Do We Test What We Test?: A Qualitative Approach to Validity Analysis in Instrument Design

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It is essential for engineering students to possess information literacy and critical thinking skills to solve complex engineering problems. Assessment of these skills, however, is challenging. The Critical Engineering Literacy Test (CELT) is an instrument designed by researchers in engineering education and library science to assess these skills, according to “Development of the Critical Engineering Literacy Test,” by Şenay Purzer, Michael J. Fosmire, and Ruth E. H. Wertz. This study reports validity evidence for the CELT instrument by using qualitative data (open-ended response questions). Specifically, we evaluated the alignment between students’ reasoning and their selected response for correct and incorrect answers. For the qualitative analysis, we developed a coding protocol using an emergent methodology to categorize students’ open-ended responses. The coding protocol was used by two raters to analyze CELT data collected in the spring of 2013 from 150 first-year engineering (FYE) students. Inter-rater reliability (IRR) was established using a percent agreement method. Results indicated that the alignment between the reasoning and the selected response was 89% for correct and incorrect responses, which indicates test items elicited appropriate reasoning. Furthermore, most frequent inappropriate rationale was IRR (irrelevant) for incorrect responses (6%) and CCON (conceptual error) for correct responses (8%), which supports that alignment was good overall. This study provided evidence supporting the construct validity of items with 89% alignment between students’ selected response and their rationale. Inter-rater reliability of 85% indicates a high reliability of the protocol. These findings suggest that the CELT instrument assesses the knowledge and skills we expect to assess.

Research advisor Şenay Purzer writes, “As Austin has shown through his research, qualitative methods can effectively be used for instrument validation. He was able to bring his background in industrial engineering to a project involving the evaluation of a challenging educational assessment that required both qualitative and quantitative reasoning.”