

Assessing the Moderating Effect of Gender on the Influence of Attitude towards Statistics Anxiety among Undergraduates Students in Malaysia

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Abstract

This study examined the moderating effect of gender on the influence of attitude towards statistics anxiety with a sample of Malaysian undergraduates (n=463) from three local universities using purposive sampling framework. The Students Attitude towards Statistics (SATS) and the Statistical Anxiety Scale (SAS) were employed for this purpose. Results from the Hayes' PROCESS macro showed that despite having significantly higher mean score on SATS, attitude only explained 1.8% of the variance in statistical anxiety and did not moderate the relationship between the two variables. We consider that this is a positive finding since efforts to reduce statistical anxiety through nurturing a positive attitude does not affect by gender.

Keywords: Attitude Towards Statistics, Statistical Anxiety, University Undergraduates, Regression, Moderating Effect

Introduction

There is a growing need for applying statistical techniques in a diverse range of jobs and workplaces. At the university level, statistics is considered one of the most critical subjects in the curriculum, where several academic departments realize its importance shown by a continuing increase in the number of students from a variety of disciplines enrolled in statistics courses (Garfield et al., 2008; Onwuegbuzie & Wilson, 2003). The use of statistics is wide-ranging and includes most aspects of our life, not limited only to statisticians but also non-statisticians in various disciplines. Furthermore, the correct understanding of information assists decision-makers in making accurate or informed decisions. Besides the direct application of statistical knowledge for research purposes, insight into statistics is more generally considered an important stepping stone in the development of critical thinking and decision and problem-solving skills (Kesici et al., 2011). Whereas the academic bachelor's prepares students with the appropriate (scientific) knowledge and skills to continue in the master's program, the professional bachelor's program focuses on professional practice providing students with competencies (knowledge, skills, and attitudes) to start a profession directly (e.g., in psychodiagnostic, counseling and coaching, selection and recruitment, etc.)

Statistics anxiety is a specific form of anxiety. Cruise et al (1985); Zeidner (1991) described statistics anxiety “as the feelings of anxiety encountered when taking statistics courses or doing statistical analyses. Later, Onwuegbuzie et al (1997) included a more general definition of statistics anxiety as a “negative state of emotional arousal experienced by individuals as a result of encountering statistics in any form and at any level.” Statistics anxiety has had an impact on the way how students are engaged in studying statistics. For example, statistics anxiety has been associated with procrastination of learning (Onwuegbuzie, 2004), less time studying, and less efficient learning strategies (Macher et al., 2012, 2013). As a result, statistics anxiety is often considered a significant negative influence on performance in statistics courses (Onwuegbuzie, 2004). Several studies reported a small but significant negative correlation between statistical anxiety and statistical performance (typically ranging between $r = -.20$ and $r = -.30$; for an overview, see Macher et al., 2015). Other studies demonstrated insignificant or positive correlations (Lester, 2016; Paechter et al., 2017).

The antecedents of statistics anxiety can be categorized into three classes: situational, dispositional, and cognitive factors (Cui et al., 2019; see Chew & Dillon, 2014 for another classification). Situational: statistics prior knowledge, statistics course grade, the status of the course (required or elective), major attitudes towards calculators, course and instructor evaluation, and satisfaction with the statistics course (Bell, 2003; Onwuegbuzie, 2003). Dispositional factors are factors that the student brings into the setting and are related to individual differences, e.g., the attitude towards statistics, the motivation to learn it, prior mathematical experience, or procrastination behavior (Schau, 2003). Environmental factors such as gender, race, country of origin, and other factors can also affect students’ statistics anxiety (for example, Bell, 1998; Benson, 1989; Bradley & Wygant, 1998, Rodarte-Luna & Sherry, 2008, Onwuegbuzie, 1999). In addition, gender was also found to impact statistics anxiety. For example, Edirisooriya and Lipscomb (2021) revealed a significant gender difference in statistics anxiety. Similar results were also found in the study of (Mandap, 2016; Alsaleh, 2014). As such, this study aims to investigate the moderating effect of gender on the influence of attitude towards statistical anxiety among Malaysian undergraduates.

Method

Sample

463 students enrolled in introductory statistics courses willingly participated in the survey. The students represented three local universities in the northern parts of Malaysia. There were 105 (22.7%) males and 358 (77.3%) females in the study.

Table 1

Sample of Study

| Demographic Characteristics | Number of Respondents (N=463) | Percentage (%) |
|-----------------------------|-------------------------------|----------------|
| Gender | | |
| Male | 105 | 22.7% |
| Female | 358 | 77.3% |
| University | | |
| USAS | 232 | 50.2% |
| USM | 146 | 31.6% |
| UUM | 84 | 18.2% |

Instrument

The Surveys of Attitudes Towards Statistics (Schau et al., 1995) instrument was developed to assess students' attitudes towards statistics. The SATS is a Likert-type instrument with seven response possibilities for each statement ranging from strongly disagree to agree strongly. The first version of SATS was designed in 1995 (Schau et al., 1995), involving four subscales, namely, (1) Affect, (2) Cognitive Competence, (3) Value, and (4) Difficulty. In 2003, it was updated by adding two subscales, that is, (1) Interest and (2) Effort (Schau, 2003).

SATS consists of six subscales: (1) Affect (six items): positive and negative feelings concerning statistics; (2) Cognitive Competence (six items): attitudes about intellectual knowledge and skills when applied to statistics; (3) Value (nine items): attitudes about the usefulness, relevance, and worth of statistics in personal and professional life; (4) Difficulty (seven items): attitudes about the difficulty of statistics as a subject; (5) Interest (four items): students' level of individual interest in statistics and (6) Effort (four items): the number of effort students spends on learning statistics. (Schau et al., 1995; Schau, 2003).

Apart from SATS, the present study also employs the Statics Anxiety Scale (Vigil-Colet et al., 2008). SAS consisted of 24 items, categorized into three dimensions, (1) Examination Anxiety (eight items): anxiety involved when taking a statistics class or test, (2) Fear for Asking for Help (8 items): anxiety experienced when asking a fellow student or a teacher for help in understanding specific contents, and (3) Interpretation Anxiety (8 items): anxiety experienced when students are faced with making a decision about or interpreting statistical data.

Table 2

SATS

| No | Dimension | Number of Items | Example of Item |
|---------|----------------------|-----------------|---|
| 1 | Affect | 6 | I will like statistics. |
| 2 | Cognitive Competence | 6 | I will have trouble understanding statistics because of how I think. |
| 3 | Value | 9 | Statistics are worthless. |
| 4 | Difficulty | 7 | Statistics formulas are easy to understand. |
| 5 | Interest | 4 | I am interested in being able to communicate statistical information to others. |
| 6 | Effort | 4 | I plan to complete all of my statistics assignments. |
| Overall | | 36 | |

Table 3

SAS

| No | Dimension | Number of Items | Example of Item |
|----|-------------------------|-----------------|--|
| 1 | Examination Anxiety | 8 | I was walking into the classroom to take a statistics test. |
| 2 | Fear of Asking for Help | 8 | Going to the teacher's office to ask questions. |
| 3 | Interpretation Anxiety | 8 | I am trying to understand the statistical analyses described in a journal article. |

Overall 24

Data Analysis

In line with the purpose of the study, we conducted the independent sample t-test to investigate the gender difference in attitude toward statistics and statistical anxiety. Regression analysis was conducted to examine the influence of attitude towards statistics on statistical anxiety. Meanwhile, we employed Hayes' PROCESS macro using Model 1 to investigate moderating variables of gender towards the relationship between attitude and statistical anxiety.

Findings

Firstly, we examine the quality of measurements from the two instruments. As shown in Table 4, both SATS and SAS demonstrated high evidence of reliability based on the high value of Cronbach's α s. In addition, the measurement using the scales also demonstrated sufficient evidence of construct validity since, in general, there were significant correlations between the dimensions, except for Fear for Asking for Help and Interpretation Anxiety (See Tables 5 and 6).

Table 4

Evidence of Reliability

| SATS | | | | SAS | | | |
|------|----------------------|-----------------|-------------------|-----|-------------------------|-----------------|-------------------|
| No | Dimension | Number of Items | Cronbach α | No | Dimension | Number of Items | Cronbach α |
| 1 | Affect | 6 | .856 | 1 | Examination Anxiety | 8 | .655 |
| 2 | Cognitive Competence | 6 | .828 | 2 | Fear of Asking for Help | 8 | .730 |
| 3 | Value | 9 | .821 | 3 | Interpretation Anxiety | 8 | .567 |
| 4 | Difficulty | 7 | .847 | | | | |
| 5 | Interest | 4 | .907 | | | | |
| 6 | Effort | 4 | .802 | | | | |
| | Overall | 36 | .929 | | Overall | 24 | .864 |

Table 5

SATS - Correlation between Dimensions

| Dimension | 1 | 2 | 3 | 4 | 5 | 6 |
|-------------------------|------|------|------|------|------|------|
| 1- Affect | 1.00 | .806 | .607 | .482 | .587 | .374 |
| 2- Cognitive Competence | | 1.00 | .619 | .436 | .597 | .409 |
| 3- Value | | | 1.00 | .224 | .578 | .427 |
| 4- Difficulty | | | | 1.00 | .261 | .083 |
| 5- Interest | | | | | 1.00 | .639 |
| 6- Effort | | | | | | 1.00 |

Table 6

SAS - Correlation between Dimensions

| Dimension | 1 | 2 | 3 |
|----------------------------|------|-------|-------|
| 1- Examination of Anxiety | 1.00 | .153* | .365* |
| 2- Fear of Asking for Help | | 1.00 | .045 |
| 3- Interpretation Anxiety | | | 1.00 |

With regards to the impact of gender on attitude towards statistics, we found that the male undergraduates demonstrated significantly higher mean scores ($M = 153.54$, $SD = 19.39$) compared with the females ($M = 144.51$, $SD = 21.74$) [$t(459) = 3.815$, $p < .01$]. Nevertheless, no significant difference was found with regards to the statistical anxiety mean score (Male: $M = 99.03$, $SD = 14.68$; Female: $M = 100.73$, $SD = 14.50$) – $t(459) = -1.052$, $p = .293$. Meanwhile, based on the linear regression analysis, we found that despite functioning as a significant predictor, attitude towards statistics only explained 1.8% of the variance in statistical anxiety. Meanwhile, from the moderating analysis, because the value of lower level (LLCI) and upper level (ULCI) of the confident intervals contain 0 (see Table 6) for the interaction, gender was found to have an insignificant effect on the relationship between attitude towards statistics and statistical anxiety.

Table 6

The Moderating Analysis

| | Coefficient | SE | t | p | LLCI | ULCI |
|-------------------|-------------|-------|--------|-------|----------|----------|
| Constant | 113.4912 | 23.31 | 4.8676 | .0000 | 67.6722 | 159.3102 |
| Attitude | -.1003 | .15 | -.6639 | .5071 | -.3973 | .1966 |
| Gender | -2.27 | 12.48 | -.0221 | .9824 | -24.8035 | 24.2527 |
| Attitude x Gender | .0079 | .082 | .0973 | .9225 | -.1522 | .1681 |

Discussion

The present study aimed to investigate the moderating effect of gender on the influence of attitude towards statistical anxiety among Malaysian undergraduates. Results showed that the male undergraduates showed significantly higher mean scores in attitude towards statistics. The finding was in line with many previous studies such as (Tempelaar & Nijhuis, 2007; Chiesi and Primi, 2016; Hommik and Luik, 2017). The finding was not unexpected since male students were generally found to be more confident with their skills, while female students were more concerned about their success (Vale & Leder, 2004). In addition, the result might also be explained in terms of the confidence gap, where that women are less self-assured than men.

The present study also found no significant gender difference in the mean score of statistical anxiety. The result is in line with studies such as (Hsiao and Chiang (2011); Zhang et al (2012) as well as (Alizamar et al., 2019). However, it is interesting to note that earlier studies (such as Onwuegbuzie (1995); Royse & Rompf (1992) Zeidner (1991) do report significant differences between gender. As such, one might speculate that the difference might be decreased over the years because of several factors. For further investigation, we recommend that future researchers look into the impact of previous mathematics experience (PME) (Balog'lu, 2003) in reducing gender differences in statistical anxiety among undergraduates.

The third finding of the present study showed that attitude toward statistics negatively influences statistical anxiety. That is, undergraduates with a positive attitude demonstrated lower statistical anxiety and vice versa. Again, the result is not unexpected based on consistent reporting from previous studies in Malaysia, such as (Rosli et al., 2017; Saidi and Siew, 2022). Focusing on the good things in statistics, such as the ability to conduct research and understand journals or reports, we naturally spend less time dwelling on the wrong things about statistics, such as its difficulty and out-of-context teaching.

Finally, the present study also showed that gender has no significant impact on the relationship between attitude towards statistics and statistical anxiety. We consider that this is a positive finding since efforts to reduce statistical anxiety through nurturing a positive attitude does not affect by gender. For example, lecturers can help your student visualize positive outcomes from learning statistics, such as the ability to differentiate between reasonable and dubious claims and to draw valid conclusions. This can be done through a case study in which both males and females take part to discuss their opinion.

Conclusion

The present study provides several interesting findings. Firstly, the male undergraduates have a significantly more positive attitude towards statistics, but no difference was found in the mean score of statistical anxiety. Secondly, as expected, attitude is a significant predictor of statistical anxiety. Moreover, finally, gender did not moderate the relationship between attitude towards statistics and statistical anxiety.

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