

Statistics Anxiety among Postgraduate Students

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Received: July 22, 2014 Accepted: November 5, 2014 Online Published: December 21, 2014

doi:10.5539/ies.v7n13p166

URL: <http://dx.doi.org/10.5539/ies.v7n13p166>

Abstract

Most postgraduate programmes, that have research components, require students to take at least one course of research statistics. Not all postgraduate programmes are science based, there are a significant number of postgraduate students who are from the social sciences that will be taking statistics courses, as they try to complete their postgraduate studies. As postgraduate students come from varied backgrounds, from those who have left school for more than a decade, to those who just completed their undergraduate studies, postgraduate statistics course may be one of the toughest to teach. These students come into the course with preconceived thoughts and attitude, which would either increase their anxiety towards statistics, or decrease their anxiety. Previous studies have shown that students reported high level of statistics anxiety during a statistics course. Unfortunately, there are limited studies on statistics anxiety in the Malaysian postgraduate population. Therefore, this study aims to determine the level of anxiety towards statistics among postgraduate student. This study also aims to explore factors that are associated with statistics anxiety among postgraduate students at the Faculty of Education, UKM. As a secondary outcome, this study explores the type of evaluation preferred by postgraduate students in relation to a statistics course. All postgraduate students who registered for the Research Statistics course at the Faculty of Education, National University of Malaysia, during the study period were invited to participate in the study. A total of 141 students completed the questionnaire and was included in this paper. This study found that a significant (21.7%) of the students surveyed have anxiety in at least one of the statistics anxiety domain, either in anxiety towards class activities, attitude towards class, attitude towards Mathematics or self-perception of ability to perform in statistics. This study found that ethnicity was associated with higher anxiety towards class activities, with the Malays being more anxious compared to the non-Malays. Both ethnicity and bachelor's degree were associated with attitude towards class and attitude towards Mathematics. For these two domains, the male students and students from non-science based bachelor's degree, showed more anxiety compared to female students. Self-perception of ability to perform in statistics was not associated with any socio-demographic factors included in this study. Students in this study overwhelmingly preferred individual assignment as an evaluation method, followed by mid-semester examination, and the final semester examination. Least preferred were online participation and presentation.

Keywords: statistics anxiety, postgraduate students, postgraduate learning

1. Introduction

1.1 Background of Study

Basic research knowledge is essential for postgraduate students in a research university where the production of a well-written thesis is one of the major requirements of a postgraduate (masters or PhD) conferment. Basic statistical knowledge is essential in allowing students to answer the research questions they so carefully chosen based on the data they collected according to the research methodology adopted. Therefore, most postgraduate programs in research universities have a paper on basic statistics in helping students master these skills. With basic statistical knowledge, students will be able to manage a set of data, use appropriate statistical tests to analyse the data in an attempt to answer research questions, and interpret and report the results of those analyses in an intelligible and academic way. It is hoped that after such a statistical course for the postgraduate students, that they would have the adequate statistical literacy to complete their research thesis.

However, not all students are confident in dealing with numbers. This is especially true for postgraduate students who have left school for quite some time and are continuing their studies after a long hiatus. After leaving

schools for so long, and not having to deal with numbers in an academic way for so long, a little apprehension is expected when they enrol in one such class (Slootmeackers & Merremans, 2014; Onwuegbuzie, 1998). A student's anxiety towards statistics may not be solely due to insufficient skills or knowledge, but may have been contributed also by their perception towards statistics, and all the negative experiences in the past related to numbers in general or statistics specifically. Further, as any courses offered in a university, there will be evaluations in the form of examinations and reports, and these examinations may also contribute to the student's anxiety towards statistics.

1.2 Statistics Courses and Statistics Anxiety

Statistics literacy is one major component of research skills. As universities all over the world focuses on research as part of a postgraduate program, statistics courses are being offered to provide a platform in where postgraduate students can acquire relevant statistics literacy to help them complete their postgraduate program. Statistical literacy is defined as:

"includes many elements of quantitative literacy. It involves the mathematical approach in focusing more on signal and pattern than on noise or chance; it involves the statistical approach in focusing more on the role of context, conditional reasoning, and variation. But statistical literacy goes beyond quantitative literacy or numeracy by focusing on the ability to read, to interpret, and to communicate. Numeracy focuses primarily on numbers; statistical literacy focuses more on the words framing the numbers" (Schild, 2004, p. 6)

However, postgraduate students come from different background, and students from the social sciences background may not have much experience with numbers, and may believe themselves to be weak with numbers. This is especially true at the Faculty of Education where the students are mostly practicing teachers of various subjects at schools. Postgraduate students at a Faculty of Education would include teachers with science background (teaching the sciences subjects, engineering) and from the social science background (Language teachers, Physical Education teachers, Special Education teachers, religious studies and other humanity subjects). Others have suggested that learning statistics is akin to learning a foreign language (Lalonde & Gardner, 1993; Lazar, 1990). Many other researchers have also found that statistics is one of the biggest causes of anxiety among students (Lundgren & Fawcett, 1980; Schacht & Stewart, 1990, 1991; Zeidner, 1991), and may be regarded as a major threat to their finishing their degree.

Statistics anxiety has been defined as an anxiety, which occurs when a student encounters statistics in any form and any level (Onwuegbuzie, DaRos, & Ryan, 1997). However, Zeidner (1991) has a more detailed definition of statistics anxiety. According to Zeider (1990), statistics anxiety is defined as:

"a performance characterized by extensive worry, intrusive thoughts, mental disorganization, tension, and physiological arousal... when exposed to statistics content, problems, instructional situations, or evaluation contexts, and is commonly claimed to debilitate performance in a wide variety of academic situations by interfering with the manipulation of statistics data and solution of statistics problems" (Zeidner, 1990, p. 319)

Statistics anxiety can be associated with having problem in fully understanding research articles as well as analysing and interpreting statistical findings (Onwuegbuzie, 1997). Understanding the results section of a research article is important for postgraduate students to understand to be able to think critically or comment on the article. These skills will help them to establish their own research hypotheses, and analysing and interpreting their research data, ensuring that they can successfully complete their chosen academic programme.

1.3 Socio-demographic Predictors of Statistics Anxiety

Ethnicity and gender has been the main socio-demographic predictors mostly explored by researchers looking at statistics anxiety (Benson, 1989; Zeidner, 1991; Onwuegbuzie, 1999). This may be due to both these factors have strong association with completion of school and disparity of income. Previous studies have found that there is a significant difference in academic related anxiety and ethnicity (Coney & West, 1979; Payne, 1984). They found that African American students have higher levels of academic anxiety compared with non-African American students. A more recent study found that African American postgraduate students have higher level of statistics anxiety compared to their Caucasian counterparts (Onwuegbuzie, 1999). Previous studies have found that female students have higher statistics anxiety compared to male students (Benson, 1989; Zeidner, 1991). However, again Onwuegbuzie (1999) had a different finding. Onwuegbuzie (1999) did not find any conclusive association between gender and statistical anxiety.

1.4 Aim of Study

This study aims to determine the level of anxiety towards statistics among postgraduate student. This study also aims to explore factors that are associated with statistics anxiety among postgraduate students at the Faculty of

Education, UKM. As a secondary outcome, this study explores the type of evaluation preferred by postgraduate students in relation to a statistics course.

2. Method

To be able to effectively collect data on statistics anxiety without causing more anxiety among the postgraduate students, the four main domains of statistics anxiety were measured using a self-reported questionnaire. The questionnaire was distributed towards the end of the first lecture for a postgraduate research statistics class. Students were given 15 minutes to complete the questionnaire and return it before the class was dismissed. Administrators of the questionnaire were not allowed in the lecture hall during the time when the students were filling up the questionnaires. No identifiers were collected to encourage more “honest” reporting.

2.1 Participants

Eligible participants are students who are registered postgraduate students in the master’s program at the Faculty of Education, National University of Malaysia (UKM). Students who registered for the Research Statistics course during the time of this study were invited to participate. As the questionnaire was administered at the end of the class, students who were willing to stay back and complete the questionnaire were considered consenting to participate in the study. Students who were repeating the course due to poor grades in the previous semester were not included in the study.

2.2 Measures

2.2.1 Statistics Anxiety

The main instrument in this study is the Statistics Anxiety Measure (SAM; Earp, 2001). SAM measured the four main domain of statistics anxiety, which are (1) anxiety towards statistics class activities, (2) attitude towards statistics class, (3) attitudes towards mathematics, and (4) expected level of performance in a statistics class.

2.2.1.1 Anxiety towards Statistics Class Activities

There are eight (8) items to measure anxiety towards class activities. These are all measured using a nine point Likert scale from Strongly Disagree to Strongly Agree. The alpha Cronbach for this construct in this population was 0.95. The items measure the extent where students believe they have an anxiety when dealing with statistics, in regards to calculating probabilities, developing conclusions based on mathematical solutions, interpreting and explaining statistical findings, attending mathematics class, statistical contents and worry about taking statistics in their registered program. The higher the scores in this constructs means a higher the feeling of anxiety towards statistics.

2.2.1.2 Attitude towards Attending a Statistics Class

There are nine items to measure attitude towards attending statistical lectures required in their registered program. The items use a nine point Likert scale from Strongly Disagree to Strongly Agree. The alpha Cronbach for this construct is 0.89. This construct measures students’ motivation, class avoidance, the perceived importance of the statistics course, worth of statistics in respect to personal/academic gains. A higher score shows a more negative attitude towards attending statistics lectures.

2.2.1.3 Attitude towards Mathematics

There are nine items to measure attitude towards mathematics. Attitude towards mathematics was measured because literature has shown that anxiety towards mathematics is associated with anxiety towards statistics (ref). The items used a nine point Likert scale from Strongly Agree to Strongly Disagree. The internal reliability of the items are very good (alpha Cronbach = 0.97). Items in this construct measures attitudes of students towards mathematics as an academic subject and their perceived capabilities in handling and solving mathematical problems. A higher score for this construct shows a more negative attitude towards mathematics.

2.2.1.4 Self Perception of Ability to Perform in Statistics

There are also nine items to measure expected level of performance in a statistics course. The items used a nine point Likert scale from Strongly Agree to Strongly Disagree. The internal reliability of the items are very good (alpha Cronbach = 0.94). Items in this construct measures students expected level of performance in examinations, in doing projects, ability to perform in problem solving task in statistics. A higher score in this construct means students have higher expectation on their performance in the statistics course.

2.2.2 Preferred Evaluation Method

Students were also asked about their preferred method of evaluation for a statistics class. The evaluation methods include examinations (both mid-semester and final), group projects, assignments, quizzes, online participation,

and presentation. Students are allowed to choose more than one evaluation method that they preferred to be use in their statistics class.

2.2.3 Socio-Demographic Variables

Socio-demographic variables included in the study are gender (male, female), ethnicity (Malay, non-Malay), bachelor degree background (science based, non-science based), marital status (married, not married), age and preferred mode of assessment for the course.

2.3 Data Management and Analysis

Data was cleaned for missing data, whereby incomplete questionnaire were not included in the current analysis. Descriptive statistics were used to describe characteristics of the students involved in this study, as well as to determine the level of statistics anxiety, as measured through the four main domains. To further explore if socio-demographic factors were associated with levels of anxiety, t-tests were conducted. A Welch t-test was used when the assumption for homogeneity of variance was not met in one of the analysis. Descriptive statistics was used to describe the preferred method of evaluation in a statistics course by the students.

3. Results

3.1 Recruitment

At the beginning of the semester, 180 students were registered for this research statistics course, and 161 of these students attended the first week lecture, when the questionnaires were distributed. After eliminating incomplete and spoilt questionnaires, a total of 143 completed and clean questionnaires were analysed and are reported here.

3.2 Participant Characteristics

The mean age (years) of participants in this study was 31.6 ± 6.23 . The majority of participants in this study are female, of Malay origin, with non-science based bachelor degree and are married (refer Table 1).

Table 1. Socio-demographic characteristics of participants in this study

Socio-Demographic Characteristics	N (%)
Gender	
Male	32 (22.4)
Female	111 (77.6)
Ethnicity	
Malay	126 (88.1)
Non-Malay	17 (11.9)
Bachelor's Degree	
Science based	30 (21)
Non-science based	113 (79)
Marital status	
Married	83 (58)
Single	60 (42)

3.3 Statistics Anxiety

All the main constructs were measured using a 9-point Likert scale. Interpretation of these 9-point Likert scale given to the respondents were as 1 (strongly disagree), 3 (Disagree), 5 (Moderately agree), 7 (Agree), and 9 (Strongly agree). Table 2 illustrates the continuum of the Likert scale. Due to the items and interpretation of the score detailed earlier, students who have a mean score of seven and above in the three "negative" domains (anxiety towards class activities, attitude towards class and attitude towards mathematics) may be interpreted as

may have some level of anxiety towards statistics. For the domain self-perception of ability to perform, score of < 3 is interpreted as having anxiety towards ability to perform in class.

Table 2. Continuum of Likert scale used in this study

1	2	3	4	5	6	7	8	9
Strongly Disagree		Disagree		Moderately Agree		Agree		Strongly Agree

This study found that the domain with the highest number of students having a mean score ≥ 7 is the domain anxiety towards class activities ($n=30$, 21%). The domain attitude towards Mathematics came in second with nine students (6.3%) having a mean score of ≥ 7 . Six students (4.2%) had a mean score of ≥ 7 for the domain attitude towards class. These results shows that the majority of the students included in this study do not have anxiety towards the statistics class, although 21% did show that they might have some anxiety towards completing class activities. The final domain of self-perception of ability to perform in class was also low ($n=3$, 2.1%), with only three students having a mean score of < 3 for this domain. This shows that for the majority of the students, they perceived themselves being able to perform to a certain extent in the statistics class.

Overall, the majority of students in this study ($n=105$, 73.4%) did not show anxiety towards statistics through the four main domain measured. Thirty-one students (21.7%) showed anxiety in one domain, four students (2.8%) showed anxiety in two domains and three students (2.1%) showed anxiety in three domains. No students in this study showed anxiety in all four domains measured.

3.3.1 Level of Anxiety towards Statistics Class Activities

This study found that although students constantly verbalise their anxiety towards any statistics course, the overall perceived anxiety towards statistics class activities were only moderate (5.60 ± 1.43). This is also the overall highest mean score among the four statistics anxiety domain. There were no significant differences in level of anxiety between male and female students, students with a science or non-science based bachelor degree, and marital status. However, Malay students have a significantly higher perceived anxiety towards class activities compared with their non-Malay counterpart (refer Table 3).

3.3.2 Postgraduate Students' Attitude towards the Statistics Class

The majority of the students in this study did not have negative attitudes towards the statistics course (4.09 ± 1.42). Male students viewed the statistics course more negatively compared to female students, as the mean scores of male students in this domain were significantly higher compared with female students ($t(141) = 2.04$, $p = 0.044$). Students who have had a non-science based bachelor degree also had a higher mean score compared to students with a science based bachelor's degree ($t(141) = 2.313$, $p = 0.022$). A further analysis using chi square showed that there is no significant relationship between gender and bachelor's degree ($X^2(1) = 3.35$, $p = 0.067$). Therefore, both gender and bachelor's degree are independently correlated with attitude scores towards statistics course (refer Table 4).

3.3.3 Postgraduate Students' Attitude towards Mathematics

The mean score of students' attitude towards mathematics (3.95 ± 1.77) were on the lower side of the mid-point on the 9-point liker scale. This shows that overall, the students have a more positive attitude towards mathematics. There was no significant difference in students' attitude towards mathematics mean scores between the Malays and the non-Malays, and between students with different marital status. However, female student were found to have lower mean scores compared to their male counterparts ($t(141) = 3.09$, $p = 0.002$). Students who had a science based bachelor's degree also has a lower attitude towards mathematics scores compared to student from a non-science based bachelor's degree ($t(141) = 3.40$, $p = 0.001$; refer Table 5).

3.3.4 Self Perception of Ability to Perform in Statistics

Students' expected themselves to perform quite well in this statistics class, with a mean score in expected performance at 5.31 ± 1.01 . As all items in this construct were using a 9-point Likert scale, a mean score of 5.31 has passed the midpoint of the 9-point Likert scale. This may indicate that the majority of the students surveyed have a more positive self-perception of their ability to perform in statistics. There was no significant difference in expectations for all socio-demographic characteristics included in this study. This means that gender, ethnicity, bachelor's degree and marital status are not correlated with expected performance (refer Table 6).

Table 3. Level of anxiety towards statistics and socio-demographic characteristics

Socio-Demographic Characteristics	N (%)	M (SD)	p-value
Gender			
Male	32 (22.4)	5.53 (1.44)	0.742
Female	111 (77.6)	5.63 (1.43)	
Ethnicity			
Malay	126 (88.1)	5.71 (1.46)	0.002* ^s
Non-Malay	17 (11.9)	4.85 (0.88)	
Bachelor's Degree			
Science based	30 (21)	5.18 (1.66)	0.069
Non-science based	113 (79)	5.72 (1.35)	
Marital status			
Married	83 (58)	5.55 (1.41)	0.620
Single	60 (42)	5.68 (1.46)	

* p<0.05.

^s Welch t-test was used because the assumption of homogeneity of variance was not met in this case.

Table 4. Attitude towards class and socio-demographic characteristics

Socio-Demographic Characteristics	N (%)	M (SD)	p-value
Gender			
Male	32 (22.4)	4.54 (1.29)	0.044*
Female	111 (77.6)	3.97 (1.43)	
Ethnicity			
Malay	126 (88.1)	4.13 (1.47)	0.463
Non-Malay	17 (11.9)	3.86 (0.97)	
Bachelor's Degree			
Science based	30 (21)	3.57 (1.29)	0.022*
Non-science based	113 (79)	4.23 (1.42)	
Marital status			
Married	83 (58)	4.15 (1.38)	0.679
Single	60 (42)	4.05 (1.44)	

* p-value <0.05.

Table 5. Attitude towards Mathematics and socio-demographic characteristics

Socio-Demographic Characteristics	N (%)	M (SD)	p-value
Gender			
Male	32 (22.4)	4.78 (1.78)	0.002*
Female	111 (77.6)	3.71 (1.71)	
Ethnicity			
Malay	126 (88.1)	3.95 (1.78)	0.920
Non-Malay	17 (11.9)	3.99 (1.75)	
Bachelor's Degree			
Science based	30 (21)	3.01 (1.76)	0.001*
Non-science based	113 (79)	4.20 (1.69)	
Marital status			
Married	83 (58)	4.19 (1.76)	0.177
Single	60 (42)	3.78 (1.78)	

* p-value < 0.05.

Table 6. Self-perception on ability to perform in statistics and socio-demographic characteristics

Socio-Demographic Characteristics	N (%)	M (SD)	p-value
Gender			
Male	32 (22.4)	5.41 (0.86)	0.523
Female	111 (77.6)	5.28 (1.05)	
Ethnicity			
Malay	126 (88.1)	5.33 (1.03)	0.436
Non-Malay	17 (11.9)	5.13 (0.83)	
Bachelor's Degree			
Science based	30 (21)	5.47 (1.11)	0.327
Non-science based	113 (79)	5.26 (0.99)	
Marital status			
Married	83 (58)	5.32 (1.11)	0.828
Single	60 (42)	5.28 (0.87)	

3.4 Types of Evaluation Preferred by Postgraduate Students for a Statistics Course

Students were asked how they would like to be evaluated in their statistics class. They were given a list of evaluations, ranging from projects to final examination. Students may choose as many or as little as they wish. What is interesting here is that all students (except for 1) inadvertently agree that they should be evaluated in their statistics course by choosing at least one of the options given. The meaning of that one student who did not choose any evaluation method for a statistics course is impossible to interpret. The majority of the participants in

this study agree that two to three different form of evaluation would be preferred in a statistics course.

Table 7. Evaluation methods preferred by students in a statistics course

Types of Evaluation	N	%
Individual assignment	110	76.9
Mid Semester Examination	68	47.6
Online participation being graded	40	28
Presentation	34	23.8
Group project	40	28
Final Exam	47	32.9

4. Discussion and Conclusions

Statistics anxiety is not a simple construct to measure. This paper has attempted to measure the four main domains of statistics anxiety, which are anxiety towards class activities, attitude towards class, attitude towards mathematics, and expected performance in class. This paper also explored socio-demographic factors that may be correlated with these domains to help statistics teachers at all levels to modify their teaching method for better student performance.

This study found that the majority of postgraduate students taking a research statistic course did not show any anxiety towards statistics, with the majority of the students believing that they could perform in class. However, there are quite a significant number of students who showed anxiety in at least one domain of the statistics anxiety measured in this study. Anxiety towards class activities were the highest recorded in this study, followed by attitude towards Mathematics and then attitude towards class. This shows that statistics anxiety does exist in the adult student population, and if possible, the relevant lecturers of these courses could do something to alleviate these anxieties early in the semester so that it does not impede in their learning throughout the semester. Some possible way to help students overcome statistics anxiety is through modifying their teaching methods. Once a teacher or lecturers understands the level and domain of statistics anxiety within a class, the teacher can decide how topics should be introduced as well as indicating the type of activities that may encourage or discourage students to further explore statistics. For example, Schacht and Stewart (1990) found that using humour in class helps engage students in class activities.

To better understand the domains of statistics anxiety, selected socio-demographic factors were tested for their association with the four main domains of statistics anxiety. This study found that socio-demographic factors (gender, ethnicity, bachelor's degree and marital status) were not associated with self-perception of ability to perform in statistics. This may suggests that self-perception on ability to perform are not associated with socio-demographic factors included in this study, but may be associated with other socio-demographic factors that was not covered in this study.

Both gender and bachelor's degree were significantly associated with attitude towards class and attitudes towards mathematics. Both male students have higher mean scores for attitude towards class and attitudes towards mathematics. Male students are found to have higher anxiety towards statistics compared with their female counterpart. This findings is inconsistent with previous studies that found female student have higher levels of statistics anxiety compared to their male counterpart (Benson, 1989, Zeidner, 1991). However, it must be noted that Onwuegbuzie (1999) found inconclusive results regarding increasing anxiety along gender lines. This study found that students with a science-based bachelor's degree have better attitudes towards class and better attitudes towards Mathematics compared to students with non-science based bachelor's degree. This may be due to a bachelor's degree that are science oriented will have mathematics subjects built in the programme while students graduated with a non-science based bachelor's degree have less exposure to mathematics after secondary school. However, this information could also be viewed that students with better attitude towards a statistics class and mathematics class may be more likely to choose a science based programme during their undergraduate. Lastly, ethnicity was found to be associated with anxiety towards class activities. Students of Malay descent were more anxious about class activities compared with their non-Malay counterparts. This finding differed from a previous study that found anxiety was not associated with ethnicity (Onwuegbuzie, 1999). However, it must be noted that the ethnicity Onwuegbuzie (1999) studied also differs from the population of this

study.

Postgraduate students overwhelmingly preferred individual assignments as an evaluation method for a statistics class. The second and third placing for preferred evaluation methods are mid-semester and final semester examinations. This may be due to the content of the course that students shied away from evaluation methods like presentations (lowest number of students chose this option), group projects and online participation.

Overall, this study has found that not many postgraduate students have high statistics anxiety as were previously thought. However, there still is a significant number of student have high anxiety towards class activities. Teachers, tutors and lecturers of statistics courses could use this information to help ease the students into the course early on so that this anxiety does to impede too much on their academic performance in the statistics course.

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