GADING BUSINESS AND MANAGEMENT JOURNAL
Volume 18, Number 1, 83-97, 2014

Statistics Anxiety among Diploma in Wood Technology Students at Universiti Teknologi Mara

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Abstract Mathematics performance especially in the statistical field is still an issue among students in higher learning institution. Students have learnt probability topic in the mathematics subject since SPM level, but they have a bad perception towards the statistics subject at higher learning institutions because of their bad experiences before. Therefore, the main focus of this paper is to examine the statistics anxiety level and its association with probability topic. 103 students from the science stream who were studying at one of the public universities in Malaysia were selected. The findings show that there is an association between students' opinion towards probability topic and the four predictors; students' self-confidence, class environment, self-concept and study techniques, with 63.50% of total variation. In addition, it was found that any positive improvement in any of the predictors will lead students to have better opinion towards the probability topic in the statistics course. Thus, the finding of this study is hoped to provide useful information in helping students maximize their potential in statistics courses.

Keywords Class environment; probability topic; self-confidence; self-concept; study techniques.

1 Introduction

In the process of reaching a fully developed country by the year 2020, science, mathematics and information technology have been given emphasis in the education system in Malaysia. Statistics is a subtopic of the mathematics subject at secondary school and will be tested in the Sijil Pelajaran Malaysia (SPM) examination. Moreover, statistics is separated from the mathematics course at higher learning institutions because it contains different theories and techniques that are to be learned in detail and to be applied accordingly in different study programs. In other words, the different study programs will use different theories and applications of statistics based on their needs. Even though the students need to learn the very basic of statistics, most of them still have a bad perception towards this subject (Onwuegbuzie & Wilson, 2003).

Students think that statistics is a tough subject, difficult to learn, very complex to understand especially related to the probability topic (Wiberg, 2009). As stated by Onwuegbuzie and Wilson (2003), students really have a bad perception of this subject, described to be as scary as death. Whatever perception given to it, statistics has to be accepted as a passport to either being able to continue for higher education or a promise to a better future. It is because to have a strong background in this subject is critical for many career and job opportunities. Therefore, statistics is becoming more relevant in many workforces and very useful especially in the decision making process. According to Cobb and Moore (1997), the definition of statistics is "a methodological discipline study of a coherent set of ideas and tools for dealing with data. The focus on variability naturally gives statistics a particular content that sets it apart from mathematics itself and from other mathematical sciences, but there is more than just content that distinguishes statistical thinking and mathematical thinking, because data are not just numbers, they are number with a context".

Looking at the failure rate of Diploma in Wood Technology students at Universiti Teknologi MARA (UiTM) in the course, it is clearly proven that the students' performance in statistics was not good enough since the target indicator was at least 80 percent passes. The marks obtained for the probability topic in the statistics course were very poor. Based on this phenomenon, this study was conducted to overcome the problem by determining the factors affecting students' achievement during the learning process. By

doing this, hopefully this study can help to improve the statistics performance of students not only in UiTM Pahang but in other institutions as well.

2 Statistics Anxiety and Probability

Many studies have been conducted that investigated on statistics anxiety and factors affecting it but they rarely focused on the topic of probability itself. Probability and statistics are related in an important way. Probability is used as a tool to evaluate the reliability of a conclusion about the population when given only sample information. Samples are used because of many constraints such as workforce, time and also budget. Research done by DelMas and Liu (2005) highlighted that probability becomes a problem in the learning process when students are inadequately skilled in rational number concepts and proportional reasoning. It also happened when conceptual conflict occurs between formal probabilistic ideas and everyday experiences. As a result, anxiety in statistics subject may occur among students because as mentioned earlier, probability and statistics are related in important way.

Anxiety is a natural physiological response to the unpleasant feelings experienced when facing a difficult situation. In relation to this study, statistics anxiety is "the feelings of anxiety encountered when taking a statistics course or doing statistical analyses; that is gathering, processing and interpreting data" (Cruise et. al., 1985). In addition, according to Gal and Ginsburg (1994), statistics anxiety is a pervasive problem in the teaching of statistics. Furthermore, Bertha and Alissa (2008) found out that the statistics anxiety level is statistically different between male and female students, but with small effect. Their findings also show that anxiety among male students is affected by fear of asking for help, test and class environment whereas female students' anxiety concerning statistics subject arises due to their class environment. On the other hand, the result obtained by Bui and Alfaro (2011) found no significant gender difference in statistics anxiety level between male and female.

Research conducted by Bologlu (2003) found that the psychological and emotional characteristics of the students' themselves are related to the statistics anxiety. The students' characteristics that were described by him were attitudes, perceptions and also self-concept. To identify the relationship between statistics

anxiety and statistics achievement, a study done by Bell (2001) revealed that there is negative relationship between the two variables. His study continued in the year 2008 which indicated that the international students had major problem with interpretation anxiety, computation self-concept and fear for asking help compared to the domestic students when taking statistical subject. These results are supported by Chew and Dillon (2014) that statistics anxiety had negative correlation with interpretation anxiety, test and class anxiety, and fear of asking for help. Additionally, Mustafa (2003) in his findings stated that older college students experienced more anxiety than younger students even though they showed positive attitudes towards statistics course in class. Also, Zanakis and Valenzi (1997) revealed in their research findings that statistics anxiety among undergraduate's students was influenced by test anxiety and lack of understanding of statistics was the major problem in learning a statistics course.

3 Methodology

3.1 Research Objectives

This study is to examine the anxiety level of statistics and its association with the probability topic. Other than that, it is to find the best fit equation linear regression model for anxiety level of statistics among the students. Figure 1 shows the research framework for this study.

3.2 Participants

All 103 students of Diploma in Wood Technology in Universiti Teknologi MARA participated in the present study whereby 44 (42.7%) of them were female and 59 (57.3%) were male. The results in mathematics subject at SPM level showed that only 12 (11.7%) students scored below C which indicated that these students failed the subject. In addition, their SPM results for the additional mathematics subject were also collected because the probability concept was included in this subject. About 44 (42.7%) students received at least C for the additional mathematics paper.

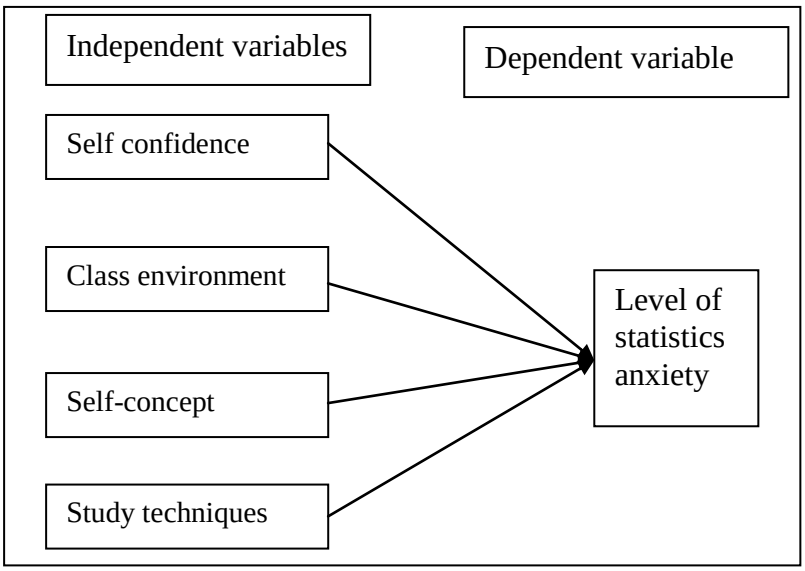

Figure 1: Research Framework

3.3 Instruments

The questionnaire used to collect data comprises various questions to measure the statistics anxiety derived from the SATS-36 of Schau et al. (1995). The questionnaire also includes a set of demographic questions. The questionnaire contains 32-items of positive statements. Responses are made on a 5-point Likert scale that ranges from 1 = *Strongly Agree* to 5 = *Strongly Disagree*. Two parts of the questionnaire were developed to measure statistics anxiety and one part for the probability topic itself. The first part includes four statements that are related to study techniques in statistics; the second part includes 21 items that are related to opinion towards the statistics course and the last part contains seven statements related to opinion about the probability topic. These three parts make up the instrument's five components; self-confidence (ten items), class environment (eight items), self-concept (three items) opinion about probability topic (seven items) and study techniques (four items).

3.4 Procedure

Data were collected during first session of the 2014 academic year for the classes of Statistics and Probability. The Statistical Procedures for Social Sciences (SPSS) 20.0 (SPSS Inc., 2008) was used to code and analyze the data. Firstly, data were tested for the assumptions of parametric statistics and also the reliability tests to signify the consistency of the internal component. The analysis continued with factor analysis whereby the analysis shows that the data were appropriate for factor analysis after KMO and Bartlett's test showed a significance result. Finally, multivariate regression analysis was used to test the relationship between four components as mentioned earlier after satisfying the three assumptions; normality, homogeneity of variances, and linearity.

4 Findings and Discussions

Data show that there are three constructs available in the data which are probability anxiety level, opinion towards probability and study techniques as shown in Table 1. Based on Table 1, the values of KMO for first and second construct are closer to 1.0 and p-value of Bartlett's test is less than 0.05 indicating that the correlation matrix is not an identity matrix, hence the factor analysis is appropriate for these data.

Table 1: KMO and Bartlett's Test

Test	Opinion towards statistics learning	Opinion towards probability	Study techniques
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.903	0.908	0.785
Bartlett's Test of Sphericity (p-value)	0.000	0.000	0.000

Results from performing the principal axis factoring for the 32 items in the three constructs are presented in Table 2. All factor loading values are above the minimum values of 0.6 hence, all items will be included in the analysis. The factor analysis procedure has extracted

five distinct components, as shown in Table 2 based on the eigenvalue greater than 1.0.

Table 2: Rotated Component Matrix

Item	Factor Loading				
	1	2	3	4	5
Component 1: Self confidence					
I can understand statistical reasoning easily	0.858				
I can understand Statistical inference easily	0.898				
I can learn statistics easily	0.781				
I take high marks in statistics	0.760				
Statistics is valuable	0.647				
Statistics makes me overqualified	0.792				
Statistics is part of our daily life	0.639				
Statistics helps me to understand economy	0.655				
I am not afraid of statistics	0.610				
I am willing to buy statistics textbooks	0.622				

Table 2: Rotated Component Matrix (continued)

Item	Factor Loading				
	1	2	3	4	5
Component 2: Class environment					
Statistics helps me to understand politics		0.637			
Statistics helps me to understand reports on the newspaper		0.609			
I am listening to my friend explain statistics formula		0.604			
My friend like learning statistics		0.716			
I am watching my lecturer work on statistics on the board		0.674			
I enjoy learning statistics with my lecturer		0.613			
I enjoy learning statistics in English		0.649			
Component 3: Self concept					
I like learning statistics			0.637		
Statistics is interesting			0.609		
Statistics is not a frustrating subject			0.604		

Table 2: Rotated Component Matrix (continued)

Item	Factor Loading				
	1	2	3	4	5
Component 4: Opinion towards probability					
I enjoy learning probability since secondary school				0.852	
I can understand probability concept easily				0.877	
I can understand probability skills easily				0.892	
I can learn probability easily				0.871	
I can increase myself motivation by learning probability				0.855	
I think probability is simple when I understand its concept				0.814	
Component 5:Study techniques					
I always have a group discussion					0.849
I always make appointment with statistics lecturer					0.733
I do lots of statistics exercises					0.816
I always submit to lecturer to grade the solved questions					0.829

Next, by referring to Table 3, the reliability statistics for all components extracted from factor analysis exceeds the minimum value of 0.6, which shows the internal consistency of the components in the scale. According to Sekaran (2003), reliabilities in the 0.70 range are acceptable and those over 0.80 are good. The reliability analyses are shown in Table 2 where the three constructs are found to have good and acceptable reliabilities.

Table 3: Reliability Statistics

Construct	Component extracted	Number of items in a component	Cronbach's Alpha
Opinion towards statistics learning	Self-confidence	10	0.951
	Class environment	8	0.911
	Self-concept	3	0.782
Opinion towards probability	Opinion towards probability	7	0.941
Study techniques	Study techniques	4	0.822

Table 4: Correlation Analysis

	X_1	X_2	X_3	X_4	Y
X_1	r = 1 N = 103	r = 0.000 p = 1.000 N = 103	r = 0.000 p = 1.000 N = 103	r = 0.453 p = 0.000 N = 103	r = 0.655 p = 0.000 N = 103
X_2	r = 0.000 p = 1.000 N = 103	r = 1 N = 103	r = 0.000 p = 1.000 N = 103	r = 0.266 p = 0.007 N = 103	r = 0.343 p = 0.000 N = 103
X_3	r = 0.000 p = 1.000 N = 103	r = 0.000 p = 1.000 N = 103	r = 1 N = 103	r = 0.106 p = 0.291 N = 103	r = 0.266 p = 0.007 N = 103
X_4	r = 0.453 p = 0.000 N = 103	r = 0.266 p = 0.007 N = 103	r = 0.106 p = 0.291 N = 103	r = 1 N = 103	r = 0.522 p = 0.000 N = 103
Y	r = 0.655 p = 0.000 N = 103	r = 0.343 p = 0.000 N = 103	r = 0.266 p = 0.007 N = 103	r = 0.522 p = 0.000 N = 103	r = 1 N = 103

The correlation analysis in Table 4 reveals that there are moderate positive relationship between opinion towards probability and self-confidence (r = 0.655, p – value = 0.000), opinion towards

probability and study techniques (r = 0.522, p – value = 0.000), as well as study techniques and self-confidence (r = 0.453, p – value = 0.000). However, there are weak positive relationship between opinion towards probability and class environment(r = 0.343, p – value = 0.000) and opinion towards probability and self-concept (r = 0.266, p – value = 0.000). The results suggest regression analysis is appropriate for the next analysis.

In this study, students' opinion towards probability is selected as the dependent variable, (Y) to be predicted by the four independent variables. The regression model obtained can be written as

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon_1$$

where X_1= self-confidence, X_2=class environment, X_3=self-concept, X_4=study techniques and ε_i is the model error which assumed to be normally distributed with constant variance.

Regression analysis results show that the model is significant ($F_{4, 97}$ =42.174, p-value < 0.05) with at least one of the predictors is significant to students' opinion towards probability topic. In addition, the R-square of the model is 0.635, while R-square adjusted is 0.620. This finding indicates that the four predictors can explain 63.50% of the variation of students' opinion towards probability topic. Results also show that all the predictors are significant predictors of students' opinion towards probability topic (p-value < 0.05) as stated in Table 5. The result of two significant predictors; self-confidence and class environment was supported by Bell (2001) and Chew and Dillon (2014) which stated that statistics anxiety is influenced by class anxiety and fear of asking help. Even though the predictors named differ, but not for its meaning. Students learned probability based on four different factors; self-confidence, class environment, self-concept and their own study techniques that will contribute indirectly to feelings of anxiety towards statistics subject.

Table 5: Analysis of Variance

Model	Sum of Squares	df	Mean Squares	F
Regression	64.746	4	16.187	42.174
Residual	37.229	97	0.384	
Total	101.975	101		

In addition, Table 6 shows the result of collinearity test in which the results obtained can conclude that there is no multicollinearity that exist since the value of tolerance (Tol) for each predictor is greater than 0.1 (VIF < 10). Therefore, the results indicate that the greater the level of self-confidence, the greater the tendency for the students to have positive opinion towards probability topic. An improvement on study techniques and source of knowledge will increase students' opinion towards probability topic, and also a positive self-concept will lead to a better opinion towards that topic too.

Table 6: Regression Analysis

Model	Coefficient	Beta	t	p-value	Collinearity Statistics	
					Tol	VIF
Constant	0.000		-0.10	0.992		
X_1	0.604	0.601	8.575	0.000	0.766	1.305
X_2	0.291	0.290	4.514	0.000	0.915	1.093
X_3	0.235	0.234	3.790	0.000	0.988	1.012
X_4	0.151	0.150	2.057	0.042	0.709	1.411

The estimated regression model can be written as

$$Y = 0.604X_1 + 0.291X_2 + 0.235X_3 + 0.151X_4$$

5 Conclusion

This study represents an effort to examine the statistics anxiety by measuring probability anxiety level among students in higher learning institution based on four different factors; self-confidence, class environment, self-concept and study techniques. Precisely, the objective of this study is to obtain the best regression model that

describes all the factors affecting opinion towards the probability topic. Results found that the model gathered was significant and all the factors were also significant. Therefore, the results indicate that high self-confidence, improvement in study techniques and class environment, and more positive self-concept, make the students tend to have positive or increased or better opinion towards probability topic. The results highlight the importance and implication of statistics anxiety in academic perspective.

Hence in order to change students' negative perception towards statistics to a positive attitude, more attention must be given to the students by doing a treatment on statistics anxiety so that students would be able to control their mind. In addition, process of skill development and self-improvement strategies to enhance self-concept of students are identified as being more effective and efficient. Students are suggested to be exposed to statistics workshops and motivational camps specifically for probability subject to reduce statistics anxiety. Future studies may emphasize in terms of reducing statistics anxiety from the early stage at primary or secondary school as a possible preventive measure to reduce the level of severe statistical anxiety. Thus, this study is hoped to provide some useful information to those involved in improving the statistics performance in higher level institution.

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