

LETTER TO THE EDITOR

We are pleased to see an increase in the number of articles on students' attitudes toward statistics being published in *SERJ*. We hope that this trend continues. We would like to comment briefly on a recent article, *Measuring statistics attitudes: Structure of the survey of attitudes toward statistics (SATS-36)* (VanHoof, Kuppens, Castro Sotos, Verschaffel, & Onghena, 2011), about assessing attitudes using the Survey of Attitudes toward Statistics-36 (or SATS-36, Copyright © C. Schau, 1996, 2003).

The SATS-36 contains six Attitude Components. These Components and their definitions are from the SATS Scoring Guide (Schau, 2005):

- Affect: "students' feelings concerning statistics"
- Cognitive Competence: "students' attitudes about their intellectual knowledge and skills when applied to statistics"
- Value: "students' attitudes about the usefulness, relevance, and worth of statistics in personal and professional life"
- Difficulty: "students' attitudes about the difficulty of statistics as a subject"
- Interest: "students' level of individual interest in statistics" and
- Effort: "amount of work the student expends to learn statistics"

As VanHoof et al. wrote, several research studies have supported this six-component structure using item parcels in structural equation models (e.g., Tempelaar, Schim van der Loeff, & Gijsselaers, 2007; Verhoeven, 2009).

Due to space considerations, we have chosen to discuss three points in response to the article:

1. The six-component SATS-36 structure is congruent with a major educational theory whereas the VanHoof article's four-component structure (which combines Affect, Cognitive Competence, and Difficulty into one component) is not.
2. We recommend that VanHoof et al. test their modifications to the survey on a new independent data set.
3. Their article indicated that:
 - a. the six- and four-component structures yielded similar fits,
 - b. SATS-36 users still must administer all 36 items in the SATS even if they want to use the four-component structure, and
 - c. mean scores differed among the three components that VanHoof et al. wanted to combine.

Thus, we see no advantage to using the four-component structure.

First, the six SATS-36 Components listed above are congruent with those found in Eccles' and colleagues Expectancy-Value Theory (or EVT). EVT was designed to explain why some students perform differently from others in academic domains, including their achievement, persistence, and course selection (Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). The six Components in the SATS-36 are distinct, although interrelated, in EVT. For example, we believe that a successful intervention designed to reduce anxiety and increase positive feelings about statistics (that is, to help students develop more positive Affect) may be quite different from an intervention designed to increase their confidence in their statistical skills (e.g., to increase their Cognitive Competence). This example illustrates why we believe that Affect and Cognitive Competence should not be combined into one component.

Because the six Components are part of an integrated educational theory supported by research findings, there will be varying degrees of relationships among their scores depending on the Components being examined. We are not aware of any established educational or cognitive theory, including EVT, which would support the article's four-component structure. We do not recommend using a four-component structure, or any other structure, without theoretical congruence. It is difficult, if not impossible, to use assessment results to improve instruction and student learning without theoretical guidance.

Second, VanHoof et al. first tested the six-component SATS-36 structure. Based on results from that data analysis, they then suggested a modified structure. This approach is commonly used in SEM analyses. However, a validation of this modification must be based on a new independent data set before such modifications should be recommended. We look forward to seeing results from the analysis of independent data.

Readers should not assume that posttest structural results will coincide with those for the pretest. As the article suggested, posttest data needs to be examined for structure and for structural invariance with pretest data. In our analyses, we have found that the correlation structures in our observed post scores differ from those in the pre scores. It would be interesting to see posttest score results for the students in the VanHoof study.

Third, VanHoof et al. concluded that the six- and four-component structures described their data adequately and similarly. They also acknowledge that users will need to administer all items in the SATS-36 that comprise the Components, even if they want to use the four-component structure for scoring. They grant that reasonably-sized differences exist in the mean values among the three Components (and their items) that they say can be combined into one Component. Almost everyone who does attitude research examines Component means. Thus, it is unclear to us why we would choose the modified four-component model in place of the more comprehensive original six-component model.

We strongly recommend that SATS-36 users continue to score the measure using the original six-component structure, at the very least until we have theoretically-based research conclusions that contradict this scoring.

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