TABLE 1

Descriptive statistics by subgrouping (mean and standard deviation).

Student group by prerequisite	N	Pre		Post		Change	
		Affective	Cognitive	Affective	Cognitive	Affective	Cognitive
General Chemistry 1 in fall 2020 (VGC1)	258	61.8 (13.5)	73.7 (11.6)	63.5 (13.9)	64.9 (12.1)	+ 1.7	- 8.8
	α	0.81	0.81	0.81	0.81		
External credit (non-VGC1)	85	65.1 (12.9)	74.1 (10.5)	67.9 (13.2)	64.7 (12.4)	+ 2.7	-9.4
	α	0.79	0.72	0.79	0.77		

Note. VGC1 = students who took virtual General Chemistry I at the institution; non-VGC1 = students who received external credit.

TABLE 2

Mixed RM ANOVA results.

	Within subject (by time)	**Between subjects** (by student group)	**Box's test** (Covariance)	**Levene's test** (Variance)
Affective	$p = 0.012$, $\eta^2 = 0.018$	$p = 0.008$, $\eta^2 = 0.021$	$p = 0.796$	$p = 0.961$, 0.584
Cognitive	$p < 0.001$, $\eta^2 = 0.360$	$p = 0.946$, $\eta^2 < 0.001$	$p = 0.551$	$p = 0.318$, 0.586

Note. RM ANOVA = repeated measure analyses of variance.

TABLE 3

Single-factor ANOVA results.

Constant	Comparison groups	Affective	Cognitive
Student group (VGC1)	Survey times (pre and post)	$p = 0.157$, $\eta^2 = 0.004$	$p < 0.001$, $\eta^2 = 0.119$
Student group (non-VGC1)	Survey times (pre and post)	$p = 0.177$, $\eta^2 = 0.011$	$p < 0.001$, $\eta^2 = 0.142$
Survey time (pre)	Student groups (VGC1 and non-VGC1)	$p = 0.045$, $\eta^2 = 0.012$	$p = 0.786$, $\eta^2 < 0.001$
Survey time (post)	Student groups (VGC1 and non-VGC1)	$p = 0.011$, $\eta^2 = 0.019$	$p = 0.892$, $\eta^2 < 0.001$

Note. ANOVA = analyses of variance; VGC1 = students who took virtual General Chemistry I at the institution; non-VGC1 = students who received external credit.

TABLE 4

Items with comparable responses between student groups at both time points.

Positive affinity for subject (affective)	Interpreting data (cognitive)	Skill acquisition and growth (cognitive)
Q01. Learned chemistry that will be useful in my life	Q08. Considered if my data made sense	Q05. Learned critical-thinking skills
Q06. Excited to come to my lab section	Q09. Thought about what the molecules were doing	Q26. Learned problem-solving skills
Q22. Intrigued by methods and protocols	Q14. Thought about chemistry I already know	Q01. Learned chemistry that will be useful in my life
Q25. Confident meeting lab objectives	Q17. Focus on procedures not concepts	
	Q18. Used observations to understand atom behavior	

TABLE 5

Items VGC1 had significant advantage over non-VGC1.

		VGC1		Non-VGC1	
Question number	**Question text**	Pre- to postsurvey	***Δ***	Pre- to postsurvey	***Δ***
Q27	Learned more doing labs with my classmates than if I had performed labs alone	84.7 to 85.8	+ 0.9	75.0 to 76.4	+ 1.4
Q28	Learned more doing labs with a TA than if I had performed labs alone	87.3 to 89.4	+ 2.1	84.2 to 83.8	- 0.4
Q13	"Got stuck" but kept trying	78.6 to 68.5	- 10.1	71.1 to 57.9	- 13.2
Q21	Made mistakes and tried again	80.3 to 75.9	- 4.4	76.7 to 69.6	- 7.1

Note. VGC1 = students who took virtual General Chemistry I at the institution; non-VGC1 = students who received external credit.