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Undergraduate Students' Profile based on Attitudes towards Statistics

Rosnalini Mansor[1*], Bahtiar Jamili Zaini[1], Zahayu Md Yusof[1,2], Darmesah Gabda[3] and Wendy Wong[1]

[1]*School of Quantitative Sciences, Universiti Utara Malaysia, 06010 UUM Sintok, Kedah, Malaysia*
[2]*Institute of Strategic Industrial Decision Science Modeling (ISIDM), School of Quantitative Sciences, Universiti Utara Malaysia, 06010 UUM Sintok, Kedah, Malaysia*
[3]*Fakulti Sains dan Sumber Alam, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu Sabah*

The purpose of this study was to investigate students' profiles based on their attitudes towards statistics in Universiti Utara Malaysia. This study adopted a quantitative survey design. The questionnaireswere administered on a sample of 274. The Stratified sampling method was used to generate the sample. The methodologies used were descriptive statistics, factor analysis and statistical test to compare between demographic factors such as gender, race, and qualification. Findings revealed that seven factors that explain the attitude of the students were self-determination, cognitive competence, effort, a value of statistics in professional life, difficulty, statistical solving and value of statistics in everyday life. The results of the descriptive statistical analyses found that students have a positive attitude towards statistics. The finding suggested that statistics should be revealedmore practicallytodeveloping a more positive attitude towards statistics can further promote the learning process and students' ability to apply the concepts.

Keywords: Attitude, Statistics, Undergraduate

I. INTRODUCTION

Attitudes have extensively studied in educational and psychological fields (Cashin & Elmore, 2005; Coetzee & van der Merwe, 2010). There are many definitions of attitude towards statistics from the past study. Attitudes towards statistics refer to the learned cognitive, affective, and behavioural predispositions to respond to any behaviour to the field of statistics (Ramirez *et. al.*, 2012). Attitude toward statistics also defined as "a disposition to respond favourably or unfavourably to the objects, situations, or people related to statistics learning" (Chiese & Primi, 2009).

Many statistics instructors believe that attitudes towards statistics are the main factor in the learning process. Students' attitudes towards statistics need to be paid more attention because these positive attitudes are important in their learning and establishment a lifelong implication (Griffith, *et. al.*, 2012; Mahmud, 2009). Therefore, understanding student attitudes towards statistics are essential because it will influence the learning process, especially students' ability to apply statistics and mathematics courses in everyday life.

Student achievement and motivation in their statistic courses may be affected by their attitudes towards statistics. However, education level and socio-demographic background may lead us to a different result of students' attitudes. Although some past studiesconducted on the attitudes of the students, their studies not attention to the differences in the students' background. Most of the past studies only compared the gender and age. For instance, Krishnan & Idris (2015) and Coetzee & van der Merwe (2010) reported that male students displayed a more positive attitude toward statistics compared to female students. While for the age characteristic, older students perceived statistics to be less tough than younger students and also displayed slightly more positive attitudes towards statistics (Coetzee & van der Merwe, 2010.

*Corresponding author's e-mail: rosnalini@uum.edu.my

In Universiti Utara Malaysia (UUM), most of the undergraduate students are required to take SQQS1013 Elementary Statistics course for many major programs. The syllabus involves fundamental concepts and techniques including descriptive statistics, probability and some distributions. Many students who may have no prior or experiences with statistics need to take this course. Therefore, it is certainly that students may have anxiety and negative feelings about statistics. Students' attitudes have a great effect on their persistence in completing their statistics course, the results of their achievement and their choices to enrol in additional statistics courses. Therefore, the objective of this study was to investigate students' profiles based on their attitudes towards statistics.

II. METHODOLOGY

A. Instrument Design

This study conducted using a survey design. The primary data for this study was collected through a paper questionnaire. Therefore, questionnaires were distributed to respondents to obtain information regarding students' attitudes. The questionnaires used for this study are developed by Schau(2003) using Survey of Attitudes towards Statistics (SATS-36). This SATS were assessed using 36 items with a 7-point scale ranging from "1 - strongly disagree" to "7 - strongly agree".

B. Data Collection

The population for this study was the non-science quantitative undergraduate students of Elementary Statistics course with the total population comprised of 962 students. These students from different undergraduate programs, ethnic and religious, gender and age group.

Stratified sampling method was used to select sample students. Since there were a total of 18 classes for Elementary Statistics course with different class size ranged at 41-57 students. Therefore 18 classes considered as strata. These 18 strata were classified as Group A until Group R. Next, in order to make the proportion of the sample students in 18 strata the same as the proportion of population members in the stratum, the sample size for the j^{th} stratum using proportional allocation was

$$n_j = \frac{N_j}{N} \times n$$

Finally, students were randomly selected from each of the strata to make a sample size of total 274.

C. Method of Data Analysis

The descriptive analysis describes the respondent's characteristics according to their gender, race and qualification based on frequencies and percentages. Furthermore, the attitudes of the students towards statistics also can be described based on their mean values.

The internal consistency of the questionnaire was tested using Cronbach's alpha. Statistical Package for the Social Sciences (IBM SPSS) was used to run the analysis. The internal consistency is acceptable if the Cronbach's alpha value is higher than 0.7 (Blunch, 2008). Cronbach alpha also showed the reliability of the questionnaire.

Factor analysis is a statistical method used to identify latent constructs or unobservable factors and used to reduce variables into a smaller set to simplify the factor interpretations (Yong, A. G., & Sean Pearce, 2013). In this study, extracted principal components method with varimax rotation was used to determine the number of indicators that make up each of the factors to explain the attitude of the students towards statistics. Statistical test like *t*-test and Analysis of Variance (ANOVA) test had been used to compare the attitude difference on the demographic factors on latent factors that were explaining student's attitude towards statistics.

III. RESULTS

Table 1. Factor Solution on Students' Attitude towards Statistics

Factor	Description	Factor Loading	Variance (%)
[F1] Self-	I like statistics	0.676	17.846
Determination	I enjoy taking statistics courses	0.601	
(α = 0.924)	I can learn statistics	0.588	
	I understand statistics equation	0.539	
	Statistics should be a required part of my study	0.609	
	Statistical skills will make me more employable	0.533	
	Statistics formulas are easy to understand	0.689	
	Statistics is a subject quickly learned by most people	0.55	
	I am interested in being able to communicate statistical information to others	0.741	
	I am interested in using statistics	0.818	
	I am interested in understanding statistical information	0.805	
	I am interested in learning statistics	0.82	
[F2] Cognitive	I stress during statistics class	0.621	11.999
Complete	I am scared by statistics	0.689	
(α = 0.859)	I have trouble understanding statistics because of how I think	0.762	
	I have no idea of what's going on in this statistics course.	0.736	
	I make a lot of math errors in statistics	0.735	
	I find it difficult to understand statistical concepts	0.517	
[F3] Effort	I plan to complete all of my statistics assignments	0.724	9.48
(α= 0.889)	I plan to work hard in my statistics course	0.817	
	I plan to study hard for every statistics test	0.867	
	I plan to attend every statistics class session	0.838	
[F4] Value of	Statistics is worthless.	0.592	7.933
statistics in			
professional	Statistics is not useful in my study	0.742	
life	Statistical thinking is not applicable in my life outside my job	0.744	
(α= 0.750)	I will have no application for statistics in my profession	0.402	
	Statistics is irrelevant in my life	0.53	
[F5] Difficulty	Statistics is a complicated subject	0.474	7.658
(α = 0.764)	Learning statistics requires a great deal of discipline	0.69	
	Statistics involves massive computations	0.816	
	Statistics is highly technical	0.804	
	Most people have to learn a new way of thinking to do statistics	0.698	
[F6] Statistical	I feel insecure when I have to solve statistics problem	0.772	4.631
(α = 0.632)	I get frustrated going over statistics tests in class	0.614	
[F7] Value of	I use statistics in my everyday life	0.762	4.034
statistics in everyday life	Statistics conclusions are rarely presented in everyday life	0.783	

A. The Latent Factors behind Students' Attitudes towards Statistics.

Factor analysis was applied to identify and revealed the latent factors behind students' attitude toward statistics. To determine the appropriateness of factor analysis, sampling adequacy measured for this dataset. We used Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO). The analysis shows that the measure of sampling adequacy Kaiser-Meyer-Olkin (KMO) was 0.899 and the result value of Bartlett's test of sphericity showed significant value where the *p*-value of Bartlett's test less than 0.05 indicating that the sample and correlation matrix were appropriate. Hence, factor analysis was appropriate for the data.

This factor analysis was performed using the Varimax rotation method with Kaiser Normalization to identify seven factors. The sevenfactors are self-determination, cognitive competence, effort, value, difficulty, statistical solving, and the last factor is the value of statistics in everyday life. All seven factors had a high ranking for reliability except for statistical solving and value of statistics in everyday life with 0.632 and 0.526, respectively as shown in Table 1.

B. Descriptive Statistics of Latent Factors behind Students' Attitudes towards Statistics.

After examined the factor that explained the attitude of students towards statistics, the analysis of students' profiles was done using descriptive statistics. According to Faustino, Zalena and Aaron (2013) and Zamalia Mahmud (2012), mean calibration for negative attitude was determined as 1.00 until 3.49, neutral attitude as 3.50 until 4.49 and positive attitude determined as 4.50 until 7.00.

Table 2 provides the mean score for attitudes of the students towards statistics based on the factors extracted. Overall, the attitude of the students towards statistics was positive with the mean of 4.45 and standard deviation of 0.564. Even though the mean almost reached the cut-off value of 4.50 for a positive attitude, but the results do not indicate that there is a strong positive attitude towards statistics. The students also show a positive attitude on the different factor extracted from factor analysis. Studentstend to have a more positive attitude on self-determination (5.695), followed by Value of statistics in professional life (4.983), cognitive complete (4.763), and effort (4.591). While there was also a negative attitude on the factor difficulty with the mean of 3.435, followed by statistical solving (3.840), and the value of statistics in every life (3.954). the results indicated that the students perceived statistics as a difficult subject.

Table 2. Overall Students' Attitude towards Statistics.

	Mean	Std. Deviation
F1 Self-determination	5.695	1.002
F2 Cognitive Complete	4.763	0.980
F3 Effort	4.591	1.122
F4 Value of statistics in professional life	4.893	1.024
F5 Difficulty	3.435	0.894
F6 Statistical solving	3.840	1.217
F7 Value of statistics in everyday life	3.954	0.777
Overall	4.45	0.564

C. Statistical Test Regarding Students' Attitudes towards Statistics Related to Their Profile

The mean difference on the students' profile that explaining students' attitude towards statistics were tested using independent sample *t*-test and ANOVA tests. Students' attitudes towards statistics were compared by gender using independent sample *t*-test, since the normality assumption were accepted based on the skewness coefficient which ranged between -0.872 to 0.833.

One of the critical assumptions of one-way ANOVA is homogeneity of variance among groups and violation of this assumption can influence hypothesis testing. Students' attitudes towards statistics were compared by races and qualifications using one-way ANOVA test, since the *p*-value

in *Levene*-test for homogeneity of variance test were greater than significant value, 0.01.

Table 3 shows the results of the mean score of students' attitudes towards statistics as a consideration with the demographic profile of students with the variables gender. The results indicated that female students have a positive attitude towards statistics with mean of 4.4953 as compared to male students with mean of 4.2735.

Table 3. Students' Attitudes towards Statistics between Genders

	Gender	N	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Overall	Male	52	4.2735	.60997	-2.577	272	**.010**
	Female	222	4.4953	.54624			
F1 Self-determination	Male	52	4.5625	1.00474	-1.639	272	.102
	Female	222	4.8093	.97104			
F2 Cognitive Complete	Male	52	4.2212	1.26056	-2.673	272	**.008**
	Female	222	4.6779	1.07148			
F3 Effort	Male	52	5.5385	.97063	-1.255	272	.211
	Female	222	5.7320	1.00801			
F4 Value of statistics in professional life	Male	52	4.5462	1.24561	-2.748	272	**.006**
	Female	222	4.9748	.95059			
F5 Difficulty	Male	52	3.4692	1.12851	.293	272	.770
	Female	222	3.4288	.83274			
F6 Statistical solving	Male	52	3.8173	1.12472	-.145	272	.885
	Female	222	3.8446	1.23923			
F7 Value of statistics in everyday life	Male	52	3.7596	.87722	-2.020	272	**.044**
	Female	222	4.0000	.74603			

Table 3 also shows the results comparing between genders for all the seven factors. The results revealed that there was a significant mean difference between male and femalefor Factor 2, Factor 4, and Factor 7, with all the *p*-values are smaller than 0.05. Based on the mean score for male and female in Table 3, the mean score for female was higher than male in both cognitive competences, the value of statistics in professional life and value of statistics in everyday life. These results showed that female students have more positive perceptions of their intellectual knowledge and skills when applies to statistic and have more positive attitude about the usefulness, relevance and worth of statistics in professional life and every life compared to male students. However, there was no statistically significant difference between the male and female for Factor 1, Factor 2, Factor 5, and Factor 6. All of these factors had the *p*-values which are larger than 0.05.

Table 4 shows the results of the mean score of students' attitudes towards statistics with their race. The results indicated that Indian students have a positive attitude towards statistics with mean 4.8233 as compared to other races. Chinese students only have a moderate attitude (4.4868), followed by Malay students (4.4555), foreigner students (4.2893) and other students (3.99). The results revealed that there was a significant mean difference between races with *p*-value = 0.018. Results based on the seven factors among the undergraduate students with races showed that only cognitive competence factor (Factor 2) and difficulty (Factor 5) are statistically significant with *p*-values 0 .048 and 0.024, respectively. Other factors did not show any significant difference.

Table 5 showed the results of the mean score of students' attitudes towards statistics as a consideration with the qualification before entering the university. The results indicated that there was a significant mean difference between qualification with *p*-value = 0.000. Students from matriculation showa more positive attitude towards statistics with mean 4.6181 as compared to other qualifications. Results based on the seven factors among the undergraduate students with qualification showed that only factors self-determination, cognitive competence, effort and value of

statistics in professional life are statistically significant with all *p*-values less than 0.05.

Table 4: Students' Attitudes towards Statistics between Races

		N	Mean	Std. Deviation	F	Sig.
Overall	Malay	191	4.4555	0.49801	**3.044**	**0.018**
	Chinese	59	4.4868	0.65357		
	Indian	9	4.8233	0.66575		
	Others	11	3.99	0.80028		
	Foreigner	4	4.2893	0.67721		
	Total	274	4.4532	0.56449		
F1 Self-determination	Malay	191	4.8041	0.93845	2.115	0.079
	Chinese	59	4.6412	0.9612		
	Indian	9	5.3148	0.97252		
	Others	11	4.1667	1.39742		
	Foreigner	4	4.9583	1.46329		
	Total	274	4.7625	0.98046		
F2 Cognitive Complete	Malay	191	4.5585	1.02566	**2.425**	**0.048**
	Chinese	59	4.7599	1.27091		
	Indian	9	5.2037	1.09854		
	Others	11	3.8182	1.34465		
	Foreigner	4	4.4167	1.85343		
	Total	274	4.5912	1.1218		
F3 Effort	Malay	191	5.7382	0.96732	1.006	0.405
	Chinese	59	5.5254	1.09633		
	Indian	9	5.8889	1.11181		
	Others	11	5.5	1.09545		
	Foreigner	4	6.25	0.5		
	Total	274	5.6953	1.00216		
F4 Value of statistics in professional life	Malay	191	4.9791	0.97137	2.37	0.053
	Chinese	59	4.7322	0.99697		
	Indian	9	5.1556	1.26403		
	Others	11	4.1636	1.54355		
	Foreigner	4	4.6	1.04563		
	Total	274	4.8934	1.02455		
F5 Difficulty	Malay	191	3.355	0.85067	**2.85**	**0.024**
	Chinese	59	3.7492	1.02291		
	Indian	9	3.5333	0.64807		
	Others	11	3.3273	0.776		
	Foreigner	4	2.8	0.78316		
	Total	274	3.4365	0.89417		
F6 Statistical solving	Malay	191	3.7749	1.14666	1.797	0.13
	Chinese	59	4.0169	1.36447		
	Indian	9	4.6111	1.21906		
	Others	11	3.6364	0.97701		
	Foreigner	4	3.125	2.17466		
	Total	274	3.8394	1.21639		
F7 Value of statistics in everyday life	Malay	191	3.9791	0.69742	1.991	0.096
	Chinese	59	3.9831	0.91899		
	Indian	9	4.0556	0.68211		
	Others	11	3.3182	1.18896		
	Foreigner	4	3.875	0.47871		
	Total	274	3.9544	0.77667		

Based on the score mean for qualification in Table 5, the mean for Matriculation was the highest for self-determination, cognitive competence, effort and values of statistics in professional life. This show that students with Matriculation qualification having a more positive attitude on self-determination, cognitive competence, effort and value of statistics in professional life compared with the other qualification.

Table 5: Attitudes of the Students toward Statistics by qualifications

		N	Mean	Std. Deviation	F	Sig.
Overall	STPM	94	4.4283	0.56431	9.222	**0**
	Matriculation	100	4.6181	0.47845		
	Diploma	51	4.4176	0.5646		
	Other	29	4.028	0.61787		
	Total	274	4.4532	0.56449		
F1 Self-determination	STPM	94	4.57	0.98148	10.538	**0**
	Matriculation	100	5.105	0.80522		
	Diploma	51	4.8137	0.97119		
	Other	29	4.1149	1.10181		
	Total	274	4.7625	0.98046		
F2 Cognitive Complete	STPM	94	4.5762	1.08445	8.999	**0**
	Matriculation	100	4.9033	0.93988		
	Diploma	51	4.4902	1.16305		
	Other	29	3.7414	1.30748		
	Total	274	4.5912	1.1218		
F3 Effort	STPM	94	5.5957	1.10114	2.983	**0.032**
	Matriculation	100	5.9225	0.76185		
	Diploma	51	5.4706	1.1064		
	Other	29	5.6293	1.10118		
	Total	274	5.6953	1.00216		
F4 Value of statistics in professional life	STPM	94	4.7638	1.02442	5.219	**0.002**
	Matriculation	100	5.166	0.95221		
	Diploma	51	4.8706	0.99263		
	Other	29	4.4138	1.10574		
	Total	274	4.8934	1.02455		
F5 Difficulty	STPM	94	3.5298	0.98971	1.288	0.279
	Matriculation	100	3.44	0.85706		
	Diploma	51	3.4157	0.78673		
	Other	29	3.1586	0.8542		
	Total	274	3.4365	0.89417		
F6 Statistical solving	STPM	94	4.0532	1.22796	2.126	0.097
	Matriculation	100	3.765	1.13363		
	Diploma	51	3.8137	1.36734		
	Other	29	3.4483	1.09662		
	Total	274	3.8394	1.21639		
F7 Value of statistics in everyday life	STPM	94	3.9096	0.69546	1.77	0.153
	Matriculation	100	4.025	0.839		
	Diploma	51	4.049	0.73658		
	Other	29	3.6897	0.83894		
	Total	274	3.9544	0.77667		

IV. CONCLUSIONS

Factor analysis extracted seven underlying factors for the attitudes of students towards statistics. The seven factors were self-determination, cognitive competence, effort, the value of statistics in professional life, difficulty, statistical solving and value of statistics in everyday life. Overall, there was a positive attitude among undergraduate students towards statistics. Regarding the gender impact, female students and male students held a relatively similar positive attitude towards statistics. However, female students tend to have a more positive attitude towards statistics compared to male students. Female students have more positive perceptions of their intellectual knowledge and skills when applies to statistic and had a more positive attitude about the usefulness, relevance and worth of statistics in professional life compared to male students. When comparing between races, only Indian student have a positive attitude towards statistics, while other races only have moderate attitude. Meanwhile, student with Matriculation qualification tends to have more positive attitude towards statistics.

The results of this study can be used by teachers and lectures or any instructors to improve students' attitudes toward statistics. Improving students' attitudes toward statistics has been shown to have a direct positive effect on the statistics learning process. Furthermore, the findings can disclose educators and students on the attitudes of students towards statistics. Moreover, learning or qualification acquired from previous experience in the mathematics and statistics subject can influence the attitude of students towards statistics. Hence, it is vital to understand the qualification and knowledge of students to develop an interesting plan to improve their feeling and attitude towards statistics.

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