DOCUMENT RESUME

ED 156 457 SE 024 372

AUTHOR Geisinger, Kurt F.; Roberts, Dennis M.
TITLE Individual Differences in Calculator Attitudes and Performance in a Statistics Course.
PUB DATE Mar 78
NOTE 9p.; Paper presented at the annual meeting of the American Educational Research Association (Toronto, Canada, March 27-31, 1978)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Attitude Tests; *Changing Attitudes; College Mathematics; *Educational Research; Graduate Students; *Higher Education; *Mathematics Education; Statistics; *Student Attitudes; Surveys; Undergraduate Students
IDENTIFIERS *Calculators

ABSTRACT

A 30-item survey was developed to assess several dimensions of attitudes about calculators. Reliability and validity data were gathered on students in a college statistics course. Based on N = 135, coefficient alpha was .874. Factor analyses identified 3 interpretable factors: trustworthiness of calculators, usefulness, and educational value. Correlations between attitude scores and both course grades and age were significant and positive. There were no differences in attitudes based on sex or whether or not a student owned a calculator. However, females owned calculators more frequently than males. Also, calculator ownership was positively related to age. (Author/MN)

AERA #10.23 1978

# Individual Differences in Calculator Attitudes and Performance in a Statistics Course

KURT F. GEISINGER

Fordham University

DENNIS M. ROBERTS

The Pennsylvania State University

A 30 item survey was developed to assess several dimensions of attitudes about calculators. Reliability and validity data were gathered on students in a college statistics course. Based on N = 135, coefficient alpha was .874. Factor analyses identified 3 interpretable factors: trustworthiness of calculators, usefulness, and educational value. Correlations between attitude scores and both course grades and age were significant and positive. There were no differences in attitudes based on sex or whether or not a student owned a calculator. However, females owned calculators more frequently than males. Also, calculator ownership was positively related to age.

Kurt F. Geisinger
Department of Psychology
Fordham University
Bronx, N. Y. 10458

Individual Differences in Calculator Attitudes and Performance in a Statistics Course

KURT F. GEISINGER
Fordham University

DENNIS M. ROBERTS
The Pennsylvania State University

Roberts and Glynn (1977) showed that individuals who worked statistical problems with calculators expressed more positive attitudes about both themselves and their problem-solving tasks than students who worked the same problems manually. Additional corroborative data was provided in a more complex investigation by Roberts and Fabrey (1977). The present study explored the development of a longer and more reliable survey instrument to be used in examining (1) the nature of attitudes toward calculator usage, and (2) the relationship of such attitudes to several other variables (sex, age, grades in a statistics course, and amount of previous mathematical experience).

Scale Development. Approximately 50 Likert-type (9 point scale) attitude items were written. Items were constructed to represent 4 hypothesized dimensions of affective outcomes related to calculator usage: the trustworthiness of answers arrived at with a calculator, the educational value of using a calculator in working statistical problems and learning statistics, the ease of using calculators and the resultant reduction in work time, and an overall evaluation of the effectiveness of calculators. The items were carefully edited with subsequent elimination of 20 items from the initial pool.

Scale Administration. The best 30 items were formed into a scale (Calculator Attitude Survey-CAS) and administered to 144 undergraduate and graduate students in a large enrollment statistics course at Penn State University. Each item was scored on a scale where 9 represented the most favorable attitude and 1 represented the least favorable attitude. A cover page asked students to list their age, sex, number of previous college-level mathematics or statistics courses, and whether or not they owned a calculator. Grades in the course were later obtained for each student. Example items from the CAS are appended in Table 1.

## Results

Means and standard deviations for the CAS scores across several subclassifications are appended in Table 2.

Internal consistency of the scale. Data are based on 135 students for whom complete data were available. Coefficient alpha for the 30 item scale was found to be .874. Twenty-nine items correlated significantly with the total CAS score; the average item-total scale correlation (with adjustment for effect of the item being removed from the scale) was .46. Additional internal consistency data was collected in the study by Roberts and Fabrey (1977) on a shortened 20 item CAS modification where alpha was .857 based on a similar sample of 60 students.

Factor analytic evidence. In spite of the reasonably high degree of item homogeneity, factor analytic procedures were used to determine whether the initially hypothesized dimensions of calculator beneficiality would emerge. A 3 factor solution accounted for about 40 percent of the variance. After a Varimax rotation was performed, all 3 factors appeared interpretable. Item loadings on the 3 factors are appended in Table 3. Factor I appeared to represent general trustworthiness of calculator use. Factor II represented usefulness of calculators (in working problems). Factor III appeared to represent the educational value associated with calculator usage. Only 2 of the items failed to load on any of the 3 factors (criterion of loading $\geq$ .3).

Relationships of CAS to other variables. Both correlational analyses and tests of mean differences were completed. Four analyses were performed using total CAS score as the dependent variable. Pearson product-moment correlations were calculated between total CAS scores and both grades given in the course and age. Independent t-tests were performed to see if (1) males differed from females and (2) if those who owned calculators differed from those who did not.

The correlation between CAS scores and grades was significant and positive ($r = .18$). Since the survey was administered fairly late in the course term, it was not clear if some directional causal influence may have been present. That is, either positive attitudes could have resulted from prior classroom success or classroom success may have resulted partially from more positive attitudes.

The correlation between CAS scores and age was also significant and again positive ($r = .22$). Older students expressed more positive attitudes than did younger students. Two possible explanations of this finding are offered. It may be that the mathematics skills of the older students have deteriorated to some extent due to lack of practice; calculators would thus fulfill a greater need in such a population. A second possibility is that younger students may not really be aware of the complexity of computations since calculators are nearly universally available now. Older students, however, would be aware of such difficulties as existed in the "pre-calculator world." Hence, older students might better appreciate the value of using a calculator.

Sex differences in either grades in the course or CAS attitude scores were not statistically significant. As expected, however, the males in the study did tend to have taken more quantitative courses. Surprisingly, significant differences in overall CAS scores were not found between people who owned calculators and those who did not. However, calculator owners did tend to be younger than non-owners. ($\bar{X}$ for owners was 20.5; $\bar{X}$ for non-owners was 24.4). Also, a two-factor chi-square analysis showed that a significantly larger proportion of females owned calculators than did males.

Discussion. The apparent modification of attitudes concerning the benefits of using calculators represents one affective outcome either implicitly or explicitly reinforced in many introductory statistics courses today. Based on the reliability coefficient found with the CAS, it is clear that individual differences with respect to this attitude both exist and are quite large. Whether these attitudes are related to the ability to use a calculator or whether supplemental training to use calculators more effectively could increase such attitudes is open to inquiry. The factor-analytic evidence suggests that these attitudes also appear to have a multivariate structure; individuals perceive the advantages of performing computations with a calculator from different perspectives. Furthermore, these differences appear to be related to other variables. Students with higher attitudes toward calculators tended to earn higher grades in the class. The results also imply that older individuals profit more from the use of calculators than do younger students. These preliminary results suggest that numerous other relationships would be fruitful to explore.

Table 1

Sample Items for Each Factor

| | | Item Loading |
|---|---|---|
| **I. Trustworthiness** | | |
| 3. | I am never quite sure of my answer when I use a calculator. | -.65 |
| 11. | I trust my hand calculations more than those I get when I use a calculator. | -.55 |
| **II. Usefulness** | | |
| 24. | If I had a friend taking a statistics course, I would encourage him (or her) to use a calculator. | .72 |
| 21. | I think instructors in statistics classes should let their students use calculators. | .65 |
| **III. Educational Value** | | |
| 15. | I would want my child to learn math using a calculator | .91 |
| 18. | Calculators should only be used after a person has learned math. Learners should not have access to them during learning. | -.62 |

Table 2

Means and Standard Deviations of the CAS Scores According to Certain Subclassifications

| | $\bar{X}$* | $\sigma$ |
|---|---|---|
| Total Sample | 203.2 | 23.4 |
| Sub samples | | |
| Males | 206.9 | 27.7 |
| Females | 201.1 | 25.7 |
| Owners | 198.8 | 23.9 |
| Non Owners | 204.0 | 26.9 |

* Maximum possible score was 270; minimum was 30.

Table 3

Varimax Rotated Factor Matrix

| Item | Factor I | Factor II | Factor III |
|---|---|---|---|
| 1 | .63 | -.02 | .00 |
| 2 | -.33 | .30 | .14 |
| 3 | -.65 | .04 | -.06 |
| 4 | -.14 | .28 | .49 |
| *5 | -.23 | .22 | .17 |
| 6 | -.62 | -.31 | -.09 |
| 7 | .31 | -.41 | -.24 |
| 8 | -.39 | .23 | .05 |
| 9 | .57 | -.16 | -.04 |
| 10 | .53 | -.16 | .03 |
| 11 | .55 | -.27 | .06 |
| 12 | .02 | .06 | .39 |
| 13 | -.04 | .40 | .13 |
| 14 | -.09 | .11 | .75 |
| 15 | -.02 | -.03 | .91 |
| 16 | -.30 | .41 | .06 |
| *17 | -.05 | .20 | .06 |
| 18 | .06 | -.12 | -.62 |
| 19 | -.07 | .58 | .05 |
| 20 | .31 | .24 | .09 |
| 21 | -.28 | .65 | -.00 |
| 22 | .39 | -.32 | .05 |
| 23 | -.18 | .30 | .05 |
| 24 | -.39 | .72 | .02 |
| 25 | -.14 | .57 | .04 |
| 26 | .00 | .54 | .35 |
| 27 | .07 | .43 | .36 |
| 28 | -.01 | .37 | .30 |
| 29 | -.38 | .46 | .10 |
| 30 | -.24 | .49 | .08 |

*Item considered not to load on any factor

## References

Roberts, Dennis M. and Glynn, Shawn M. Calculators and Statistical Problem Solving. Paper presented at annual meeting of American Educational Research Association. April, 1977.

Roberts, Dennis M. and Fabrey, Lawrence. Impact of Prepractice Work Set and Type of Calculator on Statistical Problem Solving. Paper submitted for presentation at 1978 annual meeting of American Educational Research Association.