Attitudinal Predictors of Reform-based Pedagogy in Introductory Statistics Education

Rossi A. Hassad, PhD, MPH
Mercy College, New York
Rhassad@mercy.edu

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Rossi A. Hassad, PhD, MPH
(Rhassad@mercy.edu)

Background/Context/Objective

- For over a decade there has been emphasis on reform-oriented teaching at the college level, fueled by a consensus among educators that traditional curricular material and pedagogical strategies have not been effective in promoting statistical literacy and thinking.

- In spite of these reform efforts, research continues to show that students are emerging with a lack of understanding of core concepts.

- Such evidence has raised concerns about instructors' level of awareness, understanding, support, and appropriate use of active learning strategies.

- Above all, instructors attitudinal predisposition has been implicated as a barrier to and facilitator of the adoption of reform-based pedagogy.

➤ This study explores the role of attitude (FATS scale) in explaining and predicting the use of reform-based pedagogy (TISS scale) in accordance with the TRA and TPB (see full-text reference on the first slide, for details).

Rossi A. Hassad, PhD, MPH
(Rhassad@mercy.edu)

Operational Definitions

- The reform-oriented (concept-based or constructivist) approach is generally operationalized as a set active learning strategies intended to facilitate statistical literacy.
- Statistical literacy (thinking and reasoning): The ability to understand, critically evaluate, and use statistical information and data-based arguments.
➤ The GAISE (Guidelines for Assessment and Instruction in Statistics Education) report – "Blueprint" recommends the following:

- 1. Emphasize statistical literacy and develop statistical thinking;
- 2. Use real data;
- 3. Stress conceptual understanding rather than mere knowledge of procedures;
- 4. Foster active learning in the classroom;
- 5. Use technology for developing conceptual understanding and analyzing data;
- 6. Use assessments to improve and evaluate student learning.

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Methodology

- Exploratory cross-sectional study

- A purposive (maximum variation) sample of 227 instructors from the health and behavioral sciences (USA and International)

- Recruitment: targeted instructors/colleges based on personal knowledge, referrals, publications, course outlines, and via listservs. Contact information was also obtained from journal articles, membership directories, and conference proceedings.

- The questionnaire was programmed (HTML), and circulated via email with an online link to the questionnaire.

- Informed consent was obtained online.

- As an incentive for participation, three one-hundred dollar awards were raffled.

- Correlation, regression, t-test and ANOVA analyses were performed.

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(Rhassad@mercy.edu)

Results

- 227 participants (222 provided country information):
  USA = 165 (74%), International = 57 (26%)

- Represented 24 countries and 133 academic institutions

- Median: age (41 to 50 years); duration of teaching (10 years)

- Male, 139 (61%), and from the USA sub-sample, 135 (82%) identified as Caucasian

- Teaching area: 94 (41%) from the health sciences, 102 (45%) from the behavioral sciences, and 31(14%) who taught both

- **Highest academic degree:**
  Statistics - 92 (41%)
  Psychology/social/behavioral sciences - 71(31%)
  Health sciences/public health/epidemiology/biostatistics - 28 (12%)
  Education/business/operations research - 19(8%)
  Mathematics/engineering - 17 (8%)

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Bivariate Analysis

Bivariate Correlation between Total Attitude (and Subscale Scores) and Teaching-Practice Score

Attitude Subscales	N	Teaching-Practice Score Pearson's r
Perceived Usefulness	219	.364*
Intention	218	.452*
Personal Teaching Efficacy	217	.421*
Avoidance-Approach	218	.387*
Perceived Difficulty (Ease of Use)	218	.073
Total Attitude Score	214	.498*

*p <.001

- As shown here, the relationships are in the expected (positive) direction, and all but "perceived difficulty" (ease of use) were moderate, meaningful, and statistically significant. Indeed, these relationships could be viewed as bi-directional. Multiple regression was next.

Rossi A. Hassad, PhD, MPH
(Rhassad@mercy.edu)

Multiple Regression

- Teaching-practice score (the dependent variable) was regressed on the five attitude subscale scores (the independent variables).

- Although perceived difficulty was not statistically significant in the bivariate analysis , it was entered into the multiple regression model because of its noted conceptual (and empirical) relevance to both intention and behavior

- The strongest correlation among the predictors (attitude subscales)was noted for *perceived usefulness* and *intention* ($r = .7$). From a theoretical and empirical perspective, these two constructs are known to be strongly related but different. Multicolinearity/redundancy was therefore not considered a concern.

- Also, perceived difficulty (ease of use) was significantly correlated with personal teaching efficacy only ($r = .4$, $p < .001$).

Multiple Regression

Multiple Regression Analysis of Overall Teaching-Practice Score on Attitude Subscale Scores

Predictors (Attitude Subscales)	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta (β)	t	Sig.
(Constant)	17.05	2.30		7.42	.001
1.Perceived Usefulness	0.04	0.61	0.01	0.07	.946
2.Intention	1.58	0.52	0.26	3.01	.003
3.Personal Teaching Efficacy	1.62	0.54	0.24	3.01	.003
4.Avoidance-Approach	1.46	0.48	0.20	3.07	.002
5.Perceived Difficulty	-0.42	0.35	-0.08	-1.22	.225

Model Significance: $F (5, 208) = 17.3$, $p < .001$, Adjusted $R^2 = .28$ (28%)

Multiple Regression
Attitude Subscales ⟹ Practice

- The overall model explained 28% of the variance in teaching practice, which is consistent with major attitude-behavior research (TRA and TPB).

- ***Intention*** (one component of attitude) was the strongest predictor of practice followed by ***Personal Teaching Efficacy*** and ***Avoidance-Approach.***

- ***Perceived usefulness*** (PU)was not statistically significant, and as previously mentioned, this construct had a strong relationship with intention.
- ➤ Consider possible explanatory versus predictive role of (PU).

- Also, from a theoretical and empirical perspective, these two constructs (perceived usefulness and intention) are known to be strongly related but different.

- Perceived difficulty (ease of use) was also not statistically significant.

Conclusion & Recommendations

- While attitude is generally conceptualized as necessary for meaningful explanation and prediction of behavior (or practice), it is clearly not sufficient in this regard, in this context $(R^2 = 28\%)$.

- However, such model performance is not uncommon in the behavioral sciences, and this level of R^2 is considered acceptable.

- For example, Ajzen and Fishbein (2004, p. 433), in commenting on two attitude-behavior models with R^2 values of 21% and 31%, noted that they accounted for "considerable variance."

- Nonetheless, other factors should be explored toward improving the predictive value of this attitude-practice model.

- Regarding *Perceived Usefulness* and *Intention*, as well as *Personal Teaching Efficacy* and *Perceived Difficulty*, possible nested, higher-order or hierarchical factors should be explored.

Rossi A. Hassad, PhD, MPH
(Rhassad@mercy.edu)

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How can these findings help?

- Perceptions (or beliefs) about self-efficacy, and usefulness of reform-based pedagogy are targetable and modifiable; they should be a focus of professional development programs aimed at facilitating the adoption and use of reform-based pedagogical practices. Attention should be given to:

  – Providing information about best practices
  – Modeling best practices
  – Faculty mentorship
  – Faculty collaboration and team teaching
  – Administrative support
  – Credit toward promotion and tenure

Rossi A. Hassad, PhD, MPH
(Rhassad@mercy.edu)

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Considerations & Limitations

- These findings should be viewed as tentative, given the non-probability nature of the sample, which could limit external validity or generalizability.

- Consider that attitude and practice were concurrently measured – hence possible inflated coefficients.

- Possible confounding factors should be explored, as well as variation by socio-demographic and personal characteristics.

- The practical significance of these findings must be carefully evaluated with reference to the size of the overall sample.

- This is a cross-sectional study and no claim of cause and effect is being made.

➢ Notwithstanding these issues, these findings are interesting and plausible; they hold much potential for informing the statistics education community regarding facilitating and inhibiting factors for reform-based teaching of introductory statistics, and should be further explored with an appropriate sample.

Thank You.

Rossi A. Hassad, PhD, MPH
(Rhassad@mercy.edu)

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