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Investigating undergraduate and postgraduate tertiary education students' attitudes toward Statistics

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Background

Undergraduate and Postgraduate students' attitudes toward statistics were investigated by using the Survey of Attitudes Toward Statistics (SATS), along with a number of supplementary variables such as: gender, confidence in mathematics and confidence in statistics. Initially an exploratory Principal Components Analysis (PCA) with Varimax and Oblimin rotations was conducted and internal consistency reliability estimates were calculated, followed by various t-tests, correlations and a MANOVA. All correlations among subscales were low except for the correlation between the Difficulty and the Value subscales. No statistically significant gender differences were found but there were statistically significant defferences between the "mathematics confidence" variable and each of the four SATS subscales (Affect, Cognitive competence, Value and Difficulty) of SATS.

Research Questions

The aims of the study were to investigate:

- Undergraduate and postgraduate teriary education students' affect, cognitive competence, value and difficulty toward statistics
- Gender differences in the attitudes of undergraduate and postgraduate tertiary education students' attitudes toward statistics.

Methods

Method

Participants

The scale (SATS) was administered to 247 undergraduate (N = 155) and postgraduate (N = 92) students enrolled in the 4-year Bachelor of Education and the 1-year Graduate Diploma in Education courses in a large Australian University. 13.4% of the undergraduate students were enrolled in a second year mathematics education unit and 49.4% in a fourth year unit. The composition of the final sample was 71.2% female and 15.8% male students (13% missing).

Instrument

The SATS questionnaire used in this study consists of 28 items on a seven point Likert scale (1 = strongly disagree, 4 = neither disagree nor agree, 7 = strongly agree). After re-coding the negatively worded items, the highest values in the scale correspond to positive attitudes toward statistics. The questionnaire comprises four subscales: the Affect subscale (6 items), the Cognitive Competence subscale (6 items), the Value subscale (9 items) and the Difficulty subscale (7 items). SATS subscale scores can be calculated by simple addition of responses.

Analyses

Principal Components Analysis (PCA) with Varimax and Oblimin rotations was conducted and internal consistency reliability estimates were calculated, followed by various box plots, t-tests, correlations and a MANOVA. The SATS internal consistency reliability estimates of this study were consistent with

those reported by Schau et al. (1995). The reliability coefficients ranged from .636 to .904. The lowest estimate of Cronbach was obtained for the difficulty subscale, a result consistent with the subscale with the lowest estimates reported in both the Schau et al. (1995) and Cashin & Elmore (2005) studies.

Frame

Several researchers (Araki & Shultz, 1995; Elmore & Lewis, 1991; Elmore, Lewis, & Bay, 1993; Elmore & Vasu, 1986; Harvey, Plake, & Wise, 1985; Onwuegbuzie, 1995; Roberts & Bilderback, 1980; Schau et al, 1995; Schutz, Drogosz, White, & DiStefano, 1998; Wise, 1985; Woehlke, 1991; Woehlke & Leitner, 1980; Zimmer & Fuller, 1996) have studied the factors which have an impact on students' performance in statistics courses, including attitudes toward statistics. Roberts & Bilderback (1980) developed the Statistics Attitude Survey (SAS). The instrument was designed to be one-dimensional comprising 33 homogeneous items. Since then two other well-known survey instruments regarding attitudes toward statistics have been developed: the Attitudes Toward Statistics Scale (ATS, Wise, 1985) and the Survey of Attitudes Toward Statistics Scale (SATS, Schau et al, 1995). The ATS was designed to measure two attitude components in contrast to the one-dimensional structure of the SAS. The first component measured students' attitudes toward the usefulness of statistics in their field of study. The second component measured students' attitudes toward the statistics courses they were attending. The SATS instrument incorporates 4 subscales which have been designed to measure negative and positive attitudes about statistics. The four subscales are the following: the Affect subscale, the Cognitive Competence subscale, the Value subscale, and the Difficulty subscale.

Several studies have been conducted on the gender differences regarding students' performance and attitudes toward statistics. Schram (1996) published a meta-analysis of studies investigating the gender differences on achievement in statistics and reported that the average effect size d=.08, was in favor of the female students. Roberts and Saxe (1982) found significant differences when using SAS: the male students had more positive attitudes towards statistics than the female students (pretest, r = .26; posttest, r = .19). Araki & Shultz (1995) did not report significant gender differences when using the ATS subscale, whereas Waters, Martelli, Zakrajsek & Popovich (1988) found that the male students showed slightly more positive attitudes than the female students in the ATS Course subscale.

Research findings

Schau et al. (1995) used CFA to support a four factor structure of the SATS. In a more recent study Cashin & Elmore (2005) suggested that the SATS might be an instrument with only two domains similar to the two domains of the ATS. In this study the results of PCA suggest that a three-factor solution could offer an alternative to that of the four-factor model. The components reflecting the Affective and Cognitive competence subscales in the three-factor model loaded on a unique factor, which could be perceived as representing a subscale congruent to the ATS Course subscale, as the two subscales could be conceptualised as a measure of students' attitude toward their achievement in a statistics course.

Cashin & Elmore (2005) reported that the only significant change in attitudes measured by SATS - before and after the course - was in the scores from the Affect subscale. Affective measures like the Affect subscale of the SATS and self-efficacy confidence measures like the Cognitive Competence subscale of the SATS, are often treated as distinct constructs in educational theory and in research on attitudes toward statistics (Eccles & Wigfield, 1995; Harlow, Burkholder & Morrow, 2002)

In this study all correlations among subscales were low except for the correlation between the Cognitive and the Affect subscales, a result confirming the original Schau et al. (1995) study's results.

Finally, it was found that there were no statistically significant differences for male and female students' attitudes in any of the four SATS subscales. In addition, the results showed no evidence of statistically significant differences between male and female students in the expected statistics course achievement. This last finding is in agreement with the findings of a number of previously conducted

studies (Bradley & Wygant, 1998; Waters et al., 1988; Buck, 1985; Harvey et al, 1985; Schram, 1996; Ware & Chastain, 1991).