

Do the results of analyses with NSSE data differ depending on the treatment of measurement level as interval or ordinal?

Purpose

Cronbach's alpha is the most widely used and understood coefficient for documenting a scale's internal consistency and reliability. This reliability coefficient is based on the ratio of the hypothetical true score¹ variance to the observed score variance. In practice, Cronbach's alpha is a function of the number of items, the inter-item correlations, and the variance of the total scores. Traditionally, inter-item correlations used to estimate alpha come from Pearson correlation, which assumes continuous variables (Zumbo, Gadermann, & Zeisser, 2007). This approach to estimation may be problematic when the scale items are ordinal level. Previous studies have shown that items with less than five scale points show reduced reliability coefficients (Gelin, Beasley, & Zumbo, 2003). Many NSSE items use ordinal, Likert-type scale responses, and thus, may be subject to the attenuated reliability estimates associated with Pearson correlation-based Cronbach's alpha.

One potential mechanism for addressing this threat to accurate measures of reliability is using a correlation measure suited to ordinal data. Polychoric correlation estimates the relationship between variables assuming two unobserved continuous variables based on the observed ordinal data (Zumbo et al., 2007). This better accounts for the nature of Likert-type data. Studies using the polychoric correlation within the alpha reliability coefficient (called ordinal alpha hereafter) have demonstrated more accurate estimates of reliability (Gadermann, Guhn, & Zumbo, 2012; Zumbo et al., 2007). This study compares the ordinal alpha reliability estimates for NSSE's Engagement Indicators to the traditional Cronbach's alpha.

Data

All randomly sampled and census-administered students from participating U.S. institutions in 2018 were included in this analysis. Results were weighted by sex, enrollment status, and institution size. Because not all students responded to all of the items within a scale to receive a scale score, the number of students used varied by class and scale. The numbers of respondents analyzed by class can be seen in Table 1.

¹ The true score is the respondent's true scale score in the absence of measurement error.

Table 1. Number of Respondents by Class

Engagement Indicator	First-year	Senior
Higher-Order Learning	105,333	132,133
Reflective & Integrative Learning	109,393	135,571
Learning Strategies	99,541	126,529
Quantitative Reasoning	101,301	128,297
Collaborative Learning	120,335	144,431
Discussions with Diverse Others	100,488	127,202
Student-Faculty Interaction	108,536	135,093
Effective Teaching Practices	103,165	129,921
Quality of Interactions	82,178	97,384
Supportive Environment	93,933	120,549

Methods

This study estimates both Cronbach's and ordinal alphas for each Engagement Indicator by class. The NSSE Engagement Indicators are based on a 4-point Likert-type scale with the exception of the Quality of Interactions scale, which has a 7-point scale. Both coefficients are a function of the number of items, the inter-item correlations, and the variances of the total score. Both result in coefficients that range between 0 and 1. They differ only by the kind of correlation matrix used to estimate the inter-item correlations.

To estimate the different reliability coefficients, the syntax from Gadermann and colleagues (2012) was adapted for the NSSE dataset. We used the R package **psych** to estimate alphas (Revelle, 2018), inserting the polychoric correlation as necessary for the ordinal alpha.

Results

As shown in Table 2, for every Engagement Indicator and for both classes, the ordinal alpha produced slightly higher reliability coefficients. The increase between ordinal and Cronbach's alpha ranged from 0.02 (First-Year Quality of Interactions) to 0.05 (Learning Strategies for both, and First-Year Student-Faculty Interaction). The smaller increase between the alphas for Quality of Interactions seems reasonable as the scale has 7-point response options which are somewhat closer to a continuous response variable. The results suggest that Cronbach's alpha slightly underestimates the reliability estimates of the NSSE Engagement Indicators but from a practical perspective the results are very similar. Given the widespread use of Cronbach's alpha, NSSE will continue to use it for reporting estimates of internal consistency. In the future, this study should be reproduced every few years to determine whether the magnitude of differences between ordinal and Cronbach's alphas for the NSSE Engagement Indicators increases enough to warrant use of the ordinal alpha estimator. This study should also be reproduced if changes are made to the Engagement Indicators.

Table 2. Cronbach's and Ordinal Alphas by Class

Engagement Indicator	First-Year Cronbach's α	First-Year Ordinal α	Senior Cronbach's α	Senior Ordinal α
Higher-Order Learning	0.83	0.87	0.84	0.88
Reflective & Integrative Learning	0.85	0.88	0.86	0.90
Learning Strategies	0.75	0.80	0.77	0.82
Quantitative Reasoning	0.82	0.86	0.84	0.88
Collaborative Learning	0.82	0.86	0.83	0.87
Discussions with Diverse Others	0.86	0.90	0.88	0.92
Student-Faculty Interaction	0.81	0.86	0.84	0.88
Effective Teaching Practices	0.83	0.87	0.86	0.90
Quality of Interactions	0.85	0.87	0.82	0.86
Supportive Environment	0.88	0.91	0.88	0.91

References

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