

**Impact of Low–Stakes Assessments on Student Attitudes and Self-Concept
in General Chemistry**

| Table of Contents | |
|--|-------------|
| Item Description | Page |
| Table S1. Demographic breakdown of the Fall 2021 sections. | S2 |
| Table S2. Results of Confirmatory Factor Analysis of ASCIv2 items. | S3 |
| Table S3. Results of Confirmatory Factor Analysis of CSCI items. | S4 |
| Table S4. Correlations among measures in the quiz-retake section of general chemistry I | S5 |
| Table S5. Correlations among measures in the quiz-retake section of general chemistry II | S6 |
| Table S6. Group Statistics for the general chemistry I retake comparison. | S7 |
| Table S7. Group Statistics for the general chemistry II retake comparison. | S8 |
| Table S8. Paired t-test results for female students across general chemistry I and II courses for the quiz-retake sections. | S9 |
| Table S9. Paired t-test results for male students across general chemistry I and II courses for the quiz-retake sections. | S9 |
| Table S10. Paired t-test results for general chemistry I group Q1r students across general chemistry I and II courses for the quiz-retake sections. | S10 |
| Table S11. Paired t-test results for general chemistry I group Q1nr students across general chemistry I and II courses for the quiz-retake sections. | S10 |
| Figure S1. Evolution of assessment strategy. | S11 |
| Figure S2. AMOS v29 path diagram with standardized estimates for the ASCIv2 CFA, using data from all sections. | S12 |
| Figure S3. AMOS v29 path diagram with standardized estimates for the CSCI CFA, using data from all sections. | S13 |

Table S1. Demographic breakdown of the Fall 2021 sections.

| Category | <i>n</i> | Percentage |
|---|-----------------|-------------------|
| First Generation | 140 | 23% |
| non-First Generation | 456 | 77% |
| White | 387 | 65% |
| Hispanic/Latino | 107 | 18% |
| Black or African American | 23 | 4% |
| Native Hawaiian or Other Pacific Islander | 0 | 0% |
| Asian | 50 | 8% |
| American Indian or Alaska Native | 0 | 0% |
| Two or More Races | 16 | 3% |
| International | 3 | 1% |
| Unknown | 10 | 2% |
| Male | 260 | 44% |
| Female | 336 | 56% |
| College: Arts & Sciences | 137 | 23% |
| College: Engineering | 184 | 31% |
| College: Health Sciences | 270 | 45% |
| College: Other | 5 | 1% |

Table S2. Fit indices from confirmatory factor analysis of the ASCIv2 data using AMOS v29.^{65,66}

| Description | χ^2/df | RMSEA (< 0.08) ⁶⁷ | SRMR (< 0.1) ⁶⁸ | CFI (> 0.90) | GFI (> 0.90) | IFI (> 0.90) | NFI (> 0.90) |
|--|--------------------|-------------------------------------|-----------------------------------|---------------------|---------------------|---------------------|---------------------|
| Two-factor Model All sections (N = 518) | 5.18 | 0.090 | 0.056 | 0.91 | 0.95 | 0.91 | 0.89 |
| Two-factor Model Quiz-retake section (N = 166) | 1.29 | 0.042 | 0.043 | 0.98 | 0.97 | 0.98 | 0.92 |

Table S3. Fit indices from confirmatory factor analysis of the CSCI data using AMOS v29.^{65,66}

| Description | χ^2/df | RMSEA (< 0.08) ⁶⁷ | SRMR (< 0.1) ⁶⁸ | CFI (> 0.90) | GFI (> 0.90) | IFI (> 0.90) | NFI (> 0.90) |
|---|--------------------|-------------------------------------|-----------------------------------|---------------------|---------------------|---------------------|---------------------|
| Five-factor Model All sections (N = 509) | 3.57 | 0.071 | 0.082 | 0.80 | 0.78 | 0.80 | 0.75 |
| Five-factor Model Quiz-retake section (N = 165) | 1.97 | 0.077 | 0.099 | 0.78 | 0.70 | 0.79 | 0.64 |

Table S4. Correlations among Measures in the quiz-retake general chemistry I section.

| | | Correlations | | | | | | | | | | | | | | | |
|----------|---------------------|--------------|---------|--------|--------|---------|--------|--------|--------|--------|---------|---------|---------|----------|---------|---------|---------|
| | | M0 | M00 | M1 | M2 | M3 | M4 | M5 | M6 | M7 | Qavei | Qaver | Qdiff | Nretakes | Midterm | Final | Overall |
| M0 | Pearson Correlation | 1 | .488** | .230** | .172* | .439** | .184* | .155* | .049 | -.016 | .655** | .647** | -.316** | -.375** | .589** | .571** | .641** |
| | Sig. (2-tailed) | | <.001 | .003 | .026 | <.001 | .018 | .046 | .530 | .835 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 167 | 167 | 166 | 166 | 165 | 165 | 165 | 165 | 165 | 167 | 167 | 167 | 167 | 167 | 167 | 167 |
| M00 | Pearson Correlation | .488** | 1 | .290** | .213** | .377** | .270** | .175* | .123 | .115 | .472** | .460** | -.252** | -.310** | .411** | .468** | .486** |
| | Sig. (2-tailed) | <.001 | | <.001 | .006 | <.001 | <.001 | .025 | .114 | .142 | <.001 | <.001 | .001 | <.001 | <.001 | <.001 | <.001 |
| | N | 167 | 167 | 166 | 166 | 165 | 165 | 165 | 165 | 165 | 167 | 167 | 167 | 167 | 167 | 167 | 167 |
| M1 | Pearson Correlation | .230** | .290** | 1 | .561** | .323** | .583** | .211** | .116 | .242** | .160* | .176* | .000 | -.112 | .172* | .181* | .163* |
| | Sig. (2-tailed) | .003 | <.001 | | <.001 | <.001 | <.001 | .007 | .136 | .002 | .039 | .024 | .999 | .152 | .027 | .020 | .035 |
| | N | 166 | 166 | 166 | 166 | 165 | 165 | 165 | 165 | 165 | 166 | 166 | 166 | 166 | 166 | 166 | 166 |
| M2 | Pearson Correlation | .172* | .213** | .561** | 1 | .343** | .679** | .260** | .206** | .310** | .213** | .230** | -.015 | -.112 | .120 | .155* | .169* |
| | Sig. (2-tailed) | .026 | .006 | <.001 | | <.001 | <.001 | <.001 | .008 | <.001 | .006 | .003 | .849 | .151 | .123 | .046 | .030 |
| | N | 166 | 166 | 166 | 166 | 165 | 165 | 165 | 165 | 165 | 166 | 166 | 166 | 166 | 166 | 166 | 166 |
| M3 | Pearson Correlation | .439** | .377** | .323** | .343** | 1 | .296** | .404** | .281** | .256** | .418** | .410** | -.212** | -.273** | .432** | .429** | .460** |
| | Sig. (2-tailed) | <.001 | <.001 | <.001 | <.001 | | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | .006 | <.001 | <.001 | <.001 | <.001 |
| | N | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 |
| M4 | Pearson Correlation | .184* | .270** | .583** | .679** | .296** | 1 | .267** | .275** | .324** | .296** | .313** | -.048 | -.093 | .235** | .230** | .259** |
| | Sig. (2-tailed) | .018 | <.001 | <.001 | <.001 | <.001 | | <.001 | <.001 | <.001 | <.001 | <.001 | .541 | .233 | .002 | .003 | <.001 |
| | N | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 |
| M5 | Pearson Correlation | .155* | .175* | .211** | .260** | .404** | .267** | 1 | .536** | .311** | .216** | .251** | .060 | .009 | .202** | .251** | .234** |
| | Sig. (2-tailed) | .046 | .025 | .007 | <.001 | <.001 | <.001 | | <.001 | <.001 | .005 | .001 | .445 | .906 | .009 | .001 | .002 |
| | N | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 |
| M6 | Pearson Correlation | .049 | .123 | .116 | .206** | .281** | .275** | .536** | 1 | .153 | .175* | .208** | .073 | -.001 | .190* | .166* | .200** |
| | Sig. (2-tailed) | .530 | .114 | .136 | .008 | <.001 | <.001 | <.001 | | .050 | .024 | .007 | .354 | .992 | .015 | .033 | .010 |
| | N | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 |
| M7 | Pearson Correlation | -.016 | .115 | .242** | .310** | .256** | .324** | .311** | .153 | 1 | -.028 | .015 | .200** | .191* | -.075 | -.017 | -.017 |
| | Sig. (2-tailed) | .835 | .142 | .002 | <.001 | <.001 | <.001 | <.001 | .050 | | .725 | .848 | .010 | .014 | .340 | .828 | .825 |
| | N | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 |
| Qavei | Pearson Correlation | .655** | .472** | .160* | .213** | .418** | .296** | .216** | .175* | -.028 | 1 | .981** | -.509** | -.546** | .765** | .784** | .925** |
| | Sig. (2-tailed) | <.001 | <.001 | .039 | .006 | <.001 | <.001 | .005 | .024 | .725 | | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 167 | 167 | 166 | 166 | 165 | 165 | 165 | 165 | 165 | 167 | 167 | 167 | 167 | 167 | 167 | 167 |
| Qaver | Pearson Correlation | .647** | .460** | .176* | .230** | .410** | .313** | .251** | .208** | .015 | .981** | 1 | -.333** | -.400** | .748** | .781** | .923** |
| | Sig. (2-tailed) | <.001 | <.001 | .024 | .003 | <.001 | <.001 | .001 | .007 | .848 | <.001 | | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 167 | 167 | 166 | 166 | 165 | 165 | 165 | 165 | 165 | 167 | 167 | 167 | 167 | 167 | 167 | 167 |
| Qdiff | Pearson Correlation | -.316** | -.252** | .000 | -.015 | -.212** | -.048 | .060 | .073 | .200** | -.509** | -.333** | 1 | .882** | -.400** | -.344** | -.402** |
| | Sig. (2-tailed) | <.001 | .001 | .999 | .849 | .006 | .541 | .445 | .354 | .010 | <.001 | <.001 | | <.001 | <.001 | <.001 | <.001 |
| | N | 167 | 167 | 166 | 166 | 165 | 165 | 165 | 165 | 165 | 167 | 167 | 167 | 167 | 167 | 167 | 167 |
| Nretakes | Pearson Correlation | -.375** | -.310** | -.112 | -.112 | -.273** | -.093 | .009 | -.001 | .191* | -.546** | -.400** | .882** | 1 | -.429** | -.410** | -.447** |
| | Sig. (2-tailed) | <.001 | <.001 | .152 | .151 | <.001 | .233 | .906 | .992 | .014 | <.001 | <.001 | <.001 | | <.001 | <.001 | <.001 |
| | N | 167 | 167 | 166 | 166 | 165 | 165 | 165 | 165 | 165 | 167 | 167 | 167 | 167 | 167 | 167 | 167 |
| Midterm | Pearson Correlation | .589** | .411** | .172* | .120 | .432** | .235** | .202** | .190* | -.075 | .765** | .748** | -.400** | -.429** | 1 | .766** | .857** |
| | Sig. (2-tailed) | <.001 | <.001 | .027 | .123 | <.001 | .002 | .009 | .015 | .340 | <.001 | <.001 | <.001 | <.001 | | <.001 | <.001 |
| | N | 167 | 167 | 166 | 166 | 165 | 165 | 165 | 165 | 165 | 167 | 167 | 167 | 167 | 167 | 167 | 167 |
| Final | Pearson Correlation | .571** | .468** | .181* | .155* | .429** | .230** | .251** | .166* | -.017 | .784** | .781** | -.344** | -.410** | .766** | 1 | .909** |
| | Sig. (2-tailed) | <.001 | <.001 | .020 | .046 | <.001 | .003 | .001 | .033 | .828 | <.001 | <.001 | <.001 | <.001 | <.001 | | <.001 |
| | N | 167 | 167 | 166 | 166 | 165 | 165 | 165 | 165 | 165 | 167 | 167 | 167 | 167 | 167 | 167 | 167 |
| Overall | Pearson Correlation | .641** | .486** | .163* | .169* | .460** | .259** | .234** | .200** | -.017 | .925** | .923** | -.402** | -.447** | .857** | .909** | 1 |
| | Sig. (2-tailed) | <.001 | <.001 | .035 | .030 | <.001 | <.001 | .002 | .010 | .825 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | |
| | N | 167 | 167 | 166 | 166 | 165 | 165 | 165 | 165 | 165 | 167 | 167 | 167 | 167 | 167 | 167 | 167 |

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

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

Legend: M0-M7 = measures described in detail in the text, Qavei = initial Quiz average, Qaver = Quiz average considering retakes, Qdiff = difference in Quiz average, Nretakes = number of retakes, Midterm = Midterm exam average, Final = Final exam average, Overall = overall course average.

Table S5. Correlations among Measures in the quiz-retake general chemistry II section.

| | | Correlations | | | | | | | | | | | | | | | |
|---------|---------------------|--------------|--------|--------|--------|---------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|
| | | M0 | M00 | M1 | M2 | M3 | M4 | M5 | M6 | M7 | Qavei | Qaver | Qdiff | Nretake | Midterm | Final | Overall |
| M0 | Pearson Correlation | 1 | .957** | .005 | .174* | .211** | .150 | .179* | .100 | -.127 | .334** | .347** | -.038 | -.051 | .311** | .324** | .347** |
| | Sig. (2-tailed) | | <.001 | .947 | .026 | .007 | .055 | .022 | .204 | .106 | <.001 | <.001 | .622 | .510 | <.001 | <.001 | <.001 |
| | N | 172 | 172 | 164 | 164 | 163 | 163 | 163 | 163 | 163 | 172 | 172 | 172 | 172 | 172 | 172 | 172 |
| M00 | Pearson Correlation | .957** | 1 | .005 | .174* | .211** | .150 | .179* | .100 | -.127 | .338** | .349** | -.048 | -.068 | .323** | .330** | .351** |
| | Sig. (2-tailed) | <.001 | | .947 | .026 | .007 | .055 | .022 | .204 | .106 | <.001 | <.001 | .534 | .378 | <.001 | <.001 | <.001 |
| | N | 172 | 172 | 164 | 164 | 163 | 163 | 163 | 163 | 163 | 172 | 172 | 172 | 172 | 172 | 172 | 172 |
| M1 | Pearson Correlation | .005 | .005 | 1 | .490** | .196* | .509** | -.054 | -.162* | .159* | .065 | .039 | -.130 | -.154* | .035 | .080 | .050 |
| | Sig. (2-tailed) | .947 | .947 | | <.001 | .012 | <.001 | .493 | .039 | .043 | .409 | .620 | .097 | .050 | .661 | .310 | .522 |
| | N | 164 | 164 | 164 | 164 | 163 | 163 | 163 | 163 | 163 | 164 | 164 | 164 | 164 | 164 | 164 | 164 |
| M2 | Pearson Correlation | .174* | .174* | .490** | 1 | .296** | .719** | .173* | .237** | .160* | .151 | .151 | -.041 | -.031 | .163* | .322** | .210** |
| | Sig. (2-tailed) | .026 | .026 | <.001 | | <.001 | <.001 | .027 | .002 | .041 | .053 | .054 | .601 | .697 | .036 | <.001 | .007 |
| | N | 164 | 164 | 164 | 164 | 163 | 163 | 163 | 163 | 163 | 164 | 164 | 164 | 164 | 164 | 164 | 164 |
| M3 | Pearson Correlation | .211** | .211** | .196* | .296** | 1 | .292** | .456** | .152 | .145 | .343** | .317** | -.200* | -.232** | .347** | .287** | .335** |
| | Sig. (2-tailed) | .007 | .007 | .012 | <.001 | | <.001 | <.001 | .052 | .065 | <.001 | <.001 | .010 | .003 | <.001 | <.001 | <.001 |
| | N | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 |
| M4 | Pearson Correlation | .150 | .150 | .509** | .719** | .292** | 1 | .277** | .227** | .220** | .280** | .279** | -.078 | -.092 | .271** | .382** | .325** |
| | Sig. (2-tailed) | .055 | .055 | <.001 | <.001 | <.001 | | <.001 | .004 | .005 | <.001 | <.001 | .322 | .242 | <.001 | <.001 | <.001 |
| | N | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 |
| M5 | Pearson Correlation | .179* | .179* | -.054 | .173* | .456** | .277** | 1 | .375** | .263** | .213** | .235** | .039 | -.011 | .176* | .164* | .224** |
| | Sig. (2-tailed) | .022 | .022 | .493 | .027 | <.001 | <.001 | | <.001 | <.001 | .006 | .003 | .625 | .889 | .025 | .036 | .004 |
| | N | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 |
| M6 | Pearson Correlation | .100 | .100 | -.162* | .237** | .152 | .227** | .375** | 1 | .127 | .085 | .118 | .121 | .121 | .118 | .178* | .175* |
| | Sig. (2-tailed) | .204 | .204 | .039 | .002 | .052 | .004 | <.001 | | .106 | .280 | .135 | .124 | .123 | .133 | .023 | .026 |
| | N | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 |
| M7 | Pearson Correlation | -.127 | -.127 | .159* | .160* | .145 | .220** | .263** | .127 | 1 | -.053 | -.047 | .040 | .072 | -.146 | -.077 | -.071 |
| | Sig. (2-tailed) | .106 | .106 | .043 | .041 | .065 | .005 | <.001 | .106 | | .503 | .552 | .615 | .362 | .064 | .331 | .368 |
| | N | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 | 163 |
| Qavei | Pearson Correlation | .334** | .338** | .065 | .151 | .343** | .280** | .213** | .085 | -.053 | 1 | .978** | -.376** | -.474** | .709** | .674** | .884** |
| | Sig. (2-tailed) | <.001 | <.001 | .409 | .053 | <.001 | <.001 | .006 | .280 | .503 | | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 172 | 172 | 164 | 164 | 163 | 163 | 163 | 163 | 163 | 163 | 172 | 172 | 172 | 172 | 172 | 172 |
| Qaver | Pearson Correlation | .347** | .349** | .039 | .151 | .317** | .279** | .235** | .118 | -.047 | .978** | 1 | -.173* | -.305** | .703** | .690** | .901** |
| | Sig. (2-tailed) | <.001 | <.001 | .620 | .054 | <.001 | <.001 | .003 | .135 | .552 | <.001 | | .023 | <.001 | <.001 | <.001 | <.001 |
| | N | 172 | 172 | 164 | 164 | 163 | 163 | 163 | 163 | 163 | 172 | 172 | 172 | 172 | 172 | 172 | 172 |
| Qdiff | Pearson Correlation | -.038 | -.048 | -.130 | -.041 | -.200* | -.078 | .039 | .121 | .040 | -.376** | -.173* | 1 | .878** | -.221** | -.114 | -.168* |
| | Sig. (2-tailed) | .622 | .534 | .097 | .601 | .010 | .322 | .625 | .124 | .615 | <.001 | .023 | | <.001 | .004 | .137 | .027 |
| | N | 172 | 172 | 164 | 164 | 163 | 163 | 163 | 163 | 163 | 172 | 172 | 172 | 172 | 172 | 172 | 172 |
| Nretake | Pearson Correlation | -.051 | -.068 | -.154* | -.031 | -.232** | -.092 | -.011 | .121 | .072 | -.474** | -.305** | .878** | 1 | -.343** | -.221** | -.307** |
| | Sig. (2-tailed) | .510 | .378 | .050 | .697 | .003 | .242 | .889 | .123 | .362 | <.001 | <.001 | <.001 | | <.001 | .004 | <.001 |
| | N | 172 | 172 | 164 | 164 | 163 | 163 | 163 | 163 | 163 | 172 | 172 | 172 | 172 | 172 | 172 | 172 |
| Midterm | Pearson Correlation | .311** | .323** | .035 | .163* | .347** | .271** | .176* | .118 | -.146 | .709** | .703** | -.221** | -.343** | 1 | .776** | .885** |
| | Sig. (2-tailed) | <.001 | <.001 | .661 | .036 | <.001 | <.001 | .025 | .133 | .064 | <.001 | <.001 | .004 | <.001 | | <.001 | <.001 |
| | N | 172 | 172 | 164 | 164 | 163 | 163 | 163 | 163 | 163 | 172 | 172 | 172 | 172 | 172 | 172 | 172 |
| Final | Pearson Correlation | .324** | .330** | .080 | .322** | .287** | .382** | .164* | .178* | -.077 | .674** | .690** | -.114 | -.221** | .776** | 1 | .877** |
| | Sig. (2-tailed) | <.001 | <.001 | .310 | <.001 | <.001 | <.001 | .036 | .023 | .331 | <.001 | <.001 | .137 | .004 | <.001 | | <.001 |
| | N | 172 | 172 | 164 | 164 | 163 | 163 | 163 | 163 | 163 | 172 | 172 | 172 | 172 | 172 | 172 | 172 |
| Overall | Pearson Correlation | .347** | .351** | .050 | .210** | .335** | .325** | .224** | .175* | -.071 | .884** | .901** | -.168* | -.307** | .885** | .877** | 1 |
| | Sig. (2-tailed) | <.001 | <.001 | .522 | .007 | <.001 | <.001 | .004 | .026 | .368 | <.001 | <.001 | .027 | <.001 | <.001 | <.001 | <.001 |
| | N | 172 | 172 | 164 | 164 | 163 | 163 | 163 | 163 | 163 | 172 | 172 | 172 | 172 | 172 | 172 | 172 |

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

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

Legend: M0-M7 = measures described in detail in the text, Qavei = initial Quiz average, Qaver = Quiz average considering retakes, Qdiff = difference in Quiz average, Nretakes = number of retakes, Midterm = Midterm exam average, Final = Final exam average, Overall = overall course average.

Table S6. Group statistics for the general chemistry I retake comparison. Key: Group Q1nr are students who failed at least one quiz but did not opt for a retake, while Q1r are those students who failed at least one quiz and opted for a retake.

| Item | Group | <i>n</i> | Mean (<i>SD</i>) |
|----------------------------|-------|----------|--------------------|
| M0 | Q1nr | 27 | 6.04 (1.56) |
| | Q1r | 36 | 5.17 (2.08) |
| M00 | Q1nr | 27 | 2.76 (0.78) |
| | Q1r | 36 | 2.46 (0.78) |
| M1 | Q1nr | 26 | 2.31 (0.54) |
| | Q1r | 36 | 2.36 (0.67) |
| M2 | Q1nr | 26 | 3.31 (0.62) |
| | Q1r | 36 | 3.30 (0.73) |
| M3 | Q1nr | 25 | 3.73 (0.73) |
| | Q1r | 36 | 3.41 (0.84) |
| M4 | Q1nr | 25 | 2.95 (0.78) |
| | Q1r | 36 | 3.05 (0.68) |
| M5 | Q1nr | 25 | 3.50 (0.55) |
| | Q1r | 36 | 3.65 (0.61) |
| M6 | Q1nr | 25 | 3.88 (0.59) |
| | Q1r | 36 | 4.08 (0.78) |
| M7 | Q1nr | 25 | 3.21 (1.00) |
| | Q1r | 36 | 3.79 (0.74) |
| Q _{ave} (initial) | Q1nr | 27 | 72.8 (8.8) |
| | Q1r | 36 | 70.0 (11.1) |
| Q _{ave} (final) | Q1nr | 27 | 72.8 (8.8) |
| | Q1r | 36 | 75.0 (10.7) |
| Midterm Exam | Q1nr | 27 | 75.0 (13.3) |
| | Q1r | 36 | 73.0 (12.2) |
| Final Exam | Q1nr | 27 | 62.3 (17.8) |
| | Q1r | 36 | 63.7 (18.6) |

Table S7. Group Statistics for the general chemistry II retake comparison. Key: Group Q1nr are students who failed at least one quiz but did not opt for a retake, while Q1r are those students who failed at least one quiz and opted for a retake.

| Item | Group | <i>n</i> | Mean (<i>SD</i>) |
|----------------------------|-------|----------|--------------------|
| M0 | Q1nr | 42 | 4.57 (1.75) |
| | Q1r | 39 | 5.00 (1.85) |
| M00 | Q1nr | 42 | 0.46 (0.18) |
| | Q1r | 39 | 0.48 (0.19) |
| M1 | Q1nr | 42 | 2.43 (0.59) |
| | Q1r | 36 | 2.29 (0.67) |
| M2 | Q1nr | 42 | 3.19 (0.74) |
| | Q1r | 36 | 3.30 (0.59) |
| M3 | Q1nr | 41 | 3.45 (0.72) |
| | Q1r | 36 | 3.35 (0.63) |
| M4 | Q1nr | 41 | 3.04 (0.55) |
| | Q1r | 36 | 3.24 (0.67) |
| M5 | Q1nr | 41 | 3.52 (0.59) |
| | Q1r | 36 | 3.76 (0.44) |
| M6 | Q1nr | 41 | 3.48 (0.54) |
| | Q1r | 36 | 3.88 (0.41) |
| M7 | Q1nr | 41 | 3.27 (0.65) |
| | Q1r | 36 | 3.40 (0.75) |
| Q _{ave} (initial) | Q1nr | 42 | 72.7 (8.3) |
| | Q1r | 39 | 74.4 (10.0) |
| Q _{ave} (final) | Q1nr | 42 | 72.7 (8.3) |
| | Q1r | 39 | 78.8 (9.4) |
| Midterm Exam | Q1nr | 42 | 67.6 (15.3) |
| | Q1r | 39 | 67.3 (16.4) |
| Final Exam | Q1nr | 42 | 59.4 (18.4) |
| | Q1r | 39 | 66.7 (14.1) |

Table S8. Paired t-test results for female students across general chemistry I and II courses for the quiz-retake sections.

| Item | Group | <i>n</i> | Mean (<i>SD</i>) | <i>t</i> statistic | <i>p</i> value (two tailed) | Cohen's <i>d</i> |
|------|-------------|----------|--------------------|--------------------|-----------------------------|------------------|
| M1 | GC II -GC I | 52 | 0.20 (0.62) | 2.32 | 0.024 (n.s.) | ... |
| M2 | GC II -GC I | 52 | 0.13 (0.61) | 1.54 | 0.13 (n.s.) | ... |
| M3 | GC II -GC I | 52 | -0.03 (0.41) | -0.53 | 0.60 (n.s.) | ... |
| M4 | GC II -GC I | 52 | 0.28 (0.56) | 3.56 | < 0.001 | 0.50 |
| M5 | GC II -GC I | 52 | 0.01 (0.46) | 0.09 | 0.93 (n.s.) | ... |
| M6 | GC II -GC I | 52 | -0.44 (0.45) | -7.10 | < 0.001 | 0.98 |
| M7 | GC II -GC I | 52 | -0.09 (0.58) | -1.11 | 0.27 (n.s.) | ... |

Table S9. Paired t-test results for male students across general chemistry I and II courses for the quiz-retake sections.

| Item | Group | <i>n</i> | Mean (<i>SD</i>) | <i>t</i> statistic | <i>p</i> value (two-tailed) | Cohen's <i>d</i> |
|------|-------------|----------|--------------------|--------------------|-----------------------------|------------------|
| M1 | GC II -GC I | 42 | 0.24 (0.56) | 2.73 | 0.009 | 0.42 |
| M2 | GC II -GC I | 42 | 0.11 (0.72) | 1.02 | 0.31 (n.s.) | ... |
| M3 | GC II -GC I | 41 | -0.24 (0.52) | -2.89 | 0.006 | 0.45 |
| M4 | GC II -GC I | 41 | 0.11 (0.59) | 1.14 | 0.26 (n.s.) | ... |
| M5 | GC II -GC I | 41 | -0.13 (0.41) | -2.03 | 0.049 (n.s.) | ... |
| M6 | GC II -GC I | 41 | -0.55 (0.54) | -6.62 | < 0.001 | 1.03 |
| M7 | GC II -GC I | 41 | -0.09 (0.71) | -0.77 | 0.45 (n.s.) | ... |

Table S10. Paired t-test results for general chemistry I group Q1r students across general chemistry I and II courses for the quiz-retake sections.

| Item | Group | <i>n</i> | Mean (<i>SD</i>) | <i>t</i> statistic | <i>p</i> value (two-tailed) | Cohen's <i>d</i> |
|------|-------------|----------|--------------------|--------------------|-----------------------------|------------------|
| M1 | GC II -GC I | 16 | 0.21 (0.77) | 1.08 | 0.30 (n.s.) | ... |
| M2 | GC II -GC I | 16 | -0.43 (0.73) | -2.35 | 0.033 (n.s.) | ... |
| M3 | GC II -GC I | 16 | -0.31 (0.60) | -2.04 | 0.06 (n.s.) | ... |
| M4 | GC II -GC I | 16 | -0.06 (0.65) | -0.36 | 0.73 (n.s.) | ... |
| M5 | GC II -GC I | 16 | -0.27 (0.43) | -2.55 | 0.022 (n.s.) | ... |
| M6 | GC II -GC I | 16 | -0.57 (0.60) | -3.76 | 0.002 | 0.94 |
| M7 | GC II -GC I | 16 | -0.26 (0.63) | -1.69 | 0.12 (n.s.) | ... |

Table S11. Paired t-test results for general chemistry I group Q1nr students across general chemistry I and II courses for the quiz-retake sections.

| Item | Group | <i>n</i> | Mean (<i>SD</i>) | <i>t</i> statistic | <i>p</i> value (two-tailed) | Cohen's <i>d</i> |
|------|-------------|----------|--------------------|--------------------|-----------------------------|------------------|
| M1 | GC II -GC I | 11 | 0.32 (0.52) | 2.02 | 0.07 (n.s.) | ... |
| M2 | GC II -GC I | 11 | 0.16 (0.70) | 0.75 | 0.47 (n.s.) | ... |
| M3 | GC II -GC I | 10 | -0.21 (0.46) | -1.44 | 0.18 (n.s.) | ... |
| M4 | GC II -GC I | 10 | 0.21 (0.55) | 1.20 | 0.26 (n.s.) | ... |
| M5 | GC II -GC I | 10 | -0.27 (0.27) | -3.07 | 0.013 (n.s.) | ... |
| M6 | GC II -GC I | 10 | -0.51 (0.37) | -4.39 | 0.002 | 1.39 |
| M7 | GC II -GC I | 10 | 0.08 (0.73) | 0.33 | 0.75 (n.s.) | ... |

Figure S1. Evolution in assessment strategy over time.

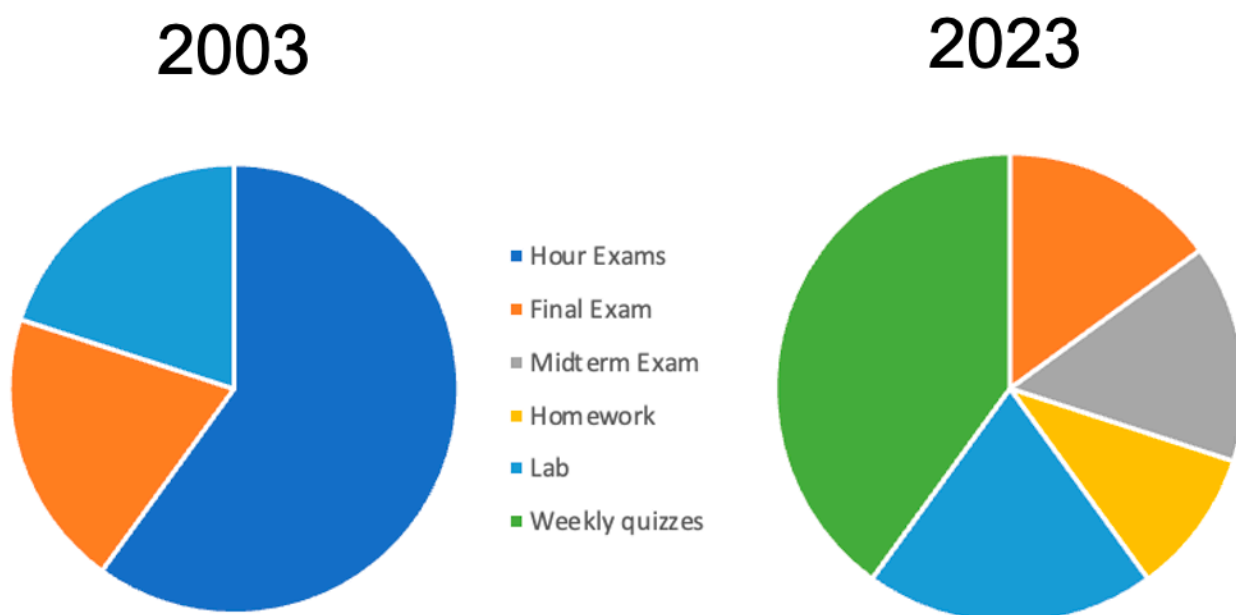


Figure S2. AMOS v29 path diagram with standardized estimates for the ASCIv2 CFA, using data from all sections. The factors correspond to intellectual accessibility (F1) and emotional satisfaction (F2).

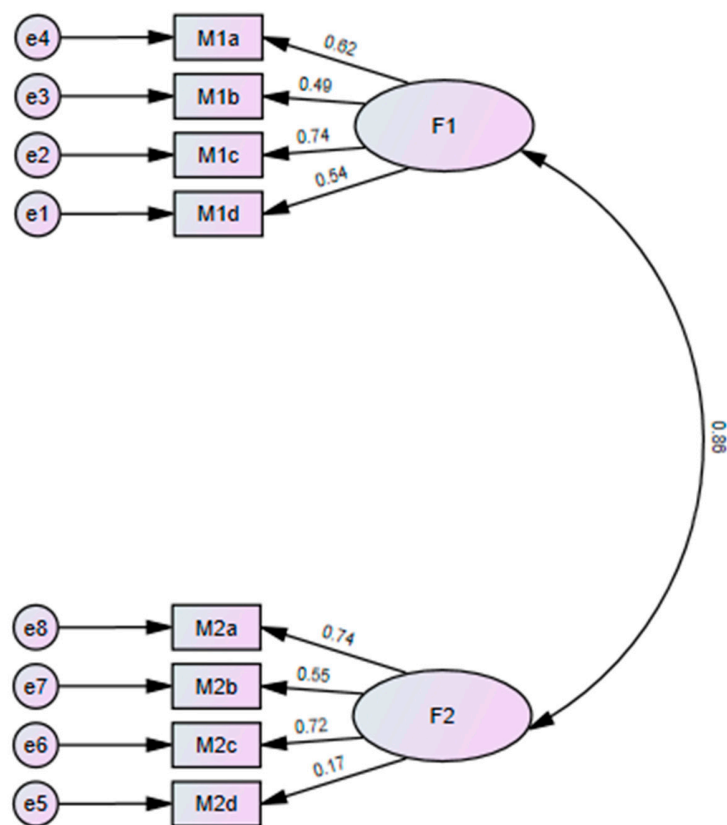


Figure S3. AMOS v29 path diagram with standardized estimates for the CSCI CFA, using data from all sections. The factors correspond to mathematical self-concept (MSC), chemistry self-concept (CHSC), academic self-concept (ASC), academic enjoyment self-concept (AE), and creativity self-concept (CSC).

