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Determining the Factors that Impacting Students' Attitude for Statistics Subject

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Abstract

Statistics is an important subject to learn. It is a branch of mathematics that deals with data collection, analysis, interpretation, presentation and organisation. Statistics is important not only for specialists in numerous fields but also for everyday life. However, some students perceive statistics to be a tough subject. Therefore, this study aims to determine the factors that impact students' attitudes toward statistics. The factors were found using factor analysis. One hundred thirty-six students responded to the questionnaire related to students' attitudes toward statistics. Data were analysed using descriptive statistics in addition to factor analysis. According to this study's findings, self-confidence was the most important factor impacting students' attitudes toward statistics. Other important factors were mindset, interest, conceptual understanding and perseverance. These findings can assist educators in developing new methods of teaching skills to improve student learning in statistics classes.

Keywords: Statistics, Attitudes, Factor Analysis, Descriptive Statistics, Self-Confidence.

Introduction

Statistics is a field of study that plays a crucial role in various disciplines, from social sciences to business and healthcare. It is also widely employed in many industries, including information and communication technology (ICT), as a structural method for problem-solving. As a result, statistics has been included as a basic subject in Malaysian Higher Education Institutes. Statistics and Probability is a required subject in the Faculty of Information and Science Technology (FTSM), which seeks to expose students to fundamental statistical concepts and techniques used in research and industry. The course covers quantitative data presentation, data description, probability, random and discrete variables, continuous and sampling distribution, among others. The course also covers inference statistics for hypothesis approximation and testing (Ashaari et al., 2011). Students often approach statistics with apprehension and struggle to grasp its concepts. For most of them, statistics may be tough to understand due to a lack of understanding and enthusiasm for the subject. However, statistics may be simple to understand and apply for some students who major in mathematics. Many students agreed that statistics and mathematics are intricately linked disciplines sharing a symbiotic relationship, with mathematics as the foundation for statistical theory and analysis. Students initially believed that statistics was useful, but they tended to link it closely with mathematics (Bond, et al., 2012). While mathematics is a broad field

encompassing various branches, statistics focuses specifically on data collection, organisation, analysis and interpretation. In the age of big data, learning statistics is crucial for data literacy, critical thinking, problem-solving, research, decision-making under uncertainty and understanding the world. It equips individuals with the necessary skills to navigate the vast amounts of data they encounter and make informed choices based on evidence and analysis.

Learning and student performance in statistics can be influenced by several factors, including students' attitudes towards the subject, teaching techniques practised by lecturers and the learning environment. Students' attitude towards learning statistics and its implications for teaching statistics has long been a concern among statistics researchers. Attitudes towards statistics have been identified as a key component affecting statistical achievement and success (Ashaari et al., 2011).

Students' attitude towards learning statistics refers to a student's general inclination, perception and emotional disposition towards statistics. It encompasses their beliefs about the usefulness and relevance of statistics, their confidence in their abilities to learn the subject, their interest in it, as well as their overall enjoyment or dislike of statistics-related activities. In learning statistics, students' attitude is crucial to their success and understanding of the subject. Attitudes in learning may involve an individual's level of interest, curiosity and motivation towards a particular subject or the learning process itself. Positive attitudes towards learning foster engagement, persistence and a desire to acquire knowledge. Judi (2011) found that a positive attitude enables students to develop statistical thinking skills, apply the knowledge acquired in everyday life and have an enjoyable course experience. Conversely, a negative attitude makes individuals feel worn out from taking the course, unable to understand the advantages of statistics, difficult to concentrate in class and more likely to be absent.

Statistics can be perceived as challenging and intimidating, but a positive attitude towards learning can greatly enhance the learning experience. Coetzee and Van der Merwe (2010) agreed that statistics could be viewed as difficult and are slightly more negative when rating the difficulty of statistics as a subject. An open and receptive attitude towards learning statistics will help students approach the subject with curiosity and a willingness to explore new concepts. Students' attitudes are influenced by their beliefs, encompassing their content knowledge and conceptual understanding of statistics (Bond, et al., 2012). Furthermore, embracing a positive mindset helps students overcome initial fears or preconceived notions about statistics, making them more receptive to new ideas and methods. Difficulties in understanding the concepts of statistics are not solely attributed to non-cognitive factors like attitude, perception, interest, expectation and motivation but are also influenced by cognitive factors related to students' intellectual aptitude for performing well in the subject (Ashaari et al., 2011). Experiencing success can generate a positive attitude towards learning the subject (Akinsola & Olowojaiye, 2008). Mazana et al (2019) stated that when teaching-learning materials and resources are limited, students' positive attitudes towards mathematics can turn into dislike. This suggests that the availability of materials and resources plays a significant role in shaping students' attitudes, and as these factors improve, students' attitudes tend to become more positive. Their further findings revealed that students' engagement in mathematics is influenced by its perceived usefulness, enjoyment, confidence

and motivation activities. Ashaari et al (2011) have recently undertaken research to investigate students' attitudes towards statistics courses and analysed the association between the six criteria and demographic variables using the mean score approach. The data acquired through the Attitudes Towards Statistics (SATS) survey observed students' attitudes towards the statistics course. According to the findings, students have a very positive attitude towards making the necessary efforts to better comprehend the subject.

Using factor analysis, a study by Al-Agili et al (2012) discovered a weak correlation between students' attitudes towards mathematics and their achievement, teaching methods and practices, teacher attribution, as well as classroom climate. However, a significant positive correlation was observed between students' attitudes towards mathematics and their anxiety levels. Anxiety towards learning statistics can stem from various factors, including fear of numbers, lack of confidence in mathematical abilities, unfamiliarity with statistical concepts and procedures, as well as negative past experiences with math or statistics. High anxiety levels can lead to poor performance on statistical tasks, exams and assignments. Students with statistics anxiety may also exhibit avoidance behaviours, such as skipping classes or procrastinating on statistical tasks. According to DeVaney (2010), statistically significant negative relationships between anxiety and attitude have been observed and reported by (Finney and Schraw, 2003).

Several factors, such as teaching methods, anxiety, curriculum design, previous experience, self-confidence and self-efficacy, can influence students' perception of learning statistics. Self-confidence in their abilities to understand and apply statistical concepts can impact their perception. Students with low self-efficacy or lack confidence in mathematical skills may perceive statistics as daunting and unapproachable. Conversely, when students feel confident and capable of learning statistics, they are more likely to have a positive perception. Students are more likely to perceive statistics positively when they understand their relevance and applicability to real-life situations. Suppose students can see how statistics is used in their fields of interest or how it contributes to solving practical problems. In that case, they will perceive it as valuable and necessary. In a study by Mazana et al (2019), students preferred mathematics owing to the inherent enjoyment they derived from it, their self-assurance in their mathematical abilities and their motivation to actively engage in mathematical activities. As statistics is closely connected to mathematics, this finding can also be extended to statistics. Consequently, educators play a critical role in assisting students in cultivating a positive attitude towards statistics, as it profoundly influences their level of involvement, motivation and overall academic performance. Ncube and Moroke (2015) demonstrated that students' self-perceptions of statistics are a key factor that might affect their performance in statistics either positively or adversely, which is related to an interest in learning about statistics, as well as motivation to attend statistics classes or do and complete statistics activities. The perceived significance or usefulness of statistics in one's academic and professional life, effort (attending classes, consulting, or studying for every test or examination) and the inherent ability to acquire statistics are all indicators of self-perception. Numerous studies have examined attitudes towards statistics using scales that consider age, gender, level, type of prior education in the field and attitudes towards certain types of statistics (Comas et al., 2017). International studies about attitudes towards statistics among university students from the scientific, technical and social fields, high school students, in-service teachers or trainee/prospective teachers have been conducted owing to the growing

interest in analysing attitudes towards statistics among various educational community members.

Research has also been done to see the significance of other factors that could affect students' attitudes, such as gender and the number of mathematics papers they took during their studies. There were no significant relationships found between students' attitudes towards statistics and the amount of math they studied in high school or the number of math or statistics courses they took in university; however, male students had slightly more positive feelings towards statistics (Coetzee & Van der Merwe, 2010).

Methodology

This study focused on 5th-semester engineering degree students at UiTM Pulau Pinang who took statistics subjects. One hundred thirty-six students were randomly selected to answer a questionnaire about attitudes and perceptions of statistics. The question contained 15 items adapted from Code et al (2016), where each question comprised a five-point Likert scale from strongly disagree to strongly agree. The questions are shown in Table 1; students must answer all questions using the Google form platform.

Table 1
Question

Item No.	Question
Q1	I have difficulty solving a statistics problem even though I have studied the topic and feel I understand it.
Q2	Statistics competency of an individual cannot be developed.
Q3	When I get stuck, I stop. I will ask my friends or lecturer about possible steps to continue.
Q4	When answering statistics problems, if I do not remember a formula needed, I would not have any other way to figure it out.
Q5	I must fully understand statistics formulas and steps before I can use them.
Q6	Solving a statistics problem is enjoyable.
Q7	My mind goes blank, and I cannot think clearly during a statistics test.
Q8	I am not confident taking a statistics test even though I have studied.
Q9	I am not interested to know the origin of statistics formulas.
Q10	Being good in statistics is about natural ability.
Q11	When solving a statistics problem, understanding the underlying concepts and formulas is crucial.
Q12	I escape attempting statistics problems if I can.
Q13	I often get frustrated when I cannot solve a statistics problem.
Q14	Understanding statistics concepts is not an easy thing for everyone.
Q15	I study statistics only when I have to.

The data obtained were then collected and analysed using descriptive statistics and factor analysis (FA). The main components that explain students' attitudes and perceptions about statistics can be identified using FA, which can also be used to determine the variables that can 'go together' (DeCoster, 2012) and how many other variables affect that variable.

FA is carried out through several stages. The first stage involves developing an FA based on the 15 items studied to identify groups of similar variables. In the second step, FA is tested using the Kaiser-Meyer Olkin (KMO) statistic. The KMO value must be at least 0.5 to run Bartlett's test of Sphericity in the next step. Bartlett's Sphericity test establishes that the population variables are not correlated as a null hypothesis (Ozbay et al., 2011). To proceed with the FA analysis, the p-value in this test must be less than 0.5, indicating that the population variables are correlated (the null hypothesis is rejected). The next stage is to choose the optimal number of factors. This selection is based on eigenvalues greater than one. This factor will then go through the varimax rotation method to produce the most suitable factor. Finally, renaming is performed for the resulting FA components.

Results and Discussion

Based on descriptive statistics in Table 2, 83 respondents were male, while 53 were female. Out of a total of 136 students, 64 of them were from Civil Engineering Studies (PKA), 22 students were from Chemical Engineering Studies (PKK), 25 students were from Electrical Engineering Studies (PKE), and the remaining students were from Mechanical Engineering Studies (PKM) who took the statistics subject.

Table 2
Descriptive Data

		Gender		Total	Percentage (%)
		Male	Female		
Centre of Studies	PKA	36	28	64	47.06%
	PKK	15	7	22	16.18%
	PKE	13	12	25	18.38%
	PKM	19	6	25	18.38%
Total		83	53	136	
Percentage (%)		61.03%	38.97%		

Figure 1 illustrates the percentage of students based on the Centre of Studies, which was represented by the values of 47.06% (PKA), 15.18% (PKK) and 16.18% for both studies (PKE and PKM). Meanwhile, Figure 2 shows the percentage of students based on gender. Male students (61.03%) were more than female students (38.97%).

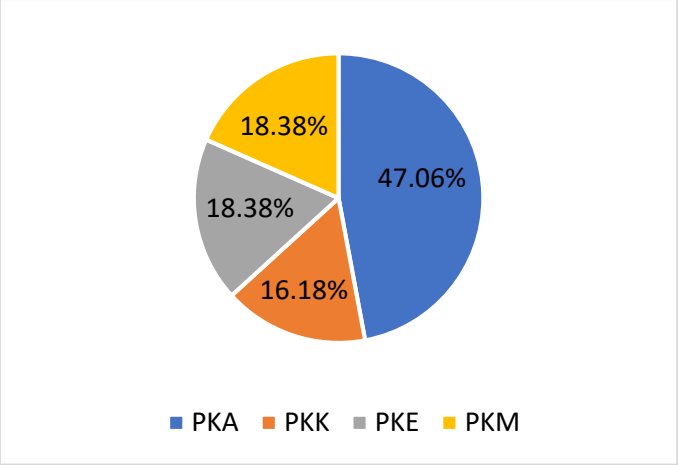

Figure 1. Percentage of Students (Centre of Studies)

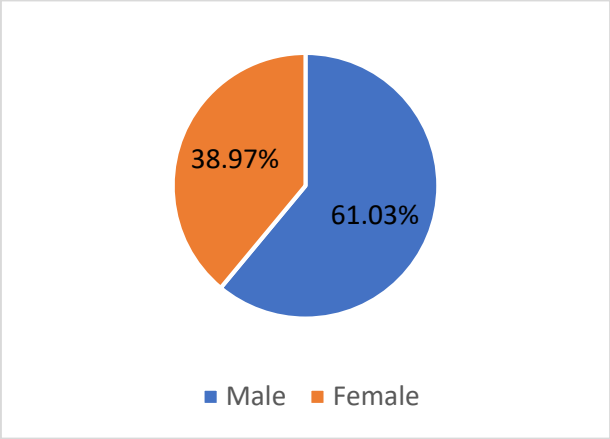

Figure 2. Percentage of Students (Gender)

Next, the data was analysed using FA to identify the main factor that impacts students' attitudes toward statistics. According to Table 3, the value of Kaiser-Meyer-Olkin (KMO) obtained was 0.791, greater than 0.5. FA is only appropriate when the KMO value is at least 0.5. Based on Bartlett's Test of Sphericity, it is significant since the p-value = .000 was less than the predetermined value alpha = 0.05, suggesting that the factor analysis can be done.

Table 3
KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.791
Bartlett's Test of Sphericity	Approx. Chi-Square	446.377
	df	105
	Sig.	.000

Table 4 shows 15 components that were first identified before extraction using FA. After the extraction, five factors with eigenvalues greater than 1 were taken into consideration. These factors' eigenvalues were 4.019, 1.632, 1.199, 1.053 and 1.010. The total cumulative variances for these five factors were 59.416%. A total of 26.794% was explained by FA1, while each of 10.879%, 7.992%, 7.020% and 6.732% were explained by FA2, FA3, FA4 and FA5 after extraction. In the last part, rotation was used to optimise the structure of the five factors. The

eigenvalues must be higher than 1, similar to the extraction step. The variance for the first factor (FA1) decreased from 26.794% to 18.869%. However, all the variances of the others were increased. These results revealed that FA1 correlated more with the dependent variable than other components.

Table 4
Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Var	Cum %	Total	% of Var	Cum %	Total	% of Var	Cum %
1	4.019	26.794	26.794	4.019	26.794	26.794	2.830	18.869	18.869
2	1.632	10.879	37.673	1.632	10.879	37.673	2.075	13.832	32.701
3	1.199	7.992	45.665	1.199	7.992	45.665	1.468	9.786	42.487
4	1.053	7.020	52.685	1.053	7.020	52.685	1.349	8.992	51.479
5	1.010	6.732	59.416	1.010	6.732	59.416	1.191	7.937	59.416
6	.943	6.286	65.702						
7	.875	5.835	71.537						
8	.762	5.083	76.619						
9	.732	4.878	81.497						
10	.589	3.930	85.427						
11	.560	3.730	89.157						
12	.539	3.590	92.747						
13	.431	2.876	95.623						
14	.355	2.366	97.989						
15	.302	2.011	100.000						

Table 5 below displays the result of the Rotated Component Matrix classified into five groups of factors. The highest contribution was in the first group (FA1), which consisted of Q1, Q2, Q7, Q12, Q8 and Q10 and can generally be named the self-confidence factor. The second highest contribution was in the second group (FA2), which comprised Q9, Q15, Q13, Q4 and Q6 and named the mindset factor. The third contribution (FA3) and fourth contribution (FA4) consisted of only one, namely Q14 and Q11, which can be named and referred to as the interest and conceptual understanding factors. Meanwhile, the fifth contribution was in the fifth group (FA5), which consisted of Q3 and Q5.

Table 5
Rotated Component Matrix

	FA1	FA2	FA3	FA4	FA5
Q1	.763				
Q2	.724				
Q7	.666				
Q12	.656				
Q8	.554				
Q10	.498				
Q9		.717			
Q15		.659			
Q13		.544			
Q4		.527			
Q6		.519			
Q14			.812		
Q11				.758	
Q3					.837
Q5					.638

From Figure 3, the self-confidence factor can be classified as the main factor (FA1). Similarly, Tapia and Marsh (2005) found that self-confidence was the first factor. In the same vein, Laranang and Bondoc (2020) mentioned that students might exert more effort to improve their attitudes toward mathematics by enhancing their self-confidence to become more motivated to learn it. This result conflicts with Shamsuddin et al. (2018) previously mentioned study, which discovered self-confidence as the second factor of mathematics attitude, the first factor (FA1) in this study. However, this study only focused on statistics, while other studies focused on mathematics and calculus.

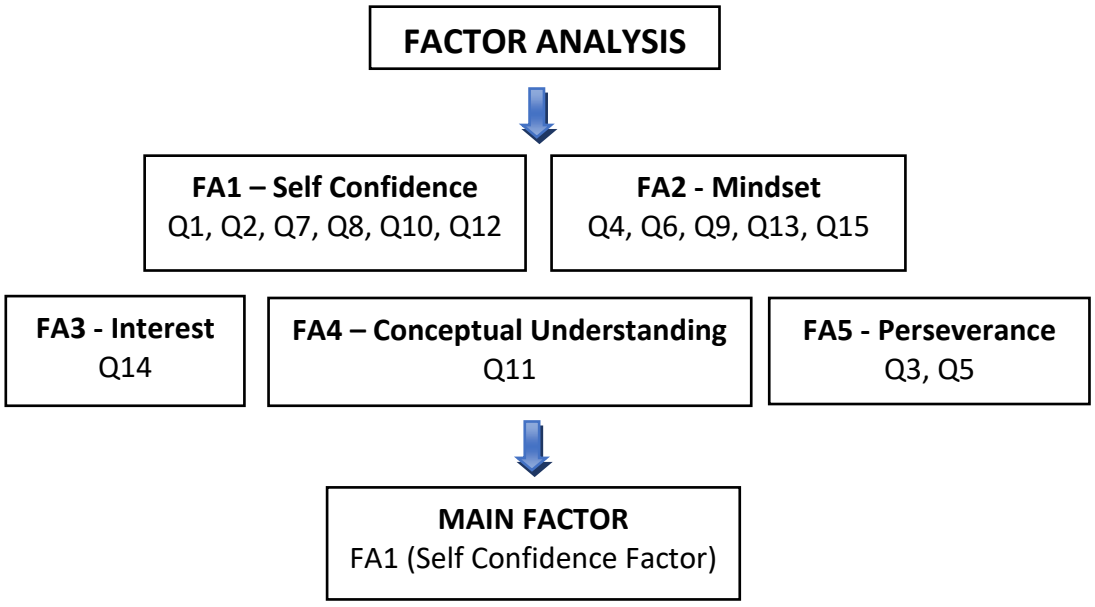

Figure 3. Main Factor of FA

Conclusion

This study revealed the student's self-confidence (FA1) as the main contributing factor. In addition, it was demonstrated that the factors of mind (FA2), interest (FA3), conceptual understanding (FA4) and perseverance (FA5) also affect students' attitudes and perceptions towards statistics. Thus, it can be said that self-confidence in learning statistics is important for students to succeed and not fear failure. This is because students with high self-confidence are ready to deal with the difficulties associated with learning statistics and subsequently improve their academic performance, compared to those with low self-confidence and self-doubt, who decide not to face such difficulties (Adelson & McCoach, 2011). In conclusion, lecturers should pay more attention to students who lack self-confidence in learning statistics to rebuild their self-confidence and ability to readily accept learning the subject. Therefore, lecturers must play an important role in attracting students' attention and interest in statistics by diversifying teaching methods and developing interactive learning. It is hoped that through this study, all parties can play an important role in building students' self-confidence and attracting their interest, thereby helping students form a positive attitude and perception towards learning statistics.

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References

Adelson, J. L., & McCoach, D. B. (2011). Development and psychometric properties of the math and me survey: Measuring third through sixth graders' attitudes toward mathematics. *Measurement and Evaluation in Counseling and Development*, 44(4), 225– 247. Retrieved from https://doi.org/10.1177/0748175611418522

Al-Agili, M. Z., Mamat, M. B., Abdullah, L., & Maad, H. A. (2012). The factors influence students' achievement in mathematics: A case for Libyan's students. *World Applied Sciences Journal*, 17(9), 1224-1230.

Akinsola, M. K., & Olowojaiye, F. B. (2008). Teacher instructional methods and student attitudes towards mathematics. *International Electronic Journal of Mathematics Education*, 3(1), 60-73.

Ashaari, N. S., Judi, H. M., Mohamed, H., & Wook, M. T. (2011). Student's attitude towards statistics course. *Procedia-Social and Behavioral Sciences*, 18, 287-294.

Bond, M. E., Perkins, S. N., & Ramirez, C. (2012). Students' Perceptions of Statistics: An Exploration of Attitudes, Conceptualisations, and Content Knowledge of Statistics. *Statistics Education Research Journal*, 11(2), 6-25. Retrieved from https://doi.org/10.52041/serj.v11i2.325

Code, W., Merchant, S., Maciejewski, Thomas, M., & Lo, J. (2016). The mathematics attitudes and perceptions survey: An instrument to assess expert-like views and dispositions among undergraduate mathematics students. *International Journal of Mathematical Education in Science and Technology,* 47(6), 917-937.

Coetzee, S., & Van der Merwe, P. (2010). Industrial psychology students' attitudes towards statistics. *SA Journal of Industrial Psychology/SA Tydskrif vir Bedryfsielkunde*, 36(1), 1-8. Retrieved from DOI: 10.4102/sajip.v36i1.843

DeCoster, J. (2012). Overview of factor analysis. Free Statistical Consulting over the Internet. Retrieved from http://www.stat-help.com/notes.html

DeVaney, T. A. (2010). Anxiety and attitude of graduate students in on-campus vs. online statistics courses. *Journal of Statistics Education*, 18(1), 1-15.

Judi, H. M., Ashaari, N. S., Mohamed, H., Wook, T. M. (2010). Students profile based on attitude towards statistics. *Procedia Social and Behavioral Sciences*, 18(1), 266-272. Retrieved from https://doi.org/10.1016/j.sbspro.2011.05.038

Junior, A. P. O., Zamora, P. R., Oliveira, L. A. (2018). Student's attitudes towards probability and statistics and academic achievement on higher education. *Acta Didactica Napocensia*, 11(2), 43-56.

Kaiser, F. G. (1974). *System Analysis by Digital Computer.* Wiley, New York.

Laranang, J. I., & Bondoc, J. F. (2020). Attitudes and self-efficacy of students toward mathematics. *International Journal of English Literature and Social Sciences*, 5(5), 1392-1423.

Mazana, M. Y., Montero, C. S., Casmir, R. O. (2019). Investigating students' attitude towards learning mathematics. *Journal of Mathematics Education*, 14(1), 207-231.

Ncube, B., Moroke, N. D. (2015). Students' perceptions and attitude towards statistics in South African University: An exploratory factor analysis approach. *Journal of Governance and Regulation*, 4(3), 231-240.

Norshahidi, N. D., Ismail, N. H. S., Abidin, S. Z., Razak, N. F. (2021). Profile identification of students' attitude towards statistics course: A case study in UiTM Pahang branch. *Mathematical Sciences and Informatics Journal*, 2(1), 63-69

Ozbay, B., Keskin, G. A., Dogruparmak, S. C., Ayberk, S. (2011). Multivariate methods for ground-level ozone modeling. *Atmospheric Research*, 102(1), 57-65.

Shamsuddin, M., Mahlan, S. B., Ul-Saufie, A. Z., Hussin, F., & Alias, F. A. (2018). An identification of factors influencing student's attitude and perception towards mathematics using factor analysis. *AIP Conference Proceedings,* 1(1), 1-9.

Tapia, M., & Marsh, G. E. (2004). An instrument to measure mathematics attitudes. *Academic Exchange Quarterly*, 8(2), 16-21.