Using Factor Analysis on Survey Study of Factors Affecting Students' Learning Styles

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***Abstract*—** This study focused on the statistical technique using the factor analysis on constructing the new factors affecting students' learning styles of the survey done among university students. In addition, comparison means using the Kruskal-Wallis test were done to analyze the demographic differences on the new factors affecting students' learning styles. The data were collected using survey questionnaires. The number of respondents was 189 students. The methodologies used were descriptive statistics, factor analysis and non-parametric technique using the Kruskal-Wallis test. The results showed seven new factors were successfully constructed using factor analysis and assigned as the factors affecting the learning styles; which are 1) students' attitude before and after attending class, 2) strategies used to comprehend the lecture, 3) the importance of lecture, 4) class size and its condition, 5) efforts outside class, 6) classroom convenient and 7) importance on listening to lecture. The Kruskal-Wallis test results showed there was a significant mean difference between gender on students' efforts outside class (factor 5) while there was no significant mean difference between genders on the other factors of students' learning style. As for years of study, Kruskal-Wallis test showed that students' attitude before and after attending class influenced learning style. The result from Kruskal-Wallis test showed different in score for science and non-science stream students. Non-science students have a better comprehend strategy as their field could be practiced outside classroom and do not merely based on theory. On the other hand, science students satisfy with their class size and its condition as compared to non-science students. The result shows that CGPA is only influenced by the importance of class size and its condition and the importance of lecture. Students with CGPA 2.00-2.49 indicated that attending lecture is crucial and satisfy with classroom size and its condition as compared to students with other group of CGPA.

***Keywords*—** Factor analysis, Demographic factors, Learning styles, Kruskal-Wallis

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I. Introduction

SOME research shows that the students learning activities in higher education were influence by a lot of factors since at school level. These covers from the quality of the teacher, textbooks, time on-task, and the facilities in school to the teaching aid kit and technology (Wright *et al.* [1], Lubben *et al.* [2]). Therefore, at higher education level which focusing on bridging programmes to minimize the gap between school and degree programme, the foundation courses to strengthening conceptual and academy, as well as extending curriculum programme are essential (Lubben *et al.*, [2]). These would give the students fitting environment for adjustment in term of social and emotional gap which have been confirm by Sennet *et al.* [3] and Mann [4]. In their study, they found that grade levels and student achievement highly correlate with their level of adjustment in University.

Lubben *et al.* [2] stated that as the student continue in their study in the university, academic workload, career aspirations, financial difficulties, family issues, attitude to being part of an access programme become the reasons for some of the student to drop out from university.

In Malaysia, students' academic excellence is very much valued as most parents assume that their child's academic success would guarantee a life success. It is because having a good qualification will ensure them to get a good job with a high remuneration. This is parallel with Hussein [5] that having academic excellence is correlated with good life. Based on that, students are expected to have a good academic excellence as a failure to have might lead to other problems such as high rate unemployment rate and low socio economic income.

Hence, it is significant to study and divulge factors affecting students' learning styles which may influence students' academic performance. This study used factor analysis to analyze the factors affecting students' learning styles. In addition, comparison means using the Kruskal-Wallis test were

done to analyze the demographic differences on the new factors affecting students' learning styles.

II. Literature Review

Chen [6] investigated the relationships among self-directed learning, learning styles, learning strategies, and learning achievement in English courses by insurance finance students. Amongst the three factors, Chen [6] found that learning styles had influence students' learning strategies; however, learning styles did not have significant effect to students' learning achievement. Due to some limitations this result presented the Taiwanese experiences but did not reflect the global population.

Kim [7] stated that understanding student' learning style is important as this will ensure that whatever learning environment created by instructors or teachers matches with students' needs and preferences. Hence, it will maximize students' performance.

Bontchev and Vassileva [8] accessed the adaptive courseware delivery and provide results of a study that examining the preference of students to various types of educational contents such tasks, projects, essays, games and intermediate tests according to their learning styles. Bontchev and Vassileva [8] used ADOPTA (ADaptive techn0logy-enhanced Recent Researches in Educational Technologies) platform to design and deliver the adaptive-learning platform to 42 students of Faculty of Mathematics and Informatics at Sofia University, Bulgaria. It showed that adaptive learning gave more appealing and efficient result, however, with the complete assessment there were four preferences of learners provided those were activist, reflector, theorist and pragmatist. Moreover, a strong dependency of the learning objects and learning styles had been revealed.

A study conducted by Prepelita-Raileanu [9] in Polytechnic University of Bucharest, Romania focused on introducing ICT in education system as new learning environment. In Romania, technical universities and the traditional school model coexist; hence, ICT was used to create harmonization in knowledge and standardization of competencies. The result from the multidisciplinary survey shows that ICT integration has a profound impact on the learning environment.

Dunn and Dunn [10] suggested that it is not fair if one learning style such as study in a group was forced to all students. This is because it can reduce the student performance that has preference on other learning style.

Ayersman [11] stated that findings found in books and journals showed that if learning environments are carefully planned and includes the learning styles, then the academic performance will increase. Dyver [12] reported that in whatever the learning environments, the process should be planned by focusing on the inviduals preference learning styles. Bigss *et al*. [13] illustrated students' learning activities and experience influences their learning process.

Comeaux [14] suggested that academic performance was affected by the facilities provided by the faculty in a college. Students with learning facilities had better academic performance compared to others. In his study, there was a positive correlation between students' academic performance with the environment facilities provided by his faculty.

Davidson [15] reported that learning style correlates with the learning outcome and student's academic performance. According to Hussein [5], academic excellence is students' achievements which are based from university's assessments such as test, assignments, presentation, final exam and etc.

A research between students' hobby and attitude towards learning Arab language was done to university undergraduate students who studied Arab language [16]. The findings showed that students' attitude and hobby towards studying Arab language were very importance in determining the students' successfulness. This shows that attitude towards study influences the students' academic performance.

III. Materials and Method

The data were collected using a survey form which was distributed randomly. SPSS was used to perform statistical analysis of the data collected from the survey forms. The methodologies used were descriptive statistics, reliability analysis, factor analysis and non-parametric technique using the Kruskal-Wallis test.

McClave *et al.* [17] defined descriptive statistics utilizes numerical and graphical methods to look for patterns in a data set, to summarize the information revealed in a data set, and to present the information in a convenient form.

Altman *et al.* [18] stated that pilot study was a small experiment done to test the logic and to improve the information quality and efficiency collected from big study. Coakes and Ong [19] suggested that reliability analysis was used to determine the internal consistency of the scales using Cronbach's Alpha. The formula as stated by Fraenkel and Wallen [20]:

$$r_{kk} = \left(\frac{k}{k-1}\right).\left(1-\frac{{s_i}^2}{{s_x}^2}\right) \quad (1)$$

where:

r_{kk} = estimated Cronbach Alpha coefficient value

k = number of items in the questionnare

${s_i}^2$ = sum of item variances

${s_x}^2$ = factor variances

Chua [21] suggested that factor analysis is the procedure which always been used by the researchers to organize, identify and minimize big items from the questionnaire to certain constructs under one dependent variable in a research. KMO test was done to identify whether the data is suitable for factor analysis. The KMO test formula as stated by Norusis [22] is:

$$\text{KMO} = \frac{\sum_{j=1}^{n} \sum_{i=1}^{n} r_{ij}^2}{\left(\sum_{j=1}^{n} \sum_{i=1}^{n} r_{ij}^2 + \sum_{j=1}^{n} \sum_{i=1}^{n} a_{ij}^2\right)} \quad (2)$$

where:

r_{ij} = Correlation coefficient

a_{ij} = Partial correlation coefficient

The factor analysis model as stated by Johnson and Wichern in [23] is:

$$\begin{aligned} X_1 - \mu_1 &= \ell_{11}F_1 + \ell_{12}F_2 + \cdots + \ell_{1m}F_m + \varepsilon_1 \\ X_2 - \mu_2 &= \ell_{21}F_1 + \ell_{22}F_2 + \cdots + \ell_{2m}F_m + \varepsilon_2 \\ &\vdots \qquad\qquad\qquad\qquad \vdots \\ X_p - \mu_p &= \ell_{p1}F_1 + \ell_{p2}F_2 + \cdots + \ell_{pm}F_m + \varepsilon_p \end{aligned} \quad (3)$$

Johnson and Wichern in [23] stated the orthogonal factor model with *m* common factors as follows:

$$\underset{(pX1)}{X} = \underset{(pX1)}{\mu} + \underset{(pXm)}{L}\ \underset{(mXm)}{F} + \underset{(pX1)}{\varepsilon} \quad (4)$$

where:

μ_i = mean of variable *i*

ε_i = *i*th specific factor

F_j = *j*th common factor

ℓ_{ij} = loading of the *i*th variable on the *j*th factor

Johnson and Wichern in [23] also estimated the communalities as

$$\tilde{h}_i^2 = \tilde{\ell}_{i1}^2 + \tilde{\ell}_{i2}^2 + \cdots + \tilde{\ell}_{im}^2 \quad (5)$$

The principal component factor analysis of the sample covariance matrix S is specified in terms of its eigenvalue-eigenvector pairs $(\hat{\lambda}_1, \hat{e}_1), (\hat{\lambda}_2, \hat{e}_2), \cdots, (\hat{\lambda}_p, \hat{e}_p)$, where $(\hat{\lambda}_1 \geq \hat{\lambda}_2 \geq \cdots \geq \hat{\lambda}_p)$. Let $m < p$ be the number of common factors. Then the matrix of estimated factor loadings $\{\tilde{\ell} i_j\}$ is given by

$$\tilde{L} = \left[\sqrt{\hat{\lambda}_1}\hat{e}_1 \vdots \sqrt{\hat{\lambda}_2}\hat{e}_2 \vdots \cdots \vdots \sqrt{\hat{\lambda}_m}\hat{e}_m\right] \quad (6)$$

Johnson and Wichern in [23] stated that the estimated specific variances are provided by the diagonal elements of the matrix $S - \tilde{L}\tilde{L}'$, so

$$\tilde{\psi} = \begin{bmatrix} \tilde{\psi}_1 & 0 & \cdots & 0 \\ 0 & \tilde{\psi}_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \tilde{\psi}_p \end{bmatrix} \text{ with } \hat{\psi}_i = s_{ii} - \sum_{j=1}^{m} \tilde{\ell}_{ij}^2 \quad (7)$$

Carver and Nash [24] stated the Kruskal-Wallis H test is the nonparametric version of the one factor independent measures ANOVA. Newbold *et al.* [25] defined Kruskal-Wallis test statistic as:

Let $n = n_1 + n_2 + \cdots + n_k$

$$W = \frac{12}{n(n+1)} \sum_{i=1}^{K} \frac{R_i^2}{n_i} - 3(n+1) \quad (8)$$

where,

K = number of groups derived after forming the class

n_i = sampel size

N = total of sampel size

R_i = total of stages for sampel

IV. Results

The number of respondents who participated in this study was 189 students. The collected data was significant because it was distributed to quite a big sample size. The minimum sample size suggested by [19] was five for one variable, in addition, a one hundred sample size is acceptable, and however a sample size more than two hundred is much more acceptable to fulfill the factor analysis.

The results are divided to several subsections which are descriptive statistics, reliability analysis, factor analysis and non-parametric technique using the Kruskal-Wallis test.

A. Descriptive Statistics

Descriptive Statistics that was discussed in this work was the frequency and percentages of profiles of respondents among the students. Table 1 illustrates the demographic profiles of respondents according to variable gender, age, years of study, stream and CGPA respectively.

According to their gender, 69.3% of the respondents are female and 30.7% are male. According to variable age, the respondents' age range between 19 to 28 years old. Most of the respondents are 21, 22 and 23years old, respectively with 24.9%, 25.4% and 22.2%.

Most of respondents consist of first year students as much as 78 respondents. While the second year students are 47 people and third year students are as many as 51 people. Least total respondents are fourth year students as many as 13 people.

Respondents who take Mathematics with Economics is the highest, as many as 31 people. Least respondent, which is only 1 respectively from Mathematics with Computer Graphics, Social Work, Creative Writing, Sport Science, Economic Plan and Development, Mechanical Engineering, Network and Management System, Nursing, Forest Management, Geography, History, Chemical Industry, International Affairs, Aquaculture, Forest Plantation, and Biotechnology. Meanwhile, there were 4 respondents from each of these programs, Hotel Management, Human Resource Economics, Geology, Education with Science, and Education with Social Science. As many as 9 people from Creative Art, Chemical Engineering, Food Science, Computer Science, Food Technology and Bio-process and Physic and

Electronics. There are 7 respondents from Child and Family Psychology and Medical. About 10 respondents are from Counseling and 6 respondents correspondingly from Entrepreneurship, Industrial and Organizational Psychology, TESL and International Business. As many as 2 people are respectively from Financial Economics, Electrical and Electronic Engineering, Computer Engineering, Industrial Affairs and Marine Science. There are 5 respondents respectively from Banking Management and Finance, Civil Engineering, 11 respondents from Environmental Science and 15 respondents from Sociology and Anthropology.

Amongst the respondents, 54 are from School of Science and Technology, 29 from School of Business and Economics, 26 from School of Psychology and Social Work, 16 from School of Engineering and Information Technology, 15 from School of Education and Social Development, 8 from School of Medicine, 6 from School of Food Science and Nutrition, 4 from School Of Arts Studies, and last but not least 2 from School of International Tropical Forestry.

There are 46 disciplines which can be divided into two major streams that are science and non-science. Respondents from Science stream were 89 and non-Science stream were 100 respondents.

The respondents' CGPA has been divided into four categories between 3.50-4.00, 3.00-3.49, 2.50-2.99 and 2.00-2.49. According to the respondents' CGPA as much as 14 students belong to the first category 3.50-4.00, 78 students are in category 3.00-3.49, 75 students in 2.50-2.99 and 22 students in category 2.00-2.49.

Table 1. Profiles of the respondent

Demographic factor		Frequency	Percentage
Gender	Male	58	30.7
	Female	131	69.3
Age	19 years old	8	4.2
	20 years old	31	16.4
	21 years old	47	24.9
	22 years old	48	25.4
	23 years old	42	22.2
	24 years old	9	4.8
	25 years old	2	1.1
	26 years old	1	0.5
	28 years old	1	0.5
Years of study	1	78	41.3
	2	47	24.9
	3	51	27.0
	4	13	6.9
Stream	Science	89	47.1
	Non-Science	100	52.9
CGPA	3.50-4.00	14	7.4
	3.00-3.49	78	41.3
	2.50-2.99	75	39.7
	2.00-2.49	22	11.6

B. Reliability Analysis

In this study, the main focus is to look at the factors that affecting students' learning style among the undergraduate students. The reliability analysis result showed that the Cronbach's Alpha was 0.663 for 29 items.

Mohd Salleh Abu and Zaidatun Tasir [26] stated that the reliability coefficient more than 0.6 is always used. Kroz *et al.* [27] stated the Cronbach's Alpha value for questionnaire should be between 0.65 until 0.75 . In this study, the reliability analysis result showed more than 0.65, therefore, there were internal consistency of the scales. Hence, this instrument used in this study had a high reliability value.

C. Factor Analysis

Factor analysis was used to construct the new factors affecting students' learning activities of the survey done among university students. Bartlett's test of sphericity and the Kaiser-Meyer-Olkin measure of sampling adequacy are both tests that can be used to determine the factoriability of the matrix as a whole. The results value of Bartlett's test of sphericity is significant ($p<0.001$, $p=0.000$). In addition, the Kaiser-Meyer-Olkin measure is 0.775 which is greater than 0.6.

It is suggested that if the Bartlett's test of sphericity is significant, and if the Kaiser-Meyer-Olkin measure is greater than 0.6, then factorability is assumed [19]. Thus, based from the results, it is appropriate to proceed with Factor Analysis to examine factors that affecting students' learning style among the undergraduate students.

Table 2 displays the total variance explained at seven stages for factors that affecting students' learning style among the undergraduate students. Seven factors were extracted because their eigenvalues greater than 1. When seven factors were extracted, then 60.216 percent of the variance would be explained.

Table 2. The Total Variance Explained

Factor	Rotation Sums of Squared Loadings		
	Total	Percentage of Variance	Cumulative Percentage
1	3.088	15.439	15.439
2	2.162	10.810	26.248
3	1.602	8.011	34.259
4	1.461	7.304	41.563
5	1.283	6.413	47.976
6	1.231	6.154	54.129
7	1.217	6.086	60.216

Table 3 shows the rotated factor matrix for the questionnaire. Tabachnick and Fidell [28] stated variable with factor loadings more than 0.45 were chosen in this study because loadings equals to 0.45 is considered average, whereas loadings 0.32 is considered less good.

After performing Varimax Rotation Method with Kaiser Normalization, Factor 1 comprised of five items with factor loadings ranging from 0.54 to 0.8. The items in Factor 1 are S9, S4, S10, S6 and S1. Factor 2 comprised of five items with factor loadings ranging from 0.48 to 0.72. The items in Factor 2 are S5, S11, S7, B5 and S8. Factor 3 comprised of three

items with factor loadings ranging from 0.32 to 0.83. The items in Factor 3 are E2, B2 and B3. Factor 4 comprised of two items with factor loadings ranging from 0.73 to 0.74. The items in Factor 4 are E3 and E4. Factor 5 comprised of three items with factor loadings ranging from 0.56 to 0.62. The items in Factor 3 are S2, B1 and S3. Each of Factor 6 and Factor 7 comprised of one item. The factor loadings are 0.9 and 0.5 respectively. The item in Factor 6 is E1 and the item in Factor 7 is B4.

Table 3. Rotated Factor Matrix

Item	1	2	3	4	5	6	7
S1	0.80						
S4	0.73						
S10	0.71						
S6	0.56	0.34					
S9	0.54	0.32					
S8		0.72					
S11		0.6					
S7	0.30	0.58					
B5		0.53				0.40	0.30
S5	0.34	0.48					0.40
B2			0.83				
B3			0.80				
E4				0.74			
E3				0.73			
S3	0.44				0.62		
B1	-0.40				0.61		
S2				-0.40	0.56		
E1						0.90	
E2			0.32				-0.70
B4	0.30	0.31					0.54

Seven new factors were successfully constructed using factor analysis and assigned as the factors affecting the learning style activity. Table 4 shows the name of the new factors and percentage of variance explained for each of the factors. The first factor shows the highest percentage of variance explained when it was extracted. When the first factor, students' attitude before and after attending class was extracted, then 15.439 percent of the variance would be explained.

Table 4. Name of New Factors with the Percentage of Variance

Factor	Name	Percentage of Variance
1	Students' attitude before and after attending class	15.439
2	Strategies used to comprehend the lecture	10.810
3	The importance of lecture	8.011
4	Class size and its condition	7.304
5	Efforts outside class	6.413
6	Classroom convenient	6.154
7	Importance on listening to lecture	6.086

D. Normality Test

The seven new that affecting students' learning style among the undergraduate students were tested using the normality test. Table 5 shows the results of the normality test for the seven new factors that affecting students' learning style among the undergraduate students.

When the significant p-value for the variable is bigger than 0.05 ($p>0.05$), then the data is normal [19]. The Tests of Normality results using the Kolmogorov-Smirvnos showed that the normality assumption for the seven new factors did not fulfil the normality assumption ($p< 0.05$).

Table 5. Normality Test for the New Factors

Factor	Statistic	df	Sig.
Factor 1	0.079	189	0.006
Factor 2	0.090	189	0.001
Factor 3	0.073	189	0.016
Factor 4	0.072	189	0.018
Factor 5	0.059	189	0.020
Factor 6	0.104	189	0.000
Factor 7	0.076	189	0.010

E. Kruskal-Wallis Test

The non-parametric test using the Kruskal-Wallis Test had been performed on all new seven factors because the factors did not fulfil the normality assumption. The non-parametric test using the Kruskal-Wallis Test was performed to test the mean difference on the demoghraphic factors on factors that affecting students' learning style among the undergraduate students. The demoghraphic factors that were analyzed in this study were the gender, age, years of study, stream and CGPA.

The first alternative hypothesis statement is; there is a significant mean difference between genders on factors that affecting students' learning style among the undergraduate students.

Table 6 shows the results of the non-parametric test using the Kruskal-Wallis Test for the seven new factors that affecting students' learning style among the undergraduate students. The results showed there was a significant mean difference between gender on students' efforts outside class (Factor 5), ($X^2=4.17$, $p<0.05$, $p=0.04$). The results showed that there was no significant mean difference between genders on the other factors of students' learning style ($p>0.05$).

Table 6. Kruskal-Wallis Test between Genders

Factor	*Chi-Square*	*Asymp. Sig.*
Factor 1	0.367	0.545
Factor 2	0.532	0.466
Factor 3	0.000	0.991
Factor 4	0.388	0.533
Factor 5	4.167	**0.041**

Factor 6	0.288	0.592
Factor 7	0.104	0.747

Table 7 shows the mean rank for Factor 5, the students' efforts outside class. The mean rank for female students spent more effort outside class was 100.4 compared to male students only 82.79. Female students spent more effort outside class in searching extra academic references compared to male students.

Table 7. Mean Rank between Genders for Students Effort Outside Class (Factor 5)

Factor 5		N	Mean Rank
Gender	Male	58	82.79
	Female	131	100.4

The second alternative hypothesis statement is; there is a significant mean difference among age categories on factors that affecting students' learning style among the undergraduate students.

Table 8 shows the results of the non-parametric test using the Kruskal-Wallis Test for the seven new factors that affecting students' learning style among the undergraduate students. The results showed there was no significant mean difference among age categories on all factors of students' learning style ($p>0.05$).

Table 8. Kruskal-Wallis Test among Age Categories

Factor	*Chi-Square*	*Asymp. Sig.*
Factor 1	14.801	0.063
Factor 2	12.707	0.122
Factor 3	4.323	0.827
Factor 4	6.174	0.628
Factor 5	4.365	0.823
Factor 6	4.487	0.811
Factor 7	8.873	0.353

The third alternative hypothesis statement is; there is a significant mean difference among years of study categories on factors that affecting students' learning style among the undergraduate students.

Table 9 shows the results of the non-parametric test using the Kruskal-Wallis Test for the seven new factors that affecting students' learning style among the undergraduate students. The results showed there was a significant mean difference among years of study categories on students' attitude before and after attending class (Factor 1), ($X^2=8.565$, $p<0.05$, $p=0.036$). The results showed that there was no significant mean difference among years of study categories on the other factors of students' learning style ($p>0.05$).

Table 9. Kruskal-Wallis Test among Years of Study Categories

Factor	*Chi-Square*	*Asymp. Sig.*
Factor 1	8.565	**0.036**
Factor 2	5.215	0.157
Factor 3	1.729	0.631
Factor 4	1.894	0.595
Factor 5	2.496	0.476
Factor 6	2.319	0.509
Factor 7	3.936	0.268

Table 10 shows the mean rank for Factor 1, the students' attitude before and after attending class. Students in Year 4 had the highest mean rank, which was 109.15 as compared to other years of study.

Table 10. Mean Rank among Years of Study Categories for students' attitude before and after attending class (Factor 1)

Factor 1		N	Mean Rank
Years of study	1	78	106.17
	2	47	88.87
	3	51	79.96
	4	13	109.15

The fourth alternative hypothesis statement is; there is a significant mean difference between science and non-science streams on factors that affecting students' learning style among the undergraduate students.

Table 10 shows the results of the non-parametric test using the Kruskal-Wallis Test for the seven new factors that affecting students' learning style among the undergraduate students. The results showed there was a significant mean difference between science and non-science streams on strategies used to comprehend the lecture (Factor 2), ($X^2=7.054$, $p<0.05$, $p=0.008$). The results also showed there was a significant mean difference between science and non-science streams on Class size and its condition (Factor 4), ($X^2=7.705$, $p<0.05$, $p=0.006$). The results showed that there was no significant mean difference between science and non-science streams on the other factors of students' learning style ($p>0.05$).

Table 10. Kruskal-Wallis Test between Science and Non-science Streams

Factor	*Chi-Square*	*Asymp. Sig.*
Factor 1	0.673	0.412
Factor 2	7.054	**0.008**
Factor 3	0.001	0.972
Factor 4	7.705	**0.006**
Factor 5	2.572	0.109

Factor 6	0.369	0.544
Factor 7	0.225	0.635

Table 11 shows the mean rank between science and non-science stream for strategies used to comprehend the lecture (Factor 2) and class size and its condition (Factor 4). The mean rank of non-science students for strategies used to comprehend the lecture was 104.97 compared to science students only 83.8. The non-science students had used more strategies to comprehend the lecture compared to science students. The mean rank of science students for class size and its condition was 106.71 compared to non-science students 84.58. Science students more satisfied with their class size and its condition as compared to non-science students.

Table 11. Mean Rank between Science and Non-science Streams for Strategies Used to Comprehend the Lecture (Factor 2) and Class Size and its Condition (Factor 4)

Factor	Stream	N	Mean Rank
Factor 2	Science	89	83.80
	Non-Science	100	104.97
Factor 4	Science	89	106.71
	Non-Science	100	84.58

The fifth alternative hypothesis statement is; there is a significant mean difference among CGPA categories on factors that affecting students' learning style among the undergraduate students.

Table 12 shows the results of the non-parametric test using the Kruskal-Wallis Test for the seven new factors that affecting students' learning style among the undergraduate students. The results showed there was a significant mean difference among CGPA categories on the importance of lecture (Factor 3), (X^2=9.034, p<0.05, p=0.029). The results also showed there was a significant mean difference among CGPA categories on class size and its condition (Factor 4), (X^2=10.508, p<0.05, p=0.015). The results showed that there was no significant mean difference among CGPA categories on the other factors of students' learning style (p>0.05).

Table 12. Kruskal-Wallis Test among CGPA Categories

Factor	*Chi-Square*	*Asymp. Sig.*
Factor 1	2.835	0.418
Factor 2	5.85	0.119
Factor 3	9.034	**0.029**
Factor 4	10.508	**0.015**
Factor 5	0.428	0.934
Factor 6	7.114	0.068
Factor 7	1.341	0.719

Table 13 shows the mean rank among CGPA categories for the importance of lecture (Factor 3) and class size and its condition (Factor 4). CGPA 2.00-2.49 had the highest mean rank for Factor 3, the Importance of Lecture and Factor 4, Class Size and its Condition.

Table 13. Mean Rank among CGPA Categories for the Importance of Lecture (Factor 3) and Class Size and its Condition (Factor 4)

Factor	CGPA	N	Mean Rank
Factor 3	2.00 to 2.49	22	116.59
	2.50 to 2.99	75	87.65
	3.00 to 3.49	78	100.80
	3.50 to 4.00	14	68.14
Factor 4	2.00 to 2.49	22	113.91
	2.50 to 2.99	75	86.54
	3.00 to 3.49	78	103.25
	3.50 to 4.00	14	64.64

V. Discussions And Conclusion

The results showed seven new factors were successfully constructed using factor analysis and assigned as the factors affecting the learning style styles; which are 1) students' attitude before and after attending class, 2) strategies used to comprehend the lecture, 3) the importance of lecture, 4) class size and its condition, 5) efforts outside class, 6) classroom convenient and 7) importance on listening to lecture.

There was a significant mean difference between genders on students' effort outside class (Factor 5). Female students spent more effort outside class in searching for extra academic references compared to male students. There was no significant mean difference between genders on the other factors of students' learning style.

Age does not influence on students' learning style as shown by Kruskal-Wallis score. As for years of study, Kruskal-Wallis test showed that attitude before and after class influenced students' learning style. Year 4 students prefer to do study notes before class, involve in discussion inside classroom, asking lecturers and do note making after class as compared to students in year 1, 2 and 3. It could be influenced by Year 4 experiences, maturity and strong awareness towards their study. This result is in parallel with a study conducted by Bigss *et al*. [13] which illustrated students' learning activities and experience influences their learning process.

The result from Kruskal-Wallis test showed different in score for science and non-science stream students. Non-science students have a better comprehend strategy as their field could be practiced outside classroom and do not merely based on theory. On the other hand, science students satisfy with their class size and its condition as compared to non-science students. This might be influenced by the availability of more conducive facilities in UMS Science Faculty for students to engage in their learning process.

The result shows that CGPA is only influenced by the importance of class size and its condition and the importance of lecture. This finding confirms the study by Comeaux [14], which indicated positive relationship between academic result and facilities provided by the faculties. Students with CGPA

(2.00-2.49) indicated that attending lecture is crucial and satisfy with classroom size and its condition as compared to students with other group of CGPA. Unfortunately, this finding contradict with study conducted by Ayersman [11], which stated that students' academic performance would be increased with a careful plan of learning's condition and learning styles.

In a nutshell, the finding indicates that learning style activity influence students' academic achievement. This research is vital to help university in creating and supporting a positive learning environment to increase students' academic performance. All of the objectives of this research are achieved.

REFERENCES

[1] S. P. Wright, S. P. Horn, and W. L. Sanders, Teacher and Classroom Context Effects on Student Achievement: Implications for teacher Evaluation. *Journal of Personnel Evaluation in Education*. **11**:57-67, 1997.

[2] F. Lubben, B. Davidowitz, A. Buffler, S. Allie, and I. Scott, Factors influencing access student's persistence in an undergraduate science programme: A South African case Study. *International Journal of Educational Development*. **30**: 351-358, 2010.

[3] J. Sennett, G. Finchilescu, K. Gibson, and R. Strauss, Adjustment of Black students at a historically White South African university. *Educational Psychology*. **23 (1)**:107-116, 2003.

[4] S. Mann, Alternative prospective on the student experiences: alienation and engagement. *Studies in Higher Education*. **26 (1)**, 7-19, 2001.

[5] Hussein Mahmood, *Kepimpinan dan Keberkesanan Sekolah*. Dewan Bahasa dan Pustaka, Kuala Lumpur, 1993.

[6] M-C. Chen, "Relationships among self-directed learning, learning styles, learning strategies and learning achievement for students of Technology University in Taiwan by using structural equation models (Published Conference Proceeding Style)," in *Proceedings of the 7th WSEAS/IASME International Conference on Educational Technologies (EDUTE '11)*, Iasi, Romania, 2011, pp. 67-72

[7] S.H. Kim, S.J. Jun, and S. K. Han, "Effective reasoning of learning styles using rough set theory in e-learning (Published Conference Proceeding Style)," in *Proceedings of the 5th WSEAS International Conference on E-ACTIVITIES*, Venice, Italy, 2006

[8] B. Bontchev and D. Vassileva, "Learning Objects Types Dependability on Styles of Learning (Published Conference Proceeding Style)," in *Proceedings of the 8th WSEAS International Conference on Engineering Education (EDUCATION '11)*, Corfu Island, Greece, 2011

[9] B. Prepelita-Raileanu, "Multidisciplinary Surveys in Technical Academic Education Concerning the Use of ICT for Effective Learning (Published Conference Proceeding Style)," in *Proceedings of the 8th WSEAS International Conference on Engineering Education (EDUCATION '11)*, Corfu Island, Greece, 2011.

[10] R. Dunn and K. Dunn, *Teaching Secondary Students through their Individual Learning Styles: Practical Approaches for Grades 7-12*, Boston: Allyn & Bacon, 1993.

[11] D. J. Ayersman, Reviewing the Research on Hypermedia-Based Learning, *Journal of Research on Computing in Education*, 28(4), 1996, pp 500-576

[12] J. Dvyer, *Learning Differences and Teaching Styles,* 1996. Available: http://www.yorku.ca/admin/est/learndifs.html

[13] J.B. Biggs, Teaching for learning: The view from cognitive psychology. *Victoria: The Australian Council for Educational Research Ltd,* 1987.

[14] B. Comeaux, Environmental Predictors of Academic Achievement among Student-Athletes in the Revenu-Producing Sports of Men Basketball and Footbal, *The Sport Journal*, **8**(3), 2005.

[15] R, A. Davidson, Relationship of study approach and exam performance. *Journal of Accountant education*, **20**(1), 2002, pp29-44.

[16] Abd.Halim Mohamad and Wan Mohamad Wan Sulong, Antara Minat Dan Sikap Pelajar Terhadap Bahasa Arab: Satu Kajian Kes Pelajar Bacelor Bahasa Arab Di IPTA Malaysia, *Wacana Pendidikan Islam (Siri 5). Pendidikan Islam Dan Bahasa Arab Pemangkin Peradaban Ummah*. Fakulti Pendidikan Universiti Kebangsaan Malaysia. Bangi, 2003.

[17] J. T. McClave, P.G. Benson and T. Sincich, *Statistics for Business and Economics.* Upper Saddle River, New Jersey, Pearson Prentice Hall, 2005.

[18] D. Altman, N. Burton, I. Cuthill, M. Festing, J. Hutton and L. Playle, Why do a pilot study? *National Centre for Replacement, Refinement and Reduction of Animal in Research*, 1-2, 2006.

[19] J. C. Coakes and C. Ong, *SPSS Version 18.0 for Windows Analysis Without Anguish.* 1st Edition. Dougall Street, Milton: John Wiley & Sons Australia, Ltd, 2011.

[20] J. R. Fraenkel and N. E. Wallen, *How to Design and Evaluate Research in Education*. Third Edition. McGraw Hill, Inc., New York, 1996.

[21] Y. P. Chua, *Statistik Penyelidikan Lanjutan Ujian Regresi, Analisis Faktor dan Ujian SEM.* McGraw-Hill Malaysia, 2009.

[22] M. J. Norusis, *SPSS 6.1 Base System User's Guide Part 2*. SPSS, Inc, Chicago. 1994.

[23] R. A. Johnson and D. W. Wichern, *Applied Multivariate Statistical Analysis. Fifth Edition*. Prentice-Hall, Inc, Upple Saddle River, 2002

[24] Carver, R. H. & Nash, J. G., *Doing Data Analysis with SPSS*. Thomson Brooks/Cole, Belmont, 2006.

[25] P. Newbold, W. L. Carlson and B. M. Thorne, *Statistics for Business and Economics.* 5th ed. Pearson Education, Inc., New Jersey, 2003.

[26] Mohd Salleh Abu and Zaidatun Tasir, *Pengenalan Kepada Analisis Data Berkomputer SPSS 10.0 for Windows*, Kuala Lumpur, Venton Publishing, 2001.

[27] M. Kroz, G. Feder, HB. V. Laue, R. Zerm, M Reif, M. Girke, H. Matthes, C. Gutenbrunner and C. Heckman, Validation of a questionnaire measuring the regulation of autonomic function. *BMC Complementary and Alternative Medicine,* 8, 2008, pp1-13.

[28] B. G. Tabachnick and L. S. Fidell, *Using Multivariate Statistics*. Fourth Edition. Allyn and Bacon, Boston, 2001.