) among quantitative predictor variables and with grades.

	Grade	finance college education	balance school and work	balance school and family obligations	balance school and social life	balance school and social media	change in historical thinking	change in civic disposition	change in growth mindset	post-course historical thinking	post-course civic disposition	post-course growth mindset
<b>Concerns about ability to:</b>												
finance college education	-0.039	--	.404**	.384**	.244**	0.091	-0.041	-0.049	-0.089	-.107*	-.115*	-0.063
balance school and work	-.108*	.404**	--	.558**	.438**	.139**	-0.039	-0.015	-0.032	-0.061	-0.058	-0.087
balance school and family obligations	-0.061	.384**	.558**	--	.542**	.277**	0.07	0.019	0.035	-0.042	-0.056	-.103*
balance school and social life	0.075	.244**	.438**	.542**	--	.436**	0.062	0.08	0.041	-0.013	-0.051	-0.072
balance school and social media	0.099	0.091	.139**	.277**	.436**	--	0.032	0.025	0.052	-0.009	0.011	-0.057
<b>Expert-like changes in:</b>												
historical thinking	.153**	-0.041	-0.039	0.07	0.062	0.032	--	.207**	0.09	.205**	.494**	.158**
civic disposition	0.097	-0.049	-0.015	0.019	0.08	0.025	.207**	--	0.045	.588**	.132**	.138**
growth mindset	0.012	-0.089	-0.032	0.035	0.041	0.052	0.09	0.045	--	0.077	0.043	.394**
<b>Post-course:</b>												
historical thinking	.200**	-.107*	-0.061	-0.042	-0.013	-0.009	.205**	.588**	0.077	--	.300**	.273**
civic disposition	0.085	-.115*	-0.058	-0.056	-0.051	0.011	.494**	.132**	0.043	.300**	--	.454**
growth mindset	0.043	-0.063	-0.087	-.103*	-0.072	-0.057	.158**	.138**	.394**	.273**	.454**	--

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

There are several relationships that come out of the exploratory analyses: demographics predict concerns as well as post-course thinking; the concerns are significantly intercorrelated; the concerns correlate with different measures of thinking; changes in thinking correlate with post-course levels of thinking. Because of these intercorrelations, we used a step-wise linear regression analysis to examine the unique contributions of these variables for explaining grades. The general strategy for this analysis was to enter each block of variables (demographic, concerns, changes in thinking, post-course thinking) into the regression equation one at a time to observe their individual effects on  $R^2$ . As each block was entered into the regression, the contributions of previously entered predictors were partialled out, allowing the unique contribution of each subsequent set of variables to be observed. The blocks were ordered so as to assess the effects of the concerns controlling for demographic variables, the effect of changes in thinking controlling for concerns, and the effect of post-course thinking controlling for changes in thinking.

The lower part of Table 3 shows the change in  $R^2$  as each block of predictors was entered. In the first block, demographic variables explained only 2.5% of the variation in grades and only Asian and numerical minority coefficients were significantly different from 0 (see Table 3 for all coefficients). In the second block, after controlling for demographic variables, concerns did not explain a significant amount of additional variance. In the third block, after controlling for effects of demographic and concern variables, changes in thinking explained an additional 2.2% of additional variation -- a significant contribution. The coefficients reveal that of this block, only changes in historical thinking was a significant predictor. Finally, after partialling out the effects of all previously entered predictors, post-course levels of thinking explained an additional 2.9% of the variability. This additional effect was due to post-course historical thinking. With all of the variables entered into the model, these predictors were able to account for 7.6% of variation in grades,  $F(4, 369) = 7.61, p < .001$ .

**Table 3.** This shows the changes in R<sup>2</sup> with each block of predictors (demographic variables, concerns, changes in thinking, and post-course thinking) on students' grades. Entering concerns after controlling for demographic variables did not significantly change the model so that model has been eliminated from this table. Also the significant coefficients for each model have been provided in this table.

Variable	Demographic Model			Demographic + Concerns + Changes in Thinking Model			Demographic + Concerns + Changes in Thinking + Post-Course Thinking Model		
	B	SE B	β	B	SE B	β	B	SE B	β
Race/Ethnicity									
Numerical Minority	-6.678	3.292	-0.105*	-5.804	3.273	-0.092	-4.801	3.241	-0.076
Asian	4.946	2.48	0.104*	5.303	2.458	0.111*	5.752	2.427	0.121*
Changes in Thinking									
Historical Thinking				5.13	1.755	0.149**	3.921	1.767	0.114*
Post-Course Thinking									
Historical Thinking							4.862	1.434	0.174**
R <sup>2</sup>			0.025			0.047			0.076
Change in R <sup>2</sup>			--			0.022**			0.029**

Note: Race/Ethnicity was represented as four dummy variables with Latinx students (the largest group in our sample) serving as the reference group.

\*p < .05. \*\*p < .01.